Benthic fauna of the Bay of Nhatrang, Southern Vietnam

Volume 2

Editors: T.A. Britayev, D.S. Pavlov

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The book contains 9 chapters describing different groups of marine invertebrates: symbiotic polychaetes; mollusks – chitons, gastropods of the family Eulimidae, nudibranchs; pontoniin shrimps; commercial and mangrove species of crabs; sea stars and crinoids. In the result of the processing of the samples, collected in the Bay of Nhatrang, 474 species of invertebrates are described, nearly half of them (218 species) were found in Vietnam for the first time. Eight new for science species are described. For each species the localities and general distribution data, synonymy and for many species diagnoses and descriptions are provided. The book is illustrated by 62 line drawings text figures and 70 plates with 502 original color photographs of live specimens taken in nature or in aquaria immediately after collecting.This volume significantly increases the knowledge not only about the fauna of the Bay, but of Vietnam in general.

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CHAPTER 1

Symbiotic polychaetes from Nhatrang Bay, Vietnam

T.A. Britayev[1], T.I. Antokhina[1]

ABSTRACT. Shallow-water polychaete fauna associated with benthic invertebrates in Nhatrang Bay, Vietnam was studied based on extensive sampling surveys performed from 1985 to 2012. As a result, 24 polychaete species belonging to four families were found. A check list of all these species including synonymies, list of material examined, extended diagnosis, taxonomic and ecological notes, and distribution is here presented. Most reports include *in situ* colour photos of representative specimens. The vast majority of symbionts belong to Polynoidae (13 species), followed by Syllidae (5 species), Hesionidae (5 species), and Spionidae (1 species), which were associated with echinoderms (53.8%), cnidarians (23.0%), sponges (11.5%), crustaceans (7.7%), and other polychaetes (3.8%). The number of symbiotic polychaetes occurring in Vietnamese coastal waters is here increased from 10 up to 26 species. The Vietnamese fauna of symbiotic polychaetes differs considerably from the Australian one. However, further studies on poorly investigated or even overlooked hosts (e.g. sponges, octocorals, tube dwelling polychaetes, echinoids and ophiuroids) will certainly lead to an increase in our knowledge on the diversity of symbiotic polychaetes of Vietnam.

The establishment of specialized symbiotic associations involving polychaetes is a rather common phenomenon in the World Oceans. According to the most recent review [Martin, Britayev 1998] there are ca. 370 symbiotic species of polychaetes, either obligate or facultative. Although their world distribution patterns have not been formally analyzed, it seems likely that there may be a latitudinal gradient, with a relatively low diversity in cold and temperate waters that tends to increase towards tropical areas. Conversely, the symbiotic polychaete fauna is relatively well known in the cold and temperate European waters, as well as along both coasts of North America [Barel, Kramers 1977; Pettibone 1993], while tropical areas are still poorly investigated. There are no publications focusing on these organisms from any particular tropical area, with a few exceptions [e.g. Gibbs 1969; Britayev *et al*. 1999]. In turn, most data on symbiotic species are usually scattered in faunistic, taxonomic, or, more rarely, in ecological papers [e.g. Devaney 1967; Hanley 1989; Britayev, Zamyschliak 1996; Barnich *et al*. 2004], and the Vietnamese fauna is not an exception.

Various polychaete families have been previously studied in Vietnam [e.g. Fauvel 1939; Uschakov 1972; Fauchald 1968; Gallardo 1967; Strelzov 1968, 1972]. However, only ten symbiotic species are known to date. Most of them belong to the Polynoidae (8 species), while the Syllidae and the Spionidae were represented by only one species, respectively [Fauvel 1939; Gallardo 1967; Radashevsky 1996; Britayev, Zamyschliak 1996; Britayev, Fauchald 2005; Britayev, Martin 2005; Martin *et al*. 2009; Antokhina,

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Ophthalmonoe pettiboneae Petersen et Britayev, 1997
(Pl. 4 A, B)

Ophthalmonoe pettiboneae Petersen, Britayev 1997: 266–272, figs 1–3; Britayev, Martin 2005: 4091–4096, figs 7–8.

Material examined. Nhatrang Bay: Mun Island, 15 m, sand, in tubes of *Chaetopterus* sp., coll. Marin, 16.06.2004 – 2 specimens (af and pf) and 2 mf; 11 m, sand, in tubes of *Chaetopterus* sp., coll. Savinkin – 1 cs; western point of Tre Island, 8–12 m, sandy silt, in tubes of *Chaetopterus* sp., coll. Marin, 29.06.2004 – 2 cs.

Diagnosis. Body flattened, relatively short and wide, truncate anteriorly and gradually tapering posteriorly. With 19 pairs of elytra on chaetigers 2, 4, 5, 7, 9, 11, 13, 15, 17, 19, 21, 23, 26, 29, 32, 35, 38, 41, 42. Last two to four segments cirrigerous, without elytra. Elytra relatively large, overlapping antero-posteriorly, basically oval, but markedly irregular in outline, folded along external margin, delicate, smooth except for some scarce irregularly distributed micropapillae. Prostomium slightly wider than long, without cephalic peaks, with two pairs of large dark eyes, with anterior pair slightly larger than posterior one, directed anteriorly, both pairs with conspicuous oval lenses; lateral antennae inserted slightly ventral to median antenna, short, cylindrical, ceratophores short, converging mid-ventrally. Tentaculophores relatively short, thick, achaetous, but with acicula. Dorsal cirri alternating in length along body. Notopodia, small, conical; neuropodia longer and wider than notopodia, with row of cilia along ventral side, prechaetal lobe elongated, nearly digitiform, substantially longer than triangular postchaetal lobe. Notochaetae arranged in a fan-shaped bundle orientated nearly horizontally, numerous, from 70 to more than 150 per bundle, slender than neurochaetae, long, capillaries, smooth. Neurochaetae numerous, from more than 80 to more than 240 per bundle, stout, with tips hooded, blunt and nearly rounded, with rows of narrow petaloid spines.

Measurements. Body with 44–46 chaetigers, L – 19–27 mm, WW – 2.6–3.8 mm, WP – 9.0–9.8 mm, WC – 11.2–12.3 mm.

Coloration. The body is basically light brownish and has a conspicuous transverse dark brown or black band crossing each segment. On segment 5, there is an additional characteristic oval, mid-dorsal, black spot posterior to the transverse band (Pl. 4 A, B). The longest dorsal cirri have more intense dark pigmentation than the smaller ones. The ventral body surface is always non-pigmented [Britayev, Martin 2005].

Taxonomic notes. Our specimens agree completely with description provided by Britayev and Martin [2005].

Ecological notes. Found at 8–15 m in tubes of the polychaete *Chaetopterus* sp. (Polychaeta: Chaetopteridae).

Distribution in Nhatrang Bay. Mun and Tre Islands.

General distribution. Vietnam [Britayev, Martin 2005], coasts of Ambon Island, Indonesia, Banda Sea [Petersen, Britayev 1997].

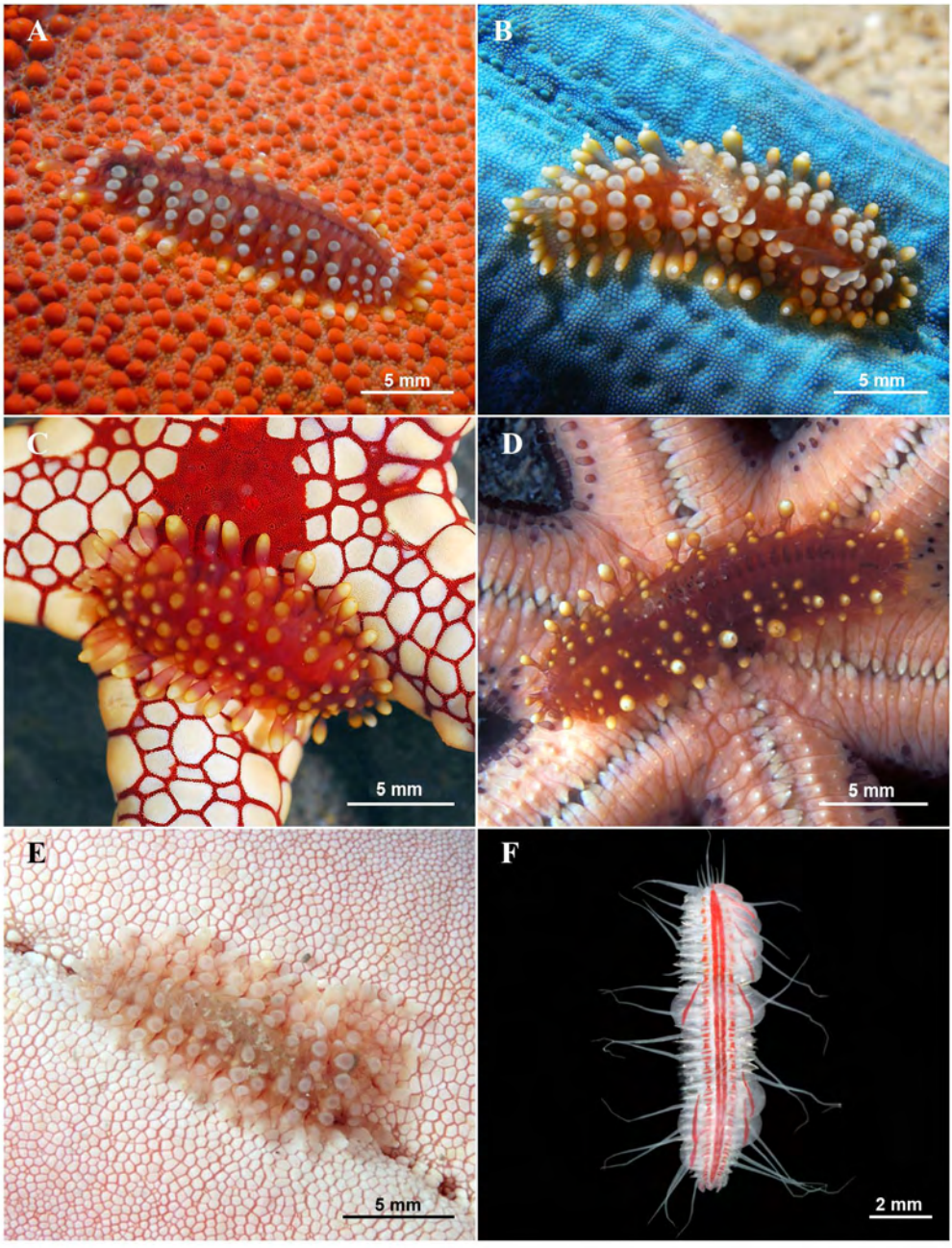

Plate 1. **A** – *Asterophilia culcitae* on the oral surface of starfish *Culcita novaeguineae* (*in situ*), **B** – *A. culcitae* on the arm of starfish *Linckia laevigata* (*in situ*), **C** – *A. culcitae* on the aboral surface of starfish *Fromia monilis* (in lab), **D** – *A. culcitae* on the oral surface of starfish *Echinaster luzonicus* (in lab), **E** – *A. culcitae* on the oral surface of starfish *Choriaster granulatus* (*in situ*), **F** – *Australaugeneria rutilans* (in lab).

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CHAPTER 2

Chitons (Mollusca, Polyplacophora) of Nhatrang Bay, South Vietnam

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ABSTRACT. The chiton fauna of Nhatrang Bay consists of 28 species. Twenty one species were found for the first time in Vietnam, and seven of them were described as new. Oyster beds are the most interesting and poorly studied biotopes widely distributed in the Southern Vietnam, and most of new species of chitons were found there. Abundance of chitons in oyster beds is probably linked with low predator pressure of crabs and fishes. The influence of predators on chitons evolution is discussed. Data on chitons fauna in Vietnam are summarized. Currently, it includese 49 species, 25 of them are new for Vietnam.

The literature about Vietnamese chitons is very scarce. It merely consists of descriptions of several species collected in the South China Sea near the Vietnamese coast. Leloup [1937, 1940, 1952] described three new species, Strack [1991] and Sirenko [1998] described two new species. Several more articles have added few new species to the fauna of Vietnam: Sirenko [1988, 1992] and Strack [2003]. First list of Vietnamese chitons, compiled by Leloup [1952], included 13 species, Dawydoff [1952] listed 17 species, but most of these records need verification. Strack [2003] compiled a final list of Vietnamese chitons that included 40 species, but almost half of them require verification. This article is a result of two years of field investigations of chitons fauna in Nhatrang Bay.

Materials and methods

Specimens were collected during two expeditions in spring (March-May) of 2009 and 2010, near Nhatrang city and neighboring islands: Tre, Mun, Mot and Nok (Fig. 2). The majority of material was collected using SCUBA diving, up to 22 m depths. Chitons were collected traditionally, from underneath stones and by a new method which allowed us to overcome some difficulty with the collection of small specimens with cryptic coloration. This new procedure involved collection of: substrata of dead bivalve and gastropod shells, dead branches of corals and pieces of coralline algae that covered dead corals and rocks. They were placed in a bucket of fresh water after which a small amount of formol has been added. One to two hours later these shells and other debris have been washed in the bucket and large pieces of shells, corals and algae have been removed. The remains were then sieved on a set of sieves with 5×5 and 1×1 mm mesh size. This sieved material has been sorted under a stereomicroscope. Additionally, I collected bottom sand near rocks that has been dried and examined under a microscope. This procedure allowed valves of several chitons species to be collected which have not otherwise been collected alive.

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Distribution in Nhatrang Bay. Mun, Nok and Tre Islands.

General distribution. East of Mediterranean Sea, Suez Canal, Red Sea, Gulf of Aden, Mozambique, Madagascar, Sri Lanka, Maldives Islands, South Vietnam, Timor Sea, Molluccas, North east of Papua New Guinea, Fiji Torres Strait and Tasman Sea [Kaas *et al*. 2006].

Rhyssoplax cf. *komaiana* (Is. et Iw. Taki, 1929)
(Pl. 12 E; Figs. 12; 13)

Chiton komaianus Is. and Iw. Taki 1929: 145, figs. 22–31, pl. 2, fig. 6
Chiton (*Rhyssoplax*) *venusta*: Leloup, 1952: 56–59, fig. 19, Pl. V, fig. 1, Pl. VI, fig. 2 (non Hull 1923)
Rhyssoplax komaiana: Bullock, Harper 1994: 39–41, Pl. 4 B, 6 C, 7 C–D, 8 B
Chiton (*Rhyssoplax*) *komaianus*: Kaas *et al*. 2006: 200–203, fig. 79, map 36 (bibliography and synonymy).

Material examined. South China Sea, Nhatrang Bay, Than Bay, 25 April 2009, 1–1.5 m, under a stone – 1 spm; 25 April 2010, 1–1.5 m, on red crustose algae – 1 spm; Tre Island, 07 May 2010, 7–8 m, on red crustose algae – 1 spm.

Measurements. Largest specimen found, was 10.2 mm long and 6.1 mm wide.

Colouration. Tegmentum and girdle olive-grey blotched with dark-grey (in tegmentum) and white (in the girdle) bands.

Taxonomic notes. Three studied specimens differ from type of *Rhyssoplax komaiana* by a carinated shell (subcarinated in *R. komaiana*), fewer radiating rows in valve I, lateral areas of intermediate valve and postmucronal area of tail valve and sculpture of dorsal scales. Perhaps these differences depend on the mollusks' size. My specimens are twice smaller than the typical specimen. My examination of the specimen (body length 9.0 mm) revealed some additional features on girdle and radula to the description of the holotype specimen. Girdle dorsally covered with large imbricating scales (up to 230×260 mm), upper side decorated with ca. 20 very fine distinctly raised riblets in the central portion of scales and numerous granules near the top of scales (Fig. 13 C). There is a marginal fringe of obtusely pointed spicules (110×20 μm) and bristles (up to 150 μm). The radula of the specimen is 3.3 mm long, with 38 transverse rows of mature teeth. Central tooth depressed and has long pointed blade (Fig. 13 D). There are 31 gills on both sides extending from valve II to VIII. Slit formula 8/1/10.

Ecological notes. Found at a depth of 1–7 m on red crustose algae or under stones.

Distribution in Nhatrang Bay. Than Bay, Tre Island.

General distribution. Hong Kong, Hainan Island and South Vietnam, South Japan. Bullock [1988] states that it lives in Malaya, Philippines and possibly south of the Admiralty Islands as well.

Rhyssoplax pulcherrima (Sowerby, 1842)
(Pl. 12 C; Figs. 14; 15)

Chiton pulcherrimus Sowerby 1842: 103; Strack 2003: 13.
Chiton (*Rhyssoplax*) *pulcherrimus*. Kaas *et al*. 2006 (bibliography and synonymy); Schwabe *et al*. 2008: 13–14, fig. 4 A–C.

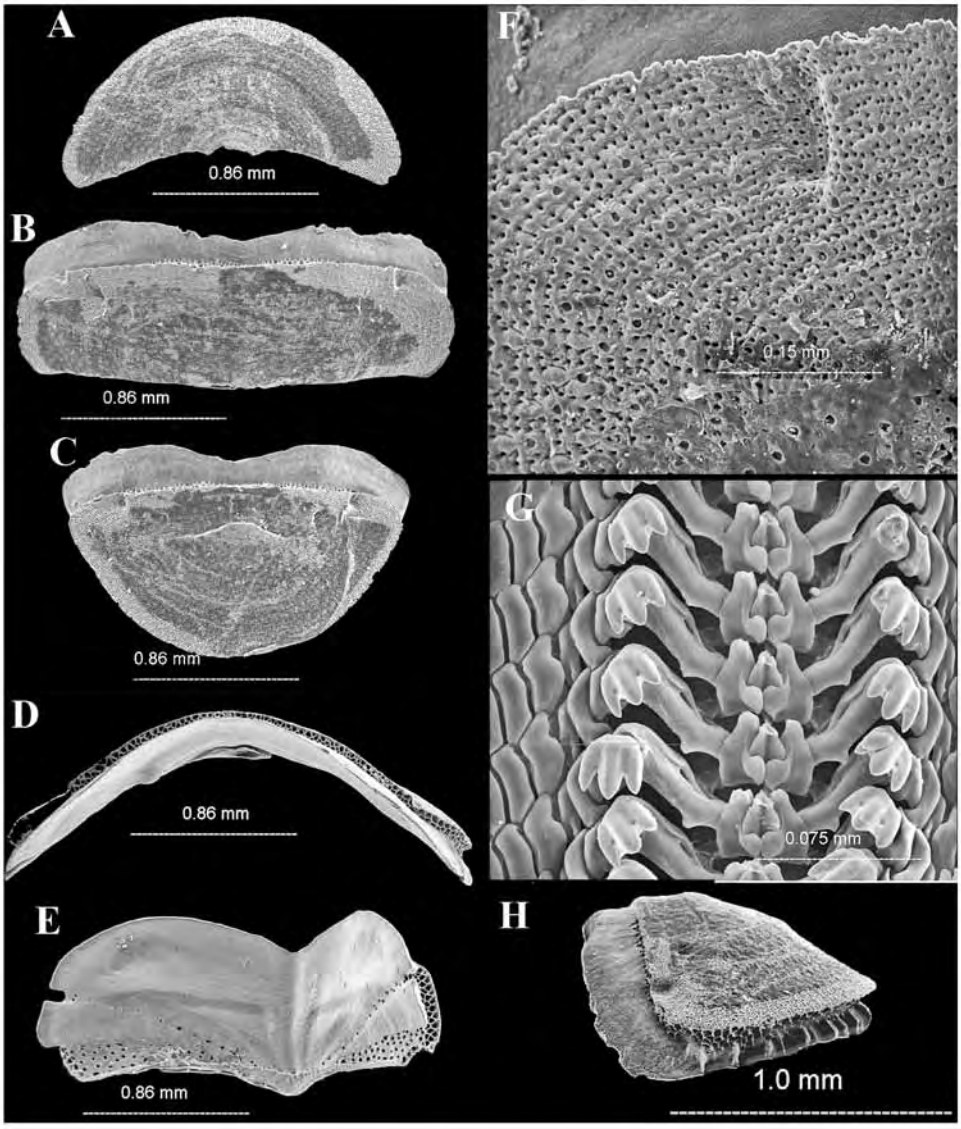

Fig. 8. *Callochiton subsulcatus*, Tre Island, 6 m, 01.05.2010, BL – 6.5 mm. **A** – valve I; **B** – valve IV; **C** – valve VIII; **D** – valve **V**; **E** – valve III, **F** – valve IV, tegmentum surface; **G** – radula; **H** – valve VIII, lateral view.

Measurements. Largest specimen has a body length of 5.2 and a width of 3.0 mm.

Colouration. Tegmentum and girdle dirty white covered with grey deposits.

Ecological notes. Found at 1.5–15 m depths on dead and live bivalve shells.

Distribution in Nhatrang Bay. Nok Island.

General distribution. Maldives Islands, Indonesia, Sulawesi, South Vietnam, Philippines, South Japan and. Southwest Australia.

#	Species	First finding for Vietnam	Nhatrang Bay	Studied by author
31	*Lucilina* cf. *sowerby* (Nierstrasz, 1905)		+	+
32	*Lucilina carnosa* (Kaas, 1979)	+	+	+
33	*Lucilina* cf. *tilbrooki* (Milne, 1958)	+	+	+
34	***Onithochiton stracki*** sp. nov.	+	+	+
35	***Plaxiphora bucklandnicksi*** sp. nov.	+	+	+
36	?*Acanthochitona bednalli* (Pilsbry, 1894)			
37	***Acanthochitona britayevi*** sp. nov.	+	+	+
38	***Acanthochitona saitoi*** sp. nov.	+	+	+
39	***Acanthochitona savinkini*** sp. nov.	+	+	+
40	*Acanthochitona* sp. (Nhatrang bay)	+	+	+
41	*Notoplax rosea* Leloup, 1940			+
42	*Notoplax* sp. 1 (Nhatrang bay)	+	+	+
43	*Notoplax* sp. 2 (10°26’ N; 109°15’E, 95 m)	+		+
44	*Leptoplax coarctata* (Sowerby, 1841)	+	+	+
45	*Leptoplax* sp. (Halong Bay)			
46	*Craspedochiton laqueatus* (Sowerby, 1842)	+	+	+
47	*Cryptoplax oculata* (Quoy et Gaimard, 1835)	+	+	+
48	*Cryptoplax* cf. *burrowi* (E.A. Smith, 1884)			+
49	*Cryptoplax* sp. (Nhatrang bay)	+	+	+

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CHAPTER 3

Eulimidae (Gastropoda, Ptenoglossa) of Nhatrang Bay

P.Yu. Dgebuadze[1], Yu.I. Kantor[1]

ABSTRACT. Seventeen species of symbiotic gastropods (Gastropoda, Eulimidae) were found in Nhatrang Bay, (South Vietnam) in the South China Sea: 5 species from starfishes, 7 species from crinoids, 3 species from echinoids, 2 species from holothurians. This research has doubled the species list for symbiotic gastropods of Eulimidae family in Vietnam waters, extending it to 32 species. Previously 15 eulimid species have been noted, only 3 of which were known in associations with hosts. Only one species that we found, *Thyca crystallina*, has been earlier recorded on starfishes *Linckia laevigata*. All symbionts have been found on their hosts, and for some of them hosts were recorded for the first time (in particular, for *Goodingia* sp., *Annulobalcis* spp., and *Stilifer variabilis*).

Echinoderms like other large marine animals with sedentary life style are often occupied by various symbionts. More than 825 species (from protozoans to fishes) are associated with different representatives of this phylum [Jangoux 1990]. In symbiotic associations, the host serves as a buffer between symbionts and the environment, which decreases the influence of abiotic factors on the symbionts and makes biological interactions more distinct [Lyskin, Britayev 2005].

The Eulimidae family is diverse but rather poorly investigated group of symbiotic gastropods. This family includes approximately 1500 species which are almost exclusively associated with all major groups of echinoderms [Warén 1983; Jangoux 1990]. Both ectoparasites and endoparasites are found in Eulimidae. Many ectoparasitic eulimids penetrate echinoderm integuments with their proboscises to reach coelomic cavity, water vascular system, or hemal system, and presumably feed on host's fluids, coelomocytes, or internal tissues. Some species consume echinoderm dermis. Endoparasitic eulimids dwell in the digestive tract or in coelomic cavity. In addition to their feeding activities, eulimids impact their hosts by causing attachment lesions and gall formation, for example in asteroids, ophiuroids and crinoids [Harms 2006].

Despite the fact that eulimids species are parasitic, only few of them were found in an association with host organisms. This is due to the fact that only a limited number of eulimid species are permanently associated with hosts. Probably most species parasitize hosts for a limited time and then leave to hide somewhere on the bottom [Bouchet, Warén 1986]. Many eulimids are not host specific.

Most species of this family occur in tropical waters [Warén 1983]. In Vietnam eulimid fauna was poorly investigated. Previous studies recorded 15 species but only three of them were found with their hosts [Hylleberg, Kilburn 2003; Lyskin, Britayev 2005; Thach 2005, 2007; Moolenbeek 2009].

Below is a list of Eulimidae species found by us with short descriptions.

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Ecological notes. All mollusks were found on cirri of comatulid crinoids *Oxycomanthus bennetti* (Comasteridae).

Distribution in Nhatrang Bay. Tre, Mun, Nok, and Dung Islands. Presently endemic of the Bay.

Annulobalcis vinarius Dgebuadze, Fedosov et Kantor, 2012
(Pl. 17 C, D)

Annulobalcis sp. 2: Dgebuadze, Kantor 2010: figs. 2 b,g; 4 b.
Annulobalcis vinarius Dgebuadze, Fedosov, Kantor 2012: 148, 150, figs. 4; 6 C–E.

Material examined. South China Sea, Nhatrang Bay, Islands Tre, Mun, and Nok, 2007–2010, 4–10 m, on *Himerometra robustipinna* Carpenter, 1881, *Stephanometra tenuipinna* (Hartlaub, 1890), *Amphimetra ensifera* (A.H. Clark, 1908) (Crinoidea, Himerometridae), *Comatella nigra* Carpenter, 1888 (Crinoidea, Comasteridae), *Stephanometra indica* (Smith, 1876) and *Dichrometra flagellata* (Müller, 1841) (Crinoidea, Mariametridae) – 1440 specimens.

Diagnosis. Shell thin, transparent, narrow, glossy, elongated-conical, with well developed irregularly situated growth lines and scars. Aperture broadly ovate, with visible angle between columellar and parietal margins. Outer lip in ventral view evenly rounded, in lateral view slightly sinuated just below the suture, then evenly protruded and curved.

In live specimens body is dark red with small white spots arranged in axial bands that are regularly situated on the visceral mass whorls.

Measurements. Average size: 3.7 mm in height.

Taxonomic notes. This species is most similar to *Annulobalcis maculatus*, for the differences see the description of *Annulobalcis maculatus*. In transparency of its shell and brightly colored red body spotted with white spots it resembles *Annulobalcis yamamotoi* Habe 1974 and *Annulobalcis aurisflamma* Simone, et Martins, 1995, but differs in the absence of spiral sculpture.

Ecological notes. All mollusks were found on calyx (lower and upper sides), on arms and on cirri of crinoids.

Distribution in Nhatrang Bay. Tre, Mun, Nok, and Dung Islands. Presently endemic of the Bay.

Annulobalcis wareni Dgebuadze, Fedosov et Kantor, 2012
(Pl. 17 E, F)

Annulobalcis wareni Dgebuadze, Fedosov, Kantor 2012: 146–148, figs. 3; 6 F.

Material examined. South China Sea, Nhatrang Bay, Tre, Mun, and Nok Islands, 2007–2010, 4–10 m, on *Comaster nobilis* (Carpenter, 1884) (Crinoidea, Comasteridae) – 16 specimens.

Diagnosis. Shell conical, glossy, grayish white, smooth except thin sigmoid scars

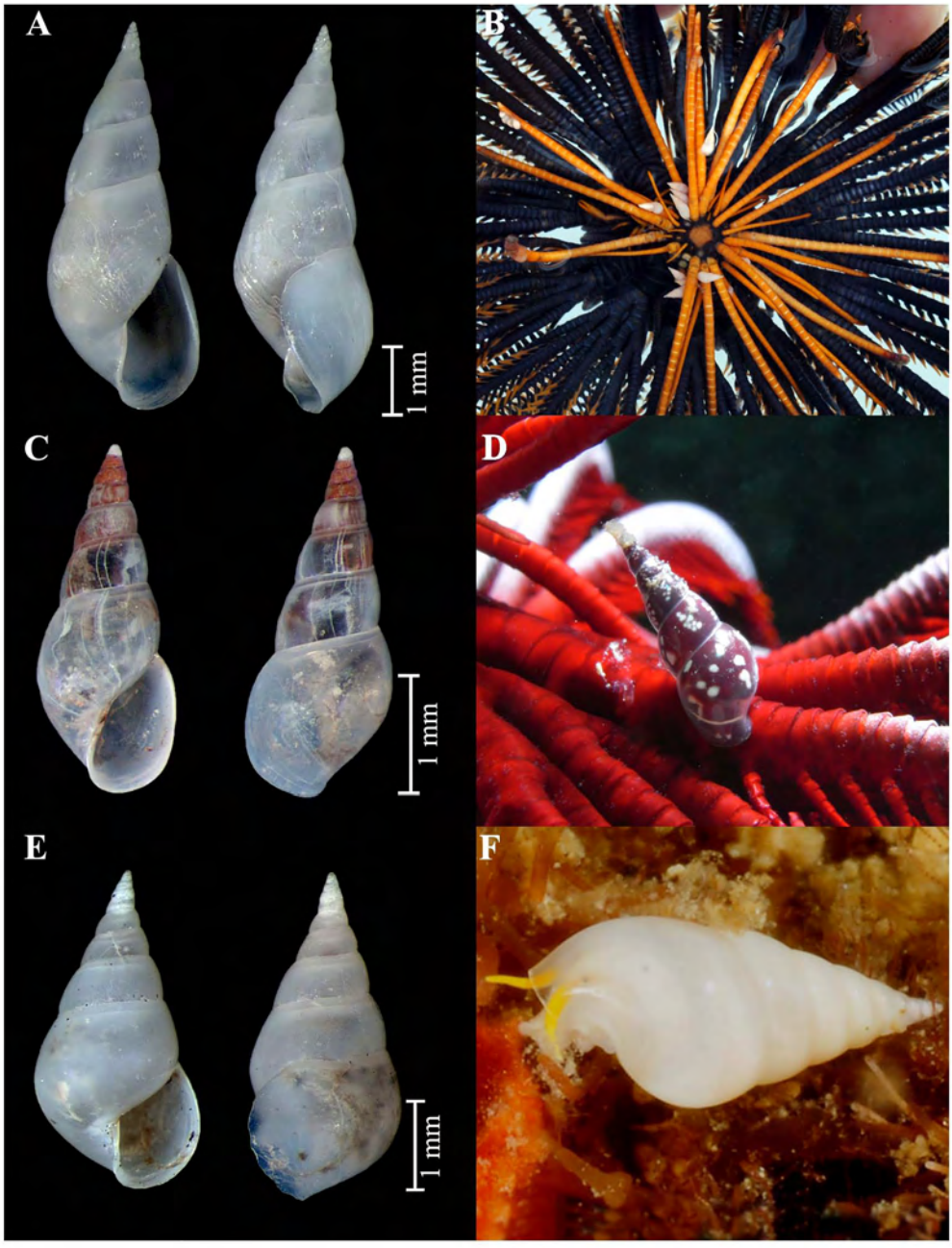

Plate 17. **A** – *Annulobalcis albus*, holotype, 6.0 mm; **B** – *Annulobalcis albus* on the host – feather star *Oxycomanthus bennetti;* **C** – *Annulobalcis vinarius*, holotype, 2.9 mm; **D** – *Annulobalcis vinarius* on the arm of feather star *Himerometra robustipinna;* **E** – *Annulobalcis wareni,* holotype, 3.8 mm; **F** – *Annulobalcis wareni*, live specimen.

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Брюхоногие моллюски семейства Eulimidae (Gastropoda, Ptenoglossa) залива Нячанг

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РЕЗЮМЕ. В заливе Нячанг Южно-Китайского моря (южный Вьетнам) обнаружено 17 видов симбиотических брюхоногих моллюсков из семейства Eulimidae: 5 видов на морских звездах, 7 видов на морских лилиях, 3 вида на морских ежах и 2 вида на голотуриях. Результаты исследований удвоили список видов симбиотических брюхоногих моллюсков семейства Eulimidae в водах Вьетнама, увеличив его до 32. Ранее отмечалось 15 видов эулимид, лишь для трех из которых были известны хозяева. Только один из обнаруженных нами видов – *Thyca crystallina* – был отмечен ранее на морских звездах *Linckia laevigata*. Все виды моллюсков-симбионтов были обнаружены с хозяевами, а для некоторых из них хозяева были установлены впервые (в частности, для *Goodingia* sp., *Annulobalcis* spp. и *Stilifer variabilis*).

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CHAPTER 4

Opisthobranch molluscs of Vietnam (Gastropoda: Opisthobranchia)

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ABSTRACT. Currently, study of opisthobranch molluscs (including well-known nudibranchs) are among the most dynamically developed fields of marine biology. Great diversity, intricate evolutionary history and numerous biological peculiarities are features of this remarkable group of the phylum Mollusca. Despite general advancements, currently there is a great deficiency in works on taxonomy of regional opisthobranch faunas. Opisthobranchs of Vietnam are among world's least studied faunas. Prior to present study, there has been a single review that dealt only with the nudibranch molluscs [Risbec, 1956], and now it is much outdated. Therefore, the review of Vietnam opisthobranch molluscs' fauna in this study is presented for the first time. For each species short synonymy, diagnostic features and data on its biology and distribution are provided. Every species in this review is illustrated with an original color photograph. In total, 150 species of opisthobranch molluscs have been recorded. This includes most orders: Cephalaspidea, Anaspidea, Umbraculida, Sacoglossa, Notaspidea, Doridacea and Nudibranchia. One of the most important results of this study is 116 new species of opisthobranch molluscs that have been recorded for the first time for Vietnamese fauna. A new colorful species, ***Janolus savinkini*** sp. nov. is described.

Tropical, Indo-West Pacific Nudibranch molluscs make up the core of this group's diversity and hold a leading place in the world's fauna species number. Apart from dramatically different morphology in comparison to other gastropods, nudibranchs processes numerous unique biological novelties. For instance, species of one of the most common tropical dorid nudibranch family, Phyllidiidae, acquired a set of unusual digestive and protective adaptations. Among various aberrant features of this family, most remarkable are: secondary respiratory leaves under the notum (primary gills are completely reduced), absence of a radula (one of the most typical molluscan character), transformation of pharynx into a strong sucking organ, and finally, an elaborate system of chemical protection that uses sponge metabolites [e.g. Cimino *et al*. 1999; Cimino, Ghiselin 2009; and many others]. Some species from another large nudibranch group (Aeolidacea), for instance *Pteraeolidia janthina* poses even more unusual features such as: a symbiosis with microalgae Zooxanthellae in the dorsal papillae; thus it has a possibility to use algae's photosynthetic products for its benefit [e.g. Wägele, Johnsen 2001]. Various other symbionts (e.g. copepod crustaceans) have also been noted with tropical Nudibranchia. These few remarkable examples are only the top of an iceberg of the nudibranch features which can be central themes of numerous other long-term studies in different fields of biology.

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Coloration. The ground color is black, covered with numerous small opaque white dots. Head bears wide transverse band. The edges of the cephalic shield and posterior mantle lobes are marked with orange spots.

Ecological notes. It can be found on coral reefs, at 8 m depth. Unlike most cephalaspids, present species (and most taxa of Aglajidae family) inhabit hard substrata, predominately coral reefs.

Distribution in Nhatrang Bay. Mot Island.

General distribution. Tropical Indo-West Pacific. First record for Vietnam.

Philinopsis cyanea (Martens, 1879)
(Pl. 21 E)

Doridium cyaneum Martens 1879: 738.
Philinopsis cyanea: Rudman, 1972 a: 381–394, fig. 15 (synonymy).

Material examined. Nhatrang Bay, Dung Island, 10.05.2004, depth 10–15 m, photographic records only (O.V. Savinkin); Nhatrang Bay, Dung Island, 26.09.2003, depth 20–25 m, photographic record only (O.V. Savinkin); Nhatrang Bay, Nok Island, 23.05.2007, depth 12–20 m, collected by O.V. Savinkin, ZMMU Op-89 – 1 specimen; Nhatrang Bay, 22.04.2007, trawling, ZMMU Op-94, collected O.V. Savinkin – 1 specimen; Nhatrang Bay, 24.04.2007, trawling, collected by O.V. Savinkin, ZMMU Op-109 – 1 specimen; Nhatrang Bay, S to Dung Island, spring 2007, trawling, collected by O.V. Savinkin, ZMMU Op-110 – 1 specimen.

Description. The body is elongated, massive, and somewhat similar in shape to shell-less nudibranchs, clearly divided into strong cephalic shield and a massive visceral sac. The posterior part of the visceral sac (mantle) has two short symmetrically rounded lobes that do not project posteriorly. The shell is rudimentary and completely internal. The foot possesses well defined parapodia which do not meet in the middle body axis.

Measurements. Body length up to 23 mm (fixed specimens).

Coloration. The ground color is purple-brown, covered by opaque yellow and white dots of various sizes, predominantly large. The edges of the foot are marked with a bright blue line. In the middle of cephalic shield there are several thick orange lines. Similar line marks lower side of the foot, just below of the blue line.

Ecological notes. It can be found on coral reefs, at depths of 10–25 m. Unlike most cephalaspids, present species (and most taxa of the family Aglajidae) inhabit hard substrata, mainly coral reefs.

Distribution in Nhatrang Bay. Dung and Nok Islands.

General distribution. Tropical Indo-West Pacific. First record for Vietnam.

Philinopsis gardineri (Eliot, 1903)
(Pl. 21 F)

Doridium gardineri Eliot 1903 a: 332–333.
Philinopsis gardineri: Rudman 1972 a: 381–396, fig. 9 (synonymy).

Plate 29. **A** – *Hypselodoris placida*; **B** – *Hypselodoris whitei*; **C** – *Mexichromis multituberculata*; **D** – *Noumea norba*; **E** – *Noumea purpurea*; **F** – *Noumea simplex*; **G** – *Noumea varians*; **H** – *Risbecia tryoni*. **A**, **C**–**G** – photos of O. Savinkin; **B**, **H** – photos of T. Korshunova.

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CHAPTER 5

Brachyuran crabs (Crustacea Decapoda Brachyura) of the mangrove intertidal zone of southern Vietnam

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ABSTRACT. An assessment of taxonomic composition and functional structure of brachyuran crab assemblages was conducted in southern Vietnam mangroves. 26 species of 10 families were found in Dam Bay (Nhatrang Bay, Tre Island), Nha Phu Lagoon (both in Khán Hoa Province) and in the Can Gio National Park (Dong Nai River). 15 species are recorded for the first time from the coast of Vietnam. These are *Episesarma palawanense* (Rathbun, 1914), *Ilyoplax punctata* (Tweedie, 1935), *Macrophthalmus milloti* (Crosnier, 1965), *Metaplax longipes* (Stimpson, 1858), *Metopograpsus latifrons* (White, 1847), *Mictyris brevidactylus* (Stimpson, 1858), *Nanosesarma batavicum* (Moreira, 1903), *Parasesarma* cf. *affine* (De Haan, 1837), *P. ungulatum* (H. Milne Edwards, 1853), *Sphaerozius scaber* (Fabricius, 1798), *Uca borealis* (Crane, 1975), *U. paradussumieri* (Bott, 1973), *U. crassipes* (White, 1847), *U. flammula* (Crane, 1975) and *U. vocans* (Linnaeus, 1758). Using literature data and on site observations of crabs' trophic specialization and morphology, we distinguished four principal life forms of mangrove brachyuran crabs: high tide active predators, low tide polyphagous forms, high tide polyphagous forms and low tide detritus feeders. Distribution of these life forms within main horizons of mangrove intertidal zone is described. A non-fragmented mangrove forest (Can Gio National Park) is characterized by high species diversity and a complex composition of life forms. On the other hand impoverished crab assemblages are associated with mangrove biotopes that are transformed into a pond system for mud crab and fish cultivation (Nha Phu Lagoon). Mangrove plantation, in Dam Bay, has already accommodated a relatively rich and diverse assemblage of intertidal brachyuran crabs.

The mangrove ecosystems of Vietnam are experiencing significant anthropogenic pressure. Mangroves are replaced by shrimp, fish and crab aquaculture farms. Maritime forests were initially threatened by the defoliant treatment, during the Vietnamese – American war (1965–1975). Although they are partly restored, their total coverage still gradually decreases [Graaf, Xuan 1998; Tong *et al*. 2004].

As a response to this, Vietnamese government established several national parks with an aim of conserving and restoring large mangrove massifs. National Park Can Gio encompasses the Dong Nai River and Long Tau River Delta and it is one of the largest among protected areas (about 75 000 ha). Besides this, mangrove forests are re-planted

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Japan, Korea and Australia. First record from Vietnam [Dai, Yang 1991; Kwok, Tang 2006; Ng *et al*. 2001; present study].

Uca crassipes (White, 1847)
Cua Cong Do [Vietnamese]
(Pl. 44 E–G)

Gelasimus crassipes White 1847a: 36.
Gelasimus crassipes: Adams, White 1849: 49.
Gelasimus gaimardi H. Milne Edwards 1852: 114, 150, pl. 4, fig. 17, 17 a.
Gelasimus latreillei H. Milne Edwards 1852: 114, 150, pl. 4, fig. 14, 20, 20 a.
Gelasimus pulchellus Stimpson 1858: 100.
Gelasimus splendidus Stimpson 1858: 99
Gelasimus chlorophthalmus Kingsley 1880: 151 (part).
Uca gaimardii: Ortmann 1897: 353.
Uca novaeguineae Rathbun 1913: 617, pl. 76.
Gelasimus latreillei: Bouvier 1915: 302, fig. 37.
Uca pulchella: Parisi 1918: 93.
Uca splendidus: Gee 1925: 165.
Uca (*Amphiuca*) *chlorophthalmus crassipes*: Sakai 1976: 606, fig. 332 b, pl. 209, figs 2–4; Dai, Yang 1991: 468, fig. 238, pl. 59 (5).
Uca (*Paraleptuca*) *chlorophthalma crassipes*: Takeda, Nunomura 1976: 80.
Uca (*Amphiuca*) *chlorophthalma crassipes*: Miyake 1983: 163, pl. 55, fig. 3.
Uca crassipes: Huang *et al*. 1989; Kwok, Tang 2006: 4 (tabular key), figs 8–9.

Material examined. Nha Phu Lagoon, coll. Udalov, 31.04.2008 – 1 male (H-C-OCY-Uca-13); Nhatrang Bay, Tre Island, Dam Bay, coll. Udalov, Chertoprud, 16.10.2008 – 1 male (H-C-OCY-Uca-14); Nhatrang Bay, Tre Island, Dam Bay, coll. Chertoprud, Spiridonov, 07.04.2010 – 3 males (H-C-OCY-Uca-40-42); Nhatrang Bay, Tre Island, Dam Bay, coll. Chertoprud, Spiridonov, 13.04.2010 – 2 males (SMF 38968).

Measurements. CW of male 15 ± 0.6 mm.

Colouration. Carapace is usually black with blue spots and bands. The palm of male major cheliped is red-orange; fingers are white-rose.

Ecological notes. Burrows were found in mangrove swamps or mud flats at river mouths or amongst rubble and coral sand [Dai, Yang 1991]. In Dam Bay in the years 2008–2010, *U. crassipes* was found to be abundant in littoral sand over tangle of adult *Rhizophora stylosa* and between pneumatophore roots of *Avicennia* sp. (Pl. 44 G). This species was also found on muddy coarse-grained sands in saltwater ponds near Nha Phu Lagoon.

Distribution in Vietnam. Tre Island, Dam Bay and Nha Phu Lagoon, 30 km north of Nhatrang City (present study).

General distribution. Malaysia, Japan, China, Hong Kong, Taiwan, Philippines, Sulu Archipelago, Indonesia, New Guinea, Caroline Islands, Marshall Islands, Vanuatu, New Caledonia, Fiji, Samoa, Tonga, Society and Marquesas Islands [reviewed by Sakai1976; Dai, Yang 1991; Crane 1975; Kwok, Tang 2006; Ng *et al*. 2001; Shen 1936, 1940]. First record from Vietnam.

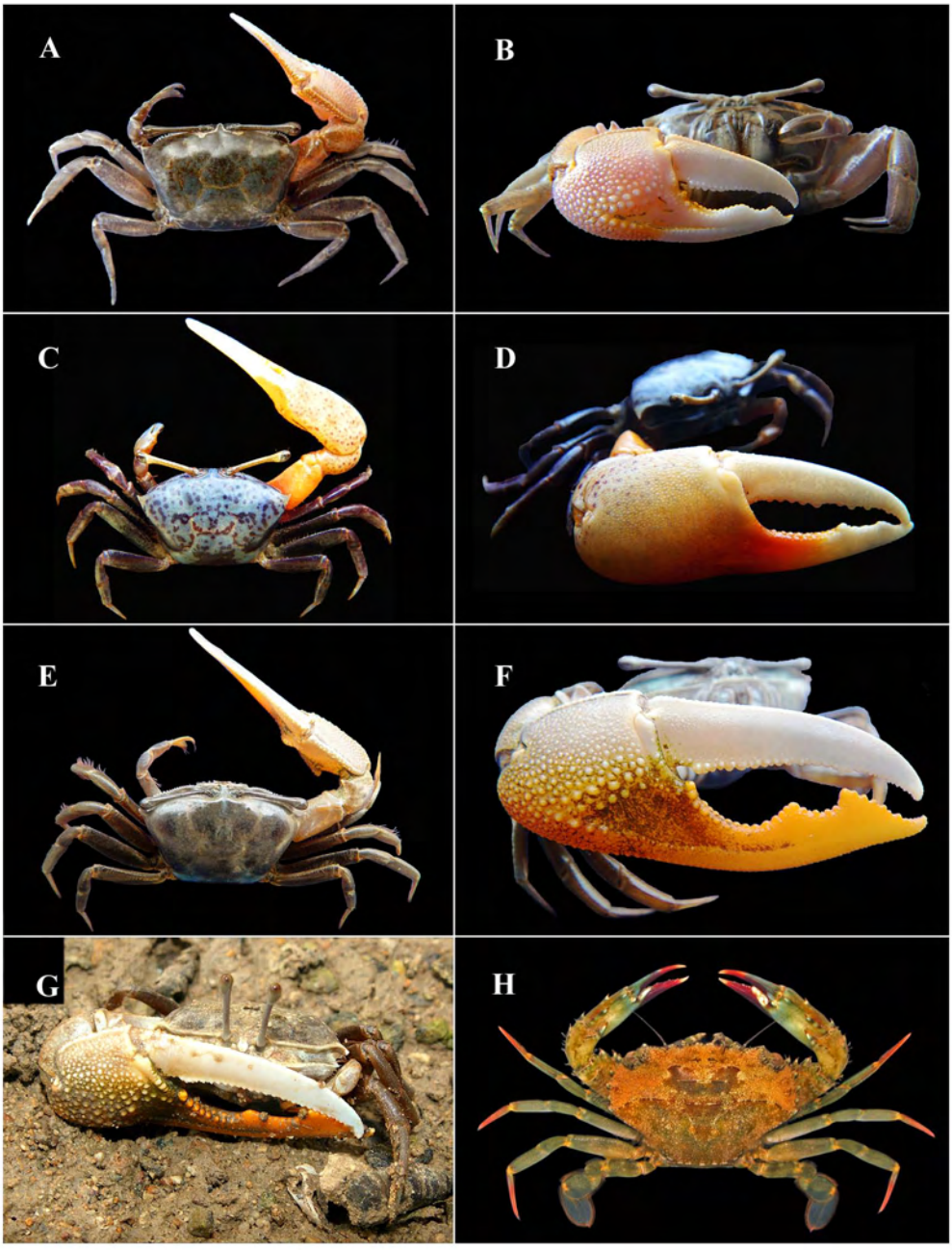

Plate 46. **A** – *Uca rosea*, ♂, CW 14.7 mm; **B** – *U. rosea*, same specimen, frontal view; **C** – *Uca tetragonon*, ♂, CW 20.2 mm; **D** – *U. tetragonon*, same specimen, frontal view; **E** – *Uca vocans*, ♂, CW 17.3 mm; **F** – *U. vocans*, same specimen, frontal view; **G** – male *U. vocans* in nature; **H** – *Thalamita crenata*, ♂, CW 56 mm.

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Крабы (Brachyura) мангровой литорали Южного Вьетнама.

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РЕЗЮМЕ. Проведен сравнительный анализ видовой и функциональной структуры ассоциаций мангровых крабов (Brachyura) заливов Дам (залив Нячанг, о. Че), Ня Фу (провинция Кхань Хоа) и одного из районов национального парка Кан Зё (река Донг Най). На мангровой литорали трех рассмотренных локусов отмечено 26 видов крабов, принадлежащих 10 семействам. Среди них 15 видов впервые отмечены у побережий Вьетнама: *Episesarma palawanense* (Rathbun 1914), *Ilyoplax punctata* Tweedie 1935, *Macrophthalmus milloti* Crosnier 1965, *Metaplax longipes* Stimpson1858, *Metopograpsus latifrons* (White 1847), *Mictyris brevidactylus* Stimpson 1858, *Nanosesarma batavicum* (Moreira 1903), *Parasesarma* cf. *affine*(De Haan, 1837), *P. ungulatum* (H. Milne Edwards, 1853), *Sphaerozius scaber* (Fabricius 1798), *Uca borealis* Crane 1975, *U. paradussumieri* Bott 1973, *U. crassipes* (White 1847), *U. flammula* Crane 1975, *U. vocans* (Linnaeus 1758). На основании литературных данных и оригинальных наблюдений с учетом трофических предпочтений и морфологических особенностей видов, выделено четыре основных типа жизненных форм мангровых крабов: активные хищники прилива, полифаги прилива, полифаги отлива и детритофаги отлива. Описано распределение этих жизненных форм по горизонтам литорали. Высокое видовое разнообразие и сложная (по набору жизненных форм) структура ассоциаций крабов характерна для нефрагментированного мангрового леса (национальный парк Кан Зё). Обедненные ассоциации крабов характерны для мангровых биотопов, превращенных в системы прудов для выращивания рыбы и крабов (лагуна Ня Фу). В то же время группировка литоральных крабов недавно существующих мангровых посадок в заливе Дам уже относительно богата видами и разнообразна по составу жизненных форм.

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CHAPTER 6

Commercial crabs (Crustacea Decapoda Brachyura) from Nhatrang Bay (Vietnam)

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ABSTRACT. A preliminary assessment of taxonomic diversity of brachyuran crabs caught and traded by local population in the Nhatrang Bay area (southern Vietnam, Khánh Hoa Province) revealed 31 species of 11 families. Among them, 6 species, though common in the neighboring areas, were recorded for the first time in Vietnam waters: *Dromia dormia* (Linnaeus, 1763); *Ranina ranina* (Linnaeus, 1758); *Dorippe sinica* Chen, 1980 (southward extension of the known range); *Calappa quadrimaculata* Takeda et Shikatani, 1990; *Eucrate solaris* Yang et Sun, 1979 and *Varuna yui* Hwang et Takeda 1986. Nomenclature of *Monomia haanii* (Stimpson, 1858) (= *Portunus gladiator* Fabricius, 1798), which is a common commercial in the Nhatrang area, is discussed. Contrary to the opinion of Ng *et al*. [2008], the name *M. haanii* should be retained as a valid name under the International Code of Zoological Nomenclature, since *P. gladiator* Fabricius, 1798 became a secondary homonym of *P. gladiator* (Fabricius, 1793) after the neotype designation of the latter species performed by Stephenson and Cook [1973]. Coloration characteristics making it possible to distinguish between morphologically very similar species *M. haanii* (Stimpson, 1858), *M. argentata* (A. Milne Edwards, 1861) and *M. pseudoargentata* Stephenson, 1961 (all constantly present in commercial catches) are provided. Based on the frequency of occurrence and abundance on the markets we distinguished several groups of caught and sold species of brachyuran crabs. A – commonly and broadly sold species that include: several species of Portunidae and most of box crabs (Calappidae, 5 species). B – valuable, but sporadically sold species that include: 1 species of Varunidae, 1 species of Carpiliidae and 1 species of Raninidae that is from time to time sold on the Nhatrang markets. C – occasional bycatch which includes species of: Dromiidae, Dorippidae, Matutidae, Galenidae, Goneplacidae and Xanthidae (8 common species). These have been never recorded at the city market but they are sold in limited number at landing places wholesale markets. Taxonomic composition of commercial crabs in the Nhatrang area and in the Western Central Pacific in general shows only partial resemblance. Portuniudae are represented by the greatest number of species in both cases. Number of commercial species of Calappidae and Matitidae in southern Vietnam even exceeds figures reported by Ng [1998] and FAO [2011] for the entire Western Central Pacific. Xanthidae taxa, which includes a number of commercial species in Indo-Pacific is poorly represented in the collections from the Nhatrang market. This is probably due insufficient availability (or accessibility) of the reef associated habitats in the Nhatrang Bay, where crabs of this family are commonly caught. Absence of deep-living Geryonidae on the Nhatrang market may be explained by the fact that most of local fishery is done in shallow water.

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Family GALENIDAE A. Milne Edwards, 1862

Galene bispinosa (Herbst, 1783)
(Pl. 50 C)

Cancer bispinosus Herbst 1783: 144, pl. VI, fig. 45.
Cancer (*Galene*) *bispinosus*: De Haan 1833: 49, pl. 5, fig. 2.
Galene granulata Miers 1884: 208, pl. XX, fig. A.
Galene bispinosa: Alcock 1898: 136; Etheridge, McCulloch 1916: 10, pl. III, figs. 3–4; Rathbun 1923 a: 105; Stephensen 1945: 153–154; Dai, Yang 1991: 303–304, pl. 39 (2), fig. 158 92; Ng 1998: 1113. Sakai 1999: 36, pl. 19 C (holotype photo); Ng *et al*. 2001: 36.

Material examined. Landing and market place in Be River mouth, coll. Chertoprud 2008 – 1 male (H–C).

Comparative material from other regions. 1 male (SMF 1655), coll. O. Löw-Beer, 1912, India, Maharashtra, Bombay Bay.

Measurements. CW 56.5 mm.

Ecological notes. Most of documented records are from relatively shallow, upper shelf depths. Khan *et al*. [2005] reported this species to occur in the estuarine mangroves. Ng [1998] reports this species to occur in shallower waters, down to depths of about 100 m, living on muddy substrates and sometimes in large numbers. *Galene bispinosa* is rather commonly found in Pleistocene and Holocene fossils deposits in Australia and South-East Asia [cf. Etheridge, McCulloch 1916; Songtam *et al*. 1999; Feldmann, Schweitzer 2006; note: regularly appear to be advertised on the Internet for fossils collectors]. This indicates some specificity of the characteristic biotope of this species which needs to be clarified.

Remarks. *Galene granulata* Miers, 1884 was synomised to *G. bispinosa* by Ng *et al*. [2001]. They stated that small specimens tend to have more granular carapace (a diagnostic character of *G. granulata*) becoming distinctly smoother with increasing size. We compared our specimen to a somewhat smaller (CW 54.0 mm) specimen of *G. bispinosa* from India (SMF 1655). This specimen has relatively dense granules along postero-lateral margins of carapace while in the specimen from Vietnam there are some smoothened granules in that region. Distinct and relatively densely packed granules are set on the dorsal faces of ambulatory legs and the upper face of cheliped carpus of the specimen from India. Its manus also bears some granules on the proximal part of the outer face vs. practically smooth condition in the specimen from Vietnam. In other respect these specimens are very similar.

Fishing and trade. In the Nhatrang area this species is occasionally caught by trawls and set nets and is rare at sea food markets. Fishery is reported for Thailand and various parts of Indonesia [Ng 1998].

Distribution in Vietnam. Tonkin (Bac Bo) Gulf [Guinot 1969], Nhatrang Bay (present study).

General distribution. Strait of Hormuz, India (Bombay area and Bay of Bengal), Singapore, Indonesia, Vietnam, Taiwan, China, Japan, northern and eastern Australia [Dai, Yang 1991; Guinot 1969; Miers 1884; Ng *et al*. 2001].

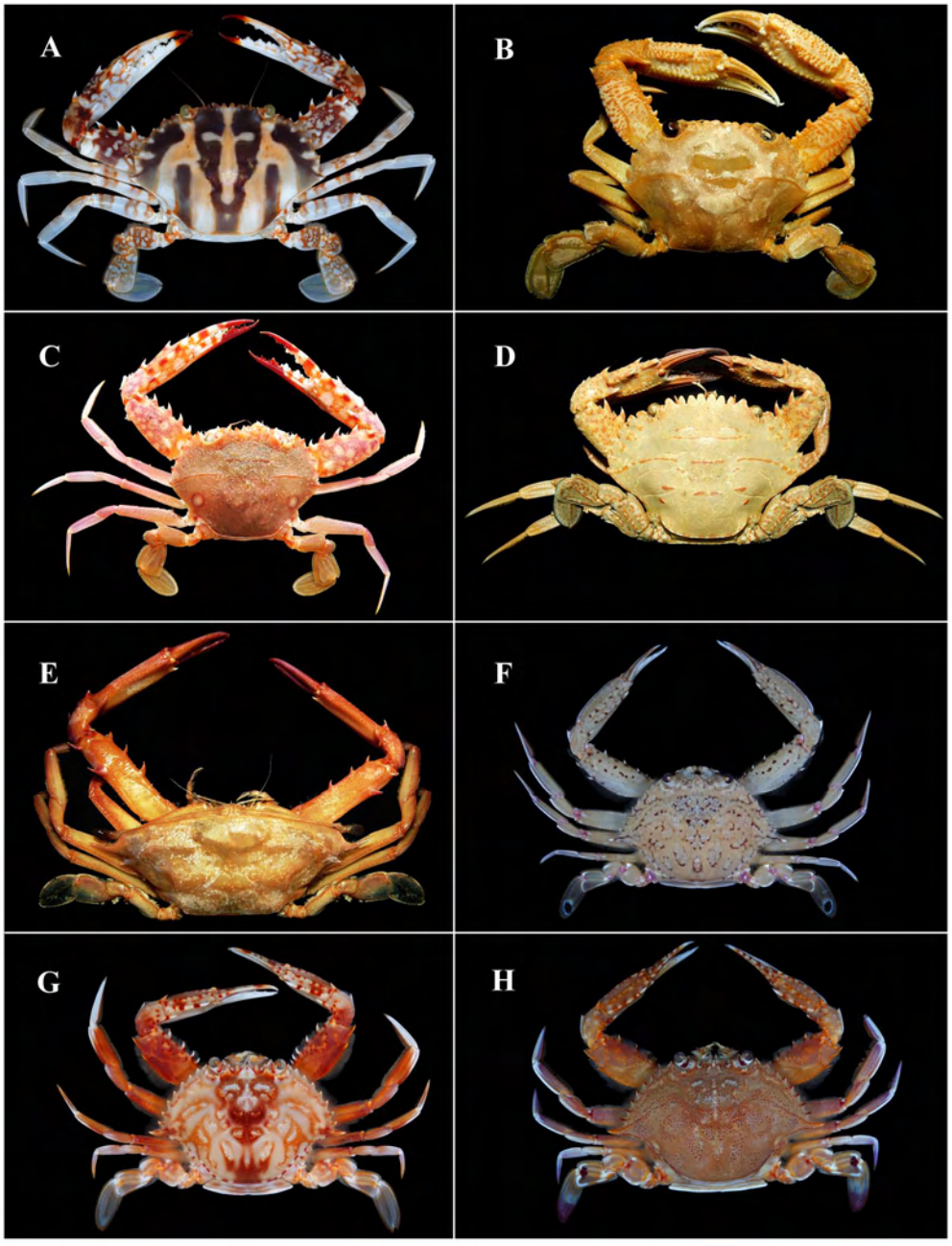

Plate 51. **A** – *Charybdis feriata*, ♂, CW 82 mm (colour in live); **B** – *Charybdis hongkongensis*, ♂, CW 36 mm (preserved specimen); **C** – *Charybdis miles*, ♂, CW 44 mm (colour in live); **D** – *Charybdis natator*, ♂, CW 56 mm (preserved specimen); **E** – *Podophthalmus vigil*, ♂, CW 68 mm (preserved specimen) ; **F** – *Monomia argentata*, ♀, CW 46 mm (colour in live); **G** – *Monomia haanii*, ♀, CW 55 mm (colour in live); **H** – *Monomia pseudoargentata*, ♀, CW 53 mm (colour in live).

sive development of aquaculture, but this brings another set of environmental problems, in particular related to the degradation of natural mangrove habitats [Graaf, Xuan 1998; Tong *et al*. 2004]. Mud crab cultivation that is practiced in southern Vietnam, these days imply moderate modification of natural mangroves. For example, on the coast of Nha Phu lagoon [Chertoprud *et al*. 2012, this volume] it appears to have lesser environmental impact than in other types of aquaculture and may turn out to be more desirable from the sustainability standpoint. In some areas of the Indo-Pacific, commercial catch of crabs is already limited by quotas, allowable size and sex composition of fished species and control of the usage of particular gears. An adaptation of community based fishery management approach may probably be most effective, although not easily achievable in Vietnam [MacClanahan, Castilla 2007].

There is no doubt that the list of commercial crabs sold at sea food markets of southern Vietnam compiled in the present study is a preliminary one and will be most probably extended. This paper may be considered as the first one in a series of studies focused on the exploited crab populations of the Nhatrang Bay. This study has to be continued in the future due to the vital importance of this issue for coastal development and management in Vietnam.

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suivant l'arrangement établi dans les galeries du Muséum d'Hist. Paris: Naturelle, parmi leurs dépouilles conservées; précédé du discours d'ouverture du cours de zoologie, donné dans le Muséum national d'Histoire naturelle l'an 8 de la République, 432 pp.

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CHAPTER 7

New records and associations of pontoniine shrimps (Crustacea: Decapoda: Caridea: Palaemonidae:Pontoniinae) from the Nhatrang Bay, Vietnam; with taxonomic remarks on some species from the Indo-West Pacific region

I.N. Marin[1]

ABSTRACT. A review of recently collected pontoniine shrimps in the Nhatrang Bay, Vietnam is provided. This paper contains 11 records of new species for the pontoniine fauna of the region, namely *Conchodytes pteriae* Fransen, 1994, *Fennera chacei* Holthuis, 1952, *Hamopontonia corallicola* Bruce, 1970, *Hamopontonia fungicola* Marin, 2012, *Harpiliopsis depressa* (Stimpson, 1860), *Laomenes holthuisi* Marin et Okuno, 2010, *Periclimenes gonioporae* Bruce, 1989, *Periclimenes toloensis* Bruce, 1969, *Philarius condi* Marin, 2012, *Platypontonia hyotis* Hipeau-Jacquotte, 1971 and *Vir smiti* Fransen et Holthuis, 2007. These records and a review of recently published papers increased the pontoniine shrimps list reported for Vietnam up to 120 species. This paper also describes newly discovered associations between pontoniine shrimps and other marine invertebrates recorded in Nhatrang Bay, Vietnam. So, *Phycomeness sulcatus* (Ďuriš, Horká et Marin, 2008) and *Periclimenes toloensis* Bruce, 1969 were recorded for the first time in association with shallow-water hydroids of the genus *Macrorhynchia* Kirchenpauer, 1872 (Hydrozoa: Leptothecata: Plumulariidae); *Rapipontonia paragalene* Marin, 2007 was firstly collected from shallow-water hydroid of the genus *Sertularia* Linnaeus, 1758 (Hydrozoa: Leptothecata: Sertulariidae); *Neoanchistus cardiodytes* Bruce, 1975 was found for the first time in association with burrowing cardiid shell *Vasticardium flavum subrugosum* (G.B. Sowerby II, 1839) (Mollusca: Bivalvia: Cardiidae); *Zenopontonia rex* (Kemp, 1922) comb. nov. was recorded for the first time from a sea star *Euretaster insignis* (Sladen, 1882) (Echinodermata: Asteroidea: Pterastridae). Additionally, firstly mentioned an unusual association of *Zenopontonia soror* (Nobili, 1904) comb. nov. with large nudibranch of the genus *Ceratosom*a Gray, 1850 (Molluska: Gastropoda: Nudibranchia: Chromodorididae) from Philippines based on photomaterials from internet. Besides, based on morphological features of collected specimens, *Periclimenes imperator* Bruce, 1967 is synonymized with *P. rex* Kemp, 1922 as a junior synonym and is transferred to the genus *Zenopontonia* Bruce, 1975 together with *Periclimenes soror* Nobili, 1904. A new genus, *Isopericlimenaeus* gen. nov., has been suggested for *Periclimenaeus gorgonidarum* (Balss, 1913). Remarks on taxonomic status of *Periclimenes delagoae* Barnard, 1958, *Periclimenes granulimanus* Bruce, 1878, *Periclimenes tonga* Bruce, 1988, *Periclimenes ischiospinosus* Bruce, 1991, *Cuapetes lacertae* (Bruce, 1992) and *Periclimenes nomadophila* Berggren, 1994 are also provided in this paper.

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Hamopontonia corallicola Bruce, 1970

Hamopontonia corallicola Bruce 1970: 41, figs. 1–4 (type locality – Hong Kong).

Material examined. Vietnam, Nhatrang Bay, Dam Bay of Tre Island., on coral *Goniopora sp*, 2 m, SCUBA, coll. I. Marin, May 2011 – 2 ovigerous females, 1 male.

Measurements. Pcl. of the largest ovigerous female – 12 mm, tl. – 23 mm; pcl of the largest male – 8 mm, tl. – 20 mm.

Ecological notes. This species is known in association with different species of the genus *Goniopora* de Blainville, 1830 (Hexacorallia, Scleractinia, Poritidae).

Distribution in the Nhatrang Bay. The species is known from Dam Bay of Tre Island only.

General distribution. This is the first record of this species from Vietnam. Distribution of the species needs verification as many records of *H. corallicola* belong to different relative species including *H. fungicola* Marin, 2012 (see below). The presence of the species is confirmed in Hong Kong, south Taiwan, the Great Barrier Reef of Australia [see review in Marin 2012]; probably widely distributed Indo-West Pacific species.

Hamopontonia fungicola Marin, 2012
Pl. 53 C, D

Hamopontonia fungicola Marin 2012: 39, figs. 3–7, 14E, F, 15F (type locality – Lizard Island, GBR, Australia).

Material examined. Vietnam, Nhatrang Bay, Mun Island, on coral *Euphyllia glabrescens*, 10 m, SCUBA, coll. I. Marin, November 2010 – 1 ovigerous female, 1 male.

Measurements. Pcl. of the largest ovigerous female – 15 mm, tl. – 28 mm; pcl. of the largest male – 12 mm, tl. – 25 mm.

Coloration. Body and appendages are transparent and covered with tiny red dots; two large irregular creamy white spots are situated on the dorsal margin of carapace and abdomen (Pl. 53 C, D).

Ecological notes. The species is usually associated with hard scleractinian corals of the family Fungiidae (Octocorallia: Scleractinia) [Marin 2012] and presently registered in association with euphyllid coral *Euphyllia glabrescens* (Chamisso et Eysenhardt, 1821) (Octocorallia: Scleractinia: Caryophyllidae) (Pl. 53 H) (new host record).

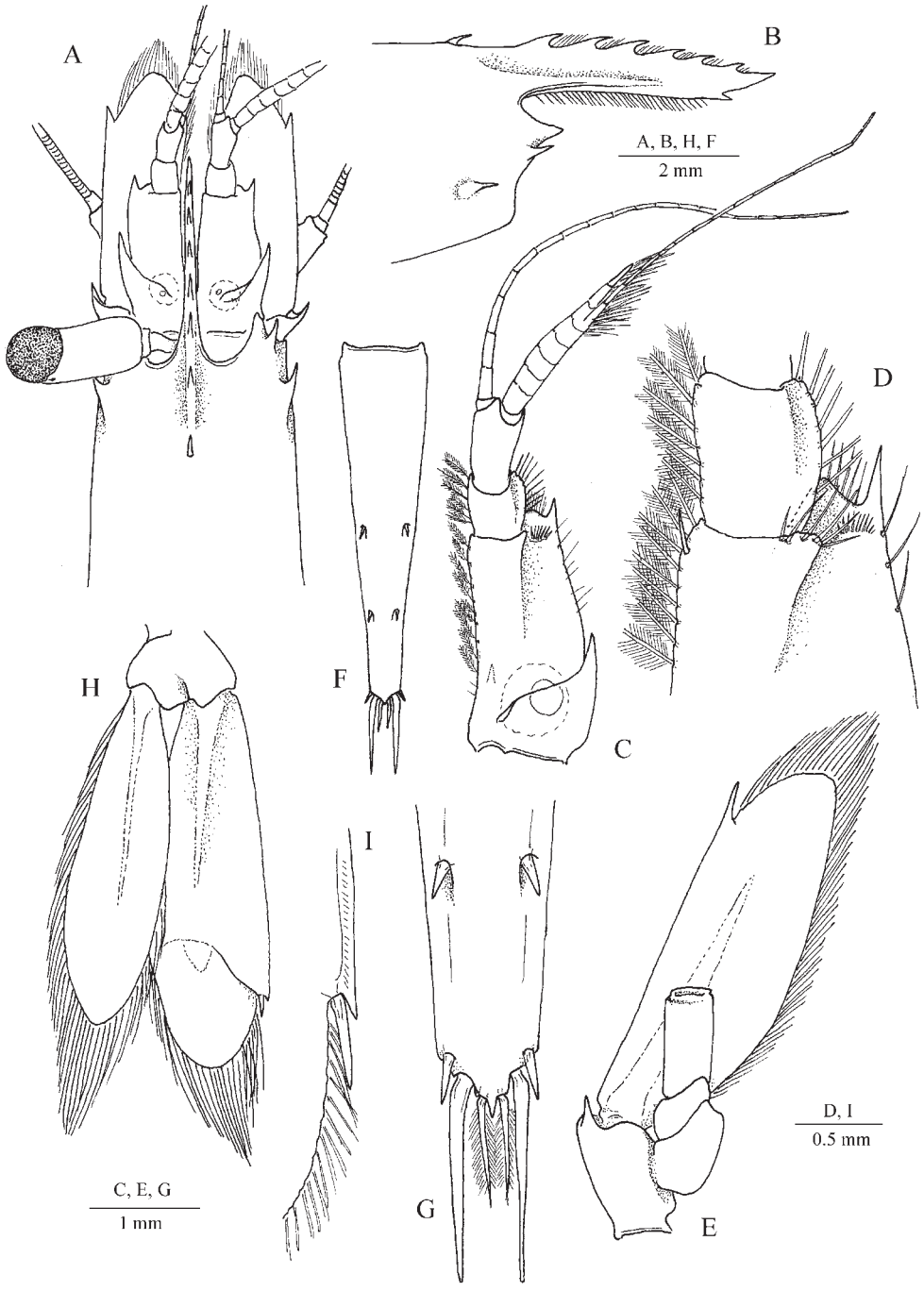
Distribution in the Nhatrang Bay. The species is known from Mun Island only.

General distribution. This is the first record of the species from Vietnam. Previously known from the Great Barrier Reef of Australia [Marin 2012].

Harpiliopsis depressa (Stimpson, 1860)

Harpiliopsis depressus Stimpson 1860: 30 (type locality – Hawaii); Holthuis 1951: 70, pls. 21, 22: figs. a–f.

Periclimenes pusillus Rathbun 1906: 921, fig. 71, pl. 24: fig. 7 (type locality – off Honolulu, Hawaii].


A
B
A, B, H, F
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C, E, G
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0.5 mm

Bay and processing of collected material. The work is partly supported by PADI Foundation, RFFI projects (08–04–92244–GFEN_a, 12–05–00239a, 12–04–33267_mol_a_ved and 12–04–00540–a) and the Grant of the President of the Russian Federation MK-1235.2012.4. Special thanks to the Editor, Dr. Temir A. Britayev (SIEE), for the possibility of sampling in Nhatrang Bay and comprehensive help during all stages of preparation of this paper; to Dr. Zdenek Ďuriš (University of Ostrava) for reviewing the manuscript and Dr. Yuri I. Kantor (SIEE) for the help with identification of bivalve shells.

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CHAPTER 8

Asteroidea of Vietnam with some notes on their symbionts

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ABSTRACT. Asteroidea and their symbionts represent an important and diverse, but poorly explored component of the biodiversity of coastal ecosystems of Vietnam. We studied data from 8 years of collecting sea stars and their symbionts by schnorkelling, scuba-diving and trawling in the Bay of Nhatrang and other coastal areas of Vietnam. A total 47 species of asteroids and 24 species of their symbionts have been found. These species of asteroids belong to 13 families, with the most diverse families Ophidiasteridae and Oreasteridae, comprising 15 and 10 species respectively. Two species of asteroids, *Nardoa novaecaledoniae* and *Stellasteropsis colubrinus* are new for the coastal waters of Vietnam. The most diverse groups of symbionts of asteroid were copepods with 8 species (33.3% of all symbiotic species found), polychaetes with 7 species (29.2%) and gastropods with 5 species (20.8%). The other groups – decapods, fishes and ctenophorans, were substantially less diverse and included 1 or 2 species only. Our study revealed a rather rich fauna of asteroids and their symbionts in the coastal waters of Vietnam in comparison to some other areas of the Indo-West Pacific. We suggest that a further increase in the asteroid and their symbionts diversity might be expected from trawling on soft grounds, especially in deeper areas of Vietnamese coast.

The South China Sea (SCS) is located in the Indo-Malayan region and partially belongs to the Coral Triangle, the area recognized as a centre of maximum biodiversity of marine species, especially corals, mollusks and marine fishes [Veron 1994, 1995; Roberts *et al*. 2002; Mora *et al*. 2003; Allen 2002, 2003; Hoeksema 2007]. SCS has a rich echinoderm fauna with close to thousand species known, of which about 12% are endemic [Lane *et al*. 2000]. However echinoderm diversity in the South China Sea probably underestimated since much of this large marine ecosystem remains unexplored. For comparison, in the better studied Australian waters 1154 echinoderm species have been recorded [Rowe, Gates 1995]. Due to the fact that the SCS borders the Coral Triangle and is a partially enclosed basin its fauna is of a special interest for biodiversity research [Lane *et al*. 2000; Ng, Tan 2000].

The recorded number of Asteroidea species in the SCS is 236 of which ~ 24% are endemic [Lane *et al*. 2000; Ho 2002; Chao 2000; Purwati, Lane 2004; Liu *et al*. 2006]. The regional faunas included in the SCS are significantly less diverse. For example, in the coastal waters of Vietnam only 56 species of asteroids have been recorded [Lane *et al*. 2000; Ho 2002]. Our previous paper [Antokhina, Britayev 2012] provided a checklist of 39 asteroids for the Bay of Nhatrang revealed new records for this area and underlined the gaps in our knowledge.

In this extended paper we provided a checklist of Asteroidea of Vietnam based on the material collected in the coastal waters of Vietnam (excluding the Bay of Tonkin) in the

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Choriaster granulatus Lütken, 1869
(Pl. 61 G)

Choriaster granulatus Lütken 1869: 35; Fisher 1919: 369; Domantay, Roxas 1938: 217; Guille *et al*. 1986: 124; Colin, Arneson 1995: 244; Gosliner *et al*. 1996: 254; Moosleitner 1997: 6; Purwati, Lane 2004: 93.

Material examined. Nhatrang Bay, Mot Island, 3–10 m, corals, rocks, coll. Antokhina, 8 April 2006 – 1 specimen; 10 April 2006 – 5 specimens; 15 April 2006 – 3 specimens; 18 April 2006 – 6 specimens; Dung Island, 10–15 m, corals, rocks, coll. Antokhina, 26 April 2006 – 1 specimen; 3 May 2006 – 1 specimen; Nok Island, 15–20 m, rocks, coll. Antokhina, 28 April 2006 – 1 specimen.

Measurements. R/r (max) = 160/60 mm; R/r (min) = 105/40 mm.

Distribution in Nhatrang Bay. Mun, Mot, Dung, Nok Islands.

General distribution. Indo-West Pacific, i.e. E. Africa, Red Sea, Maldive Island, South China Sea, Australia (Ashmore, Cartier, Scott Island, Rowley Shoals), South Pacific Islands.

Symbionts. Polychaetes *Asterophilia culcitae* Britayev et Fauchald, 2005, *Hololepidella millari* Britayev, Doignon et Eeckhaut, 1999 (Polychaeta: Polynoidae), copepods *Stellicola oreastriphilus* Kossmann 1877 (Copepoda: Lichomolgidae), decapods *Periclimenes soror* Nobili, 1914 (Decapoda: Palaemonidae).

Culcita novaeguineae Müller et Troschel, 1842
(Pls. 61 H, 62 A)

Culcita novaeguinea Müller, Troschel 1842: 38; Fisher 1919: 360; H.L. Clark 1921: 32; Livingstone 1932: 250; Guille *et al*. 1986: 124; Colin, Arneson 1995: 245; Gosliner *et al*. 1996: 255; Purwati, Lane 2004: 93.

Material examined. Nhatrang Bay, Mot Island, 4–6 m, corals, rocks, coll. Antokhina, 6 April 2006 – 14 specimens; 8 April 2006 – 14 specimens; 10 April 2006 – 16 specimens; 15 April 2006 – 19 specimens; 18 April 2006 – 13 specimens; 20 April 2006 – 15 specimens; 22 April 2006 – 24 specimens; Dung Island, 5–12 m, corals, rocks, coll. Antokhina, 24 April 2006 – 5 specimens; 26 April 2006 – 1 specimen; 3 May 2006 – 2 specimens; 10 May 2006 – 3 specimens; Nok Island, 3–15 m, rocks, coll. Antokhina, 5 May 2006 – 8 specimens; 28 April 2006 – 6 specimens; Do Island, 3–6 m, rocks, 27 May 2007 – 7 specimens; Tre Island (cape Muy Nam), 6–10 m, rocks, coll. Antokhina, 1 June 2007 – 9 specimens.

Measurements. R (max) = 185 mm; R/r (min) = 34/24 mm.

Distribution in Vietnam. Nhatrang bay: Do, Tre, Mieu, Tam, Mot, Mun, Nok, Dung, Noy Islands. Con Co Island. Con Dao Island. Phu Quoc Island.

General distribution. West Pacific including type locality, New Guinea. Indian Ocean (Andaman Island), Australia (Ashmore, Cartier and Scott reefs and Rowley Shoals).

Symbionts. Polychaetes *Asterophilia culcitae*, *Hololepidella laingensis* Britayev, Doignon et Eeckhaut, 1999, *Hololepidella millari* (Polychaeta: Polynoidae), molluscs *Stilifer variabilis* Boettger, 1893 (Gastropoda: Eulimidae), copepods *Astroxynus culcitae* Humes 1971 (Copepoda: Stellicomitidae), *Stellicola oreastriphilus*, *Stellicola parvuli-*

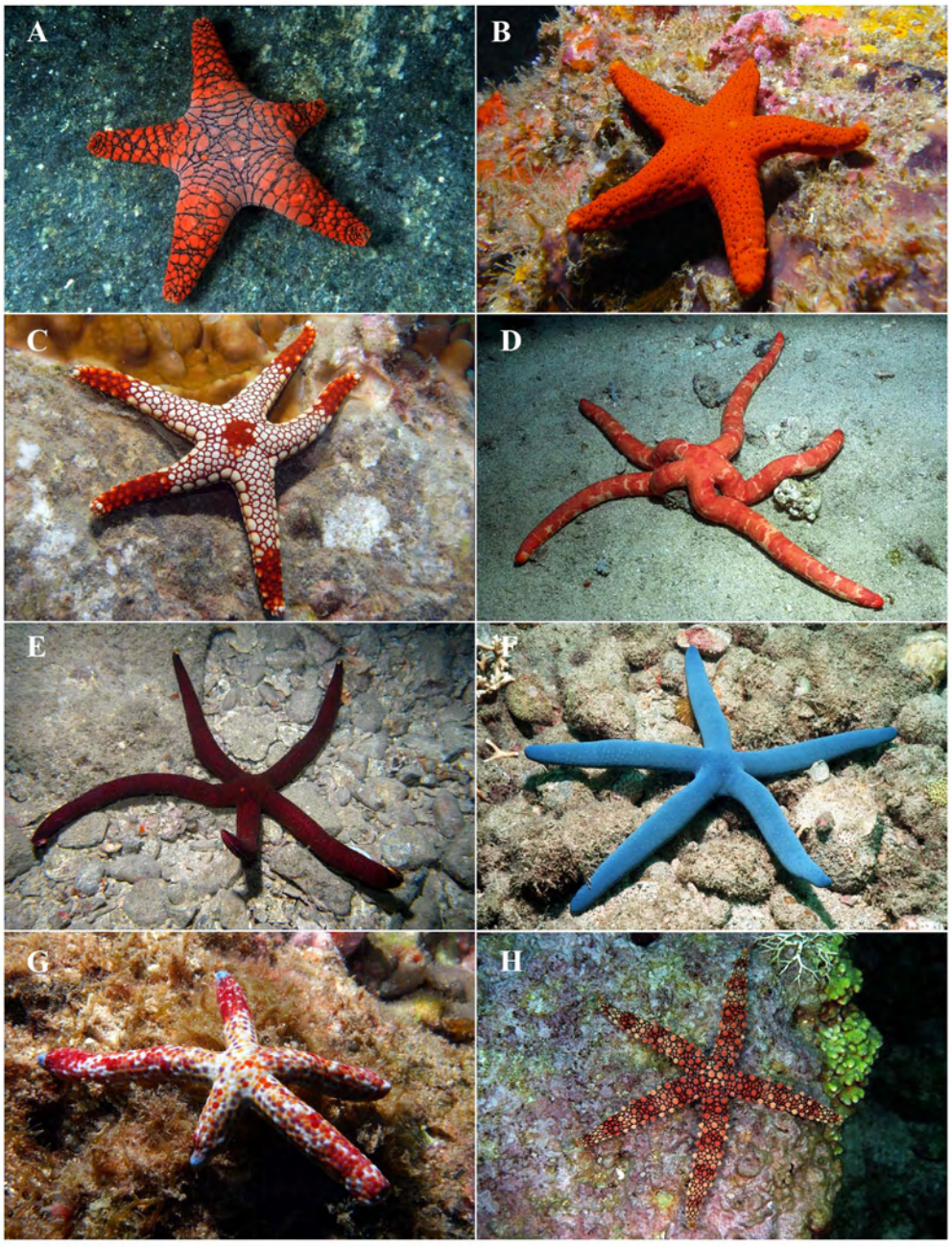

Plate 63. **A** – *Fromia indica*, **B** – *Fromia milleporella*, **C** – *Fromia monilis*, **D** – *Leiaster leachi*, **E** – *Leiaster speciosus*, **F** – *Linckia laevigata*, **G** – *Linckia multifora*, **H** – *Nardoa frianti*.

species of symbiotic animals from three main taxa, gastropods, fishes and copepods (Pl. 66 B). The obviously different taxonomic compositions of associated faunas in these studies (Pl. 66 B) reflects a focus by Jangoux [1990] on parasitic animals. While the symbiotic fauna associated with the more common shallow-water asteroids of the Bay of Nhatrang is relatively well studied now. It is restricted to 13 species of asteroid host only. Further studies of asteroids from other regions of the coastal waters of Vietnam, especially northern and deep-water areas, will increase the known diversity of asteroid associated fauna substantially.

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CHAPTER 9

Feather stars (Crinoidea, Comatulida) of Nhatrang Bay, Vietnam: fauna, habitat and symbionts

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ABSTRACT. As a result of extensive sampling performed during short field trips in 2004–2008, 31 comatulid crinoid species from 5 families were found in the Bay of Nhatrang, southern Vietnam. Comasteridae is the most species rich family in Nhatrang Bay, with 18 species from 4 subfamilies. The other families are Mariametridae with 6 species, Himerometridae with 3, and Zygometridae and Colobometridae with 2 each. The most numerous species in our samples were *Himerometra robustipinna* (Carpenter, 1881) (Himerometridae) (32 individuals) and *Cenometra bella* (Hartlaub, 1890) (Colobometridae) (27 individuals). *Cenometra bella* and *Colobometra perspinosa* were associated with gorgonians; one species was found on sediment, while others inhabit hard substrates. Twenty-three species (74%) were diurnal and 5 (16%) were nocturnal (cryptic during the day and crawling to exposed feeding perches at night. The diel activity of 3 species was not established. All crinoids were inhabited by symbionts, polychaetes (including myzostomids), gastropods, crabs, shrimps and ophiuroids. *Comaster nobilis* and *Lampometra palmata* harbored the richest symbiontic assemblages (19 and 13 species, respectively). A key for field identification of comatulids in Nhatrang Bay is provided.

Unstalked crinoids, also known as feather stars or comatulids, are relatively large, bottom-dwelling animals. They inhabit a wide range of depths, from the intertidal zone to deep ocean trenches [Belyaev 1966; Oji *et al*. 2009]. In some habitats they are very common and may reach densities up to 115 individuals per square meter [Fabricius 1994; Messing 1994]. More than a half of known comatulid species are found at shelf depths (<200 m) in the tropical Indo-West Pacific. The East Indian Archipelago, which coincides with the center of the Coral Triangle, is usually considered to be the center of comatulid biodiversity. Approximately 100 species of shallow-water crinoids (≤50 m) have been recorded there. No more than 50% of this number can be found in the fauna of local areas studied within the Archipelago. The Sulu (Jolo) Archipelago has been reported to include a maximum of 54 species [Messing 1998]. Variations in species number within this region may derive from: habitat diversity, limited geographic ranges of species and sampling efforts. Species richness declines in all directions from the hot spot described above, although local comatulid diversity may reach similar or even higher levels elsewhere, e.g., 57 species in the vicinity of the Lizard Island, Northern Great Barrier Reef [Messing 1998].

The South China Sea comatulid fauna consists of 102 species, with 90 known from shallow water [Lane *et al*. 2000]. The Vietnamese coast was never considered as a hot spot of marine biodiversity [e.g. Hoeksema 2007], with 45 comatulid species known so

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Graff, 1883, *M. ambiguum* Graff, 1887; Decapoda *Allogalathea elegans, Harrovia* sp., *Periclimenes commensalis.*

Distribution in Nhatrang Bay. Mot Island.

General distribution. Red Sea, East Africa, South Africa, Madagascar, Seychelles, South-China Sea, Vietnam, Japan, north Australia, Great Barrier Reef, New Caledonia, New Zealand, at depths 1–103 m.

Comaster nobilis (Carpenter, 1884)
(Pl. 68 A)

Actinometra nobilis Carpenter 1888: 336, pl. 65.
Comanthina nobilis: Rowe *et al*. 1986: 243, fig. 8 B; Kogo 1998: 31, fig. 25.
Comaster nobilis: Messing 1998: 206.

Material examined. South China Sea, Nhatrang Bay, Mun Island, 03.10.2003 – 1 spm; 24.05.2005 – 2 spms; Mot Island, 7–12 m, 02.10.2005 – 2 spms; 7–12 m, 08.05.2006 – 1 spm; Nok Island, 4–5 m, 12.05.2006 – 1 spm; Mun Island, 12 m, 24.04.2007 – 1 spm; Nok Island, 5 m, 25.04.2007 – 1 spm; 12 m – 1 spm; Mun Island, 8–10 m, 27.04.2007 – 1 spm; Nok Island, 12–15 m, 02.05.2007 – 1 spm; Mun Island, 6 m, 04.05.2007 – 1 spm; 5 m, 11.05.2007 – 1 spm; 12–15 m, Nok Island – 1 spm; Do Island, 5–6 m, 27.05. 2007 – 1 spm; Mun Island, 28.05.2007 – 1 spm; 5–7 m, 31.05.2008 – 1 spm; Mot Island, 30.05.2007 – 1 spm; Tam Island, 5 m, 01.06.2007 – 1 spm; Nok Island, 10 m, 16.06.2007 – 1 spm.

Measurements. Arm number ranges from 58 (juvenile) to 130 with 90–110 on average. The arms are arranged in different planes; filtering arms of a given specimen are longer than those which are used to attach to the bottom.

Coloration. Variable: white, lemon-yellow and black or dark brown in different combinations also black-orange, purely white and brown specimens.

Ecological notes. Common, diurnal, fully exposed. Numerous in the outer part of the Bay. Feeding specimens are located on top of rocks. Inactive specimens look like loose balls. During filtration, some arms extended in multidirectional posture. Pinnules of feeding arms are arranged in 4 planes, with each pinnule perpendicular to the arm axis, and are often observed to flex. Pinnules of arms used to attach to the bottom are arranged in one plane and are pressed against the arm axis. Found at 5–15 m.

Symbionts. Polychaeta *Paradyte crinoidicola*; Myzostomida *Hypomyzostoma* sp., *Myzostoma vastum* Graff, 1883, *Myzostoma coronatum* Graff, 1884, *Myzostoma* sp.1, *Myzostoma* sp. 13; Decapoda *Allogalathea elegans, Periclimenes commensalis, Synalpheus* sp., *Harrovia* sp., *Synalpheus tropidodactilus, Periclimenes affinis* (Zehntner, 1894), *Pontoniopsis comanthi, Palaemonella pottsi, Synalpheus stimpsoni* (De Man, 1888), *Laomenes* sp.; Ophiuroidea *Gymnolophus obscura*; Gastropoda *Annulobalcis wareni* Dgebuadze, Fedosov et Kantor, 2012, *Curveulima* sp.1.

Distribution in Nhatrang Bay. Do, Tam, Mot, Mun, Nok Islands.

General distribution. Sri-Lanka, Indonesia, Malaysia, South China Sea, Vietnam, Philippines, Vakayama (Japan), Coral Sea, Great Barrier Reef, New Caledonia.

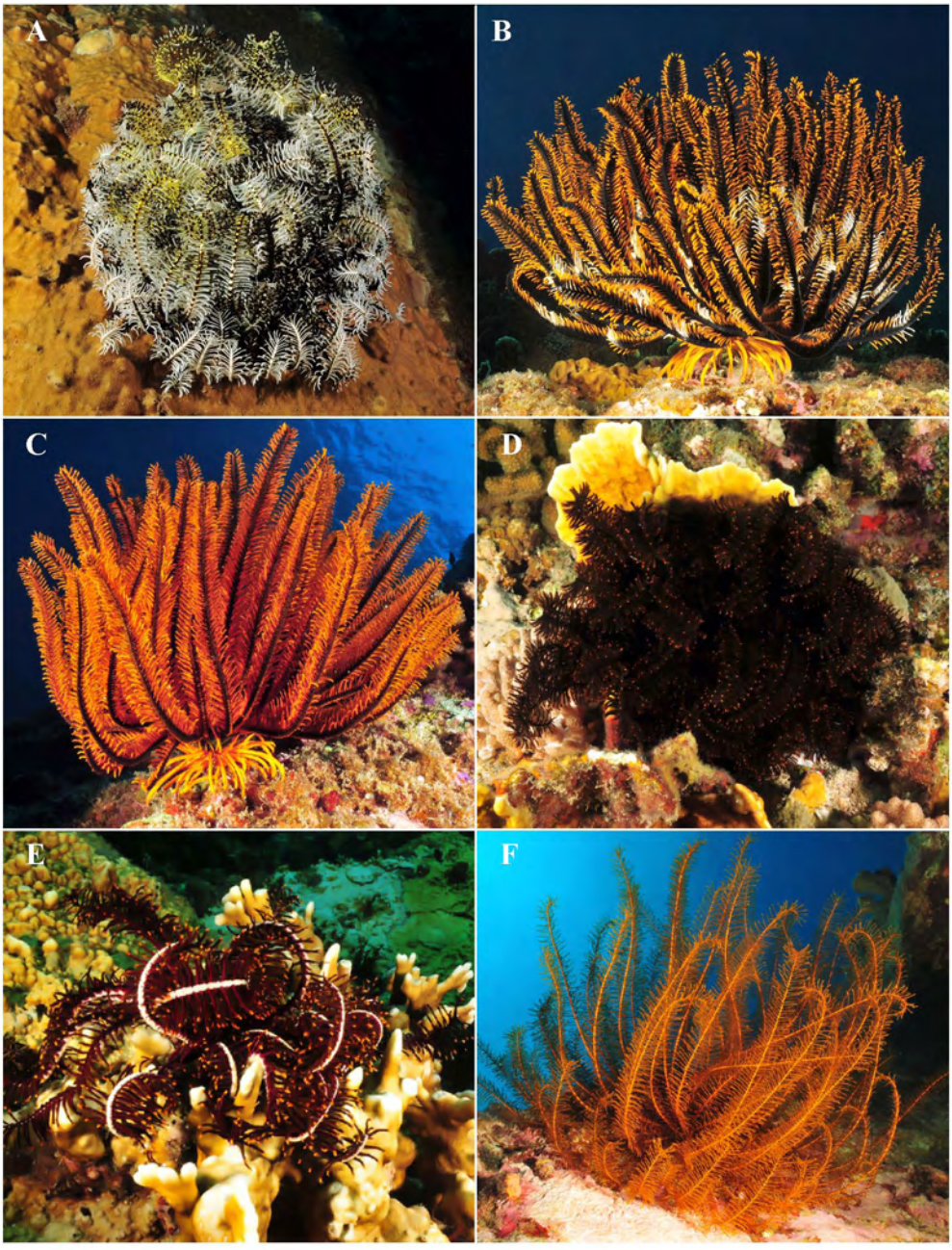

Plate 68. **A** – *Comaster nobilis*, **B** – *Oxycomanthus bennetti*, **C** – *Oxycomanthus* cf. *pinguis*, **D** – *Comatella nigra*, **E** – *Comatella stelligera*, **F** – *Phanogenia gracilis*.

activity, crown shape and feeding posture of crinoids. Symbionts associated with diurnal crinoids may be more susceptible to predation pressure. Thus diurnal crinoids should harbor less diverse assemblages than nocturnal species. Among diurnal crinoids, we may expect more diverse assemblages in cryptic and semi-cryptic species than in species fully exposed to view. Further studies are necessary to verify this hypothesis.

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Бесстебельчатые морские лилии залива Нячанг: фауна, местообитания и симбионты

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РЕЗЮМЕ. В заливе Нячанг отмечено 31 вид бесстебельчатых морских лилий из 5 семейств. Наиболее богатое видами семейство Comasteridae представлено в заливе Нячанг 18 видами (4 подсемейства), семейство Mariametridae – 6 видами, семейство Himerometridae – 3 видами, семейства Colobometridae и *Zygometridae* – 2 видами. По числу особей в наших сборах доминировали виды *Himerometra robustipinna* (Carpenter, 1881) (32 экземпляра) и *Cenometra bella* (Hartlaub, 1890) (27 экземпляров) из семейств Himerometridae и Colobometridae соответственно. Большинство обнаруженных видов (23 вида, 74% всей фауны) являются дневными, и лишь 5 видов (16%) – ночными, которые в течение дня прячутся в убежищах, а ночью выбираются на более открытые участки для фильтрации. Для 3 видов время активности в заливе не установлено. Все морские лилии были заселены симбионтами: полихетами, гастроподами, крабами, креветками и офиурами. Наиболее богатые видами симбиотические ассоциации найдены на лилиях *Comaster nobilis* и *Lamprometra palmata* (19 и 13 видов соответственно). Дан упрощенный дихотомический ключ для определения морских лилий залива Нячанг.

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