

**REVIEW OF TWO GENERA OF FRESHWATER CRABS, *Larnaudia* Bott, 1966
AND *Neolarnaudia* Türkay & Naiyanetr, 1987 (Crustacea: Decapoda: Potamidae)
WITH REDESCRIPTION *Neolarnaudiaphymatodes* (Kemp, 1923)
FROM SOUTHERN VIETNAM**

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ABSTRACT: The occurrence of *Larnaudia* Bott, 1966 in southern Vietnam remains obscure. Although some previous studies recorded the presence of *Larnaudia larnaudii* A. Milne-Edwards, 1869 in Vietnam, our analysis of freshwater crab specimens collected at many locations in southern Vietnam revealed that *Neolarnaudia* Türkay & Naiyanetr, 1987, but not *Larnaudia* Bott, 1966, is present in southern Vietnam. In this study, we recorded two species of *Neolarnaudia*, *N. phymatodes* (Kemp, 1923) and *N. botti* Türkay & Naiyanetr, 1987 in southern Vietnam. *Neolarnaudia phymatodes* was poorly known since the original description, and is, thus, re-described here. This species can be distinguished from all other *Neolarnaudia* species by a suite of characters; carapace broader, frontal area with many granules, supraorbital margin granulated, suborbital and pterygostomian regions and merus of third maxilliped covered with many granules, terminal segment of Gonopod 1 strongly curved inwards and covered with many pubescences, lateral margin of telson strongly concaved.

Keywords: *Larnaudia*, *Neolarnaudia*, freshwater crabs, Vietnam.

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INTRODUCTION

Freshwater crabs have a vital role in the freshwater ecosystems and are consumed in the daily life of some Vietnamese people. Yeo et al. (2008) have shown global endemism and diversity of freshwater crabs. In Vietnam in the 19th century, Milne-Edwards (1869) first described a new freshwater crab species, *Thelphusa longipes* from Con Dao Island. After that, increasing number of freshwater crab species have been discovered in Vietnam by both foreign and Vietnamese scientists. Dang & Ho (2012) recorded 34 freshwater crab species from Vietnam (Dang & Ho, 2012). However, these authors did not include some species that were recently described by Do (2014), who listed 49 species of freshwater crabs in Vietnam.

In general, studies on freshwater crabs in Vietnam are scarce and did not reflect the actual diversity of freshwater crabs in this country. There are still many new species yet to be described and many taxonomic issues remain unsolved (Do, 2014). Moreover, in Vietnam, the available data on the distribution, status, biology and ecology of freshwater crab species are very limited. Several species are known only from the original description from the 19th century, and some species are known from only a few specimens obtained from a few random sampling locations. Many species have limited ranges and specialized habitat, and along with human population growth, urbanization and agricultural development, many species of freshwater crabs in Vietnam are now at a high level of endangerment.

Analysis of freshwater crab specimens

recently collected from various locations in the Central Highlands and southern Vietnam disclosed some taxonomic problems between two genera *Larnaudia* Bott (1966) and *Neolarnaudia* Türkay & Naiyanetr (1987). Our particular objectives of this study were (1) to identify if the *Larnaudia* is distributed in Vietnam; (2) to confirm the existence of *Neolarnaudia* genus including two species *N. phymatodes* (Kemp, 1923) and *N. botti* Türkay & Naiyanetr, 1987 in Vietnam; and (3) to redescribe *N. phymatodes*.

MATERIALS AND METHODS

Collection of freshwater crab specimens in the field

Freshwater crab specimens were collected from streams and rivers from many sites in the Central Highlands (the national parks such as Kon Ka Kinh, Chu Mom Ray, Chu Yang Sin, Yok Don, Bidoup-Nui Ba) and some central provinces (Quang Nam, Quang Ngai, Ninh Thuan, Binh Thuan Provinces). Specimens were collected by hand or using hand nets during the day and night. Living specimens were photographed using a digital camera to record the coloration, then they were frozen before being preserved in 90% alcohol.

In the laboratory, the specimens were illustrated with the aid of a drawing tube attached to a stereomicroscope. The abbreviations G1 and G2 are used for the male first and second gonopods, respectively. Measurements (in mm) are of carapace width (CW), carapace length (CL), and the ratio of length/width of the 2nd and 4th ambulatory legs. Terminology used herein followed to that of Ng (1988).

Materials examined are deposited in the Institute of Ecology and Biological Resources (IEBR), Vietnam Academy of Science and Technology (VAST).

RESULTS AND DISCUSSION

Revision of *Larnaudia* Bott, 1966 and *Neolarnaudia* Türkay & Naiyanetr, 1987 from Vietnam

Thelphusa larnaudii was described by Milne-Edwards (1869) based on the type specimens collected in and around Bangkok, Thailand. This species was then redescribed by Rathbun (1904). In addition to specimens obtained from Bangkok by Larnaudie M in Milne-Edwards (1869), Rathbun also used the specimens (2 males and 1 female) obtained from northern part of South Vietnam (au nord de la Cochinchine) by M. Harmand, which were deposited in the National Museum of Natural History (France).

Bott (1966) introduced a new monotypic subgenus *Potamiscus* (*Larnaudia*) for *Thelphusa larnaudii* A. Milne-Edwards, 1869. He referred to the types but used for the Gonopod 1 - figure of a male specimens from "Mois-Chero" the northern part of South Vietnam ("N-Cochinchina") (MNHN B 2018). In his monograph, Bott (1970) raised *Larnaudia* to generic rank (see the review of Türkay & Naiyanetr, 1987). Accordingly, Rathbun (1904) and Bott (1966, 1970) supposed that *Larnaudialarnaudii* A. Milne-Edwards, 1869 was distributed in both Thailand and Vietnam.

Türkay and Naiyanetr (1987) checked the Gonopod 1 on the lectotype collected from Bangkok (MNHN B 4357 S) and found that *L. larnaudii* was unrelated to the specimens from "Mois-Chero" included in *larnaudii* by Bott (1966, 1970) and *larnaudii* must be a distinct species (Türkay & Naiyanetr, 1987). Consequently, these authors established a new genus and species *Neolarnaudia* Türkay & Naiyanetr, 1987 with the type species as *Neolarnaudia botti* Türkay & Naiyanetr, 1987 for species collected from "Mois-Chero". Thus, although Ng (1992) commented that *Larnaudia* was also probably distributed in Vietnam, China, and other parts of Indo-China, the specimens obtained from "Mois-Chero", South Vietnam, and identified as *Larnaudia larnaudii* in Bott (1966, 1970), must be considered as *Neolarnaudia* and *Neolarnaudia botti* (Türkay & Naiyanetr, 1987).

Yeo & Ng (2007) re-examined the poorly known species, *Potamon phymatodes* Kemp (1923) and found that it should be belonged to

the genus *Neolarnaudia*. Thus, this genus consists of two species, namely *N. phymatodes* (Kemp, 1923) and *N. botti* Türkay & Naiyanetr, 1987. However, Yeo & Ng (2007) did not mention the difference between these two species.

All the publications by Rathbun (1904), Bott (1966, 1970) and Đặng Ngọc Thanh & Hồ Thanh Hải (2001, 2012) included *Larnaudia larnaudii* A. Milne-Edwards, 1869 in the list of freshwater crab species of Vietnam. In contrast, *Neolarnaudia* Türkay & Naiyanetr (1987) has never been mentioned in the previous studies of these authors.

After having analysed many freshwater crab specimens collected at various locations in southern Vietnam, we could not find any specimen as *Larnaudia larnaudii*. Instead, we identified *Neolarnaudia botti* in the samples collected from the Serepok River (Ban Don, Krong Na Commune, Buon Don District, Dak Lak Province) and *N. phymatodes* (Kemp,

1923) from two locations (La Ngan Commune, Tanh Linh District and Nui Chua, Vinh Tan Commune, Tuy Phong District, Binh Thuan Province). We also examined the two specimens identified as *Larnaudia larnaudii* by Pr. Đặng Ngọc Thanh and confirmed that they are *Neolarnaudia botti* instead. *Neolarnaudia* has a well developed flagellum on its third maxilliped exopod and this character helps to separate it from *Larnaudia* (Türkay & Naiyanetr, 1987), of which flagellum is very short or absent.

Neolarnaudia botti was carefully described in Türkay & Naiyanetr (1987). However, the photos of species looks are not adequate. Therefore, we present here the photographs of carapace, frontal, abdomen views, sternoabdominal cavity showing G1's and G2's (Figs. 1A-D). This study also provided more information on the distribution of *N. botti* only known from the type location ("Mois-Chero", northern part of South Vietnam).

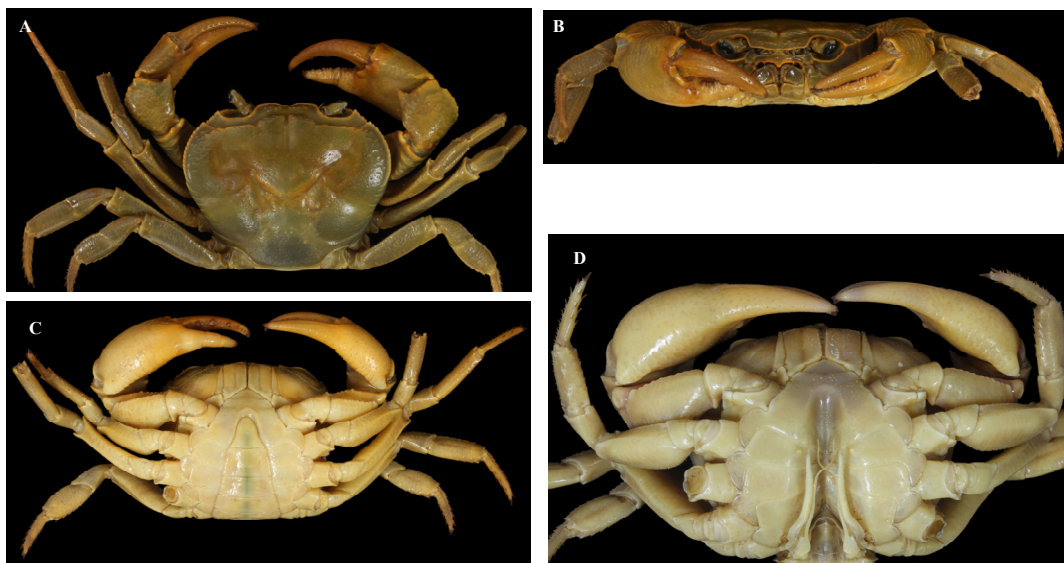


Figure 1. *Neolarnaudia botti* Türkay & Naiyanetr, 1987, male (CW 39.1 mm), IEBR-FC NBx01. A. carapace, dorsal view; B. frontal view; C. ventral view; D. sternoabdominal cavity showing G1s and G2s.

Redescription of *Neolarnaudia phymatodes* (Kemp, 1923)

***Neolarnaudia phymatodes* (Kemp, 1923)**

Potamon (Potamon) phymatodes Kemp, 1923: 13, PL.1, fig. 3.

Synonym: No

Syntypes, 1 male (37.1 × 27.1 mm) (ZSI 592/1), 1 female (29.5×22.5 mm) (ZSI 592/1), Daban, Phan Rang, Ninh Thuan, 198 m, coll. C. Boden Kloss, 03-04/1918.

Material examined: *Neolarnaudia phymatodes* (Kemp, 1923), 3 males (34.4 × 26.4, 31.2 × 23.3, 31.0 × 23.9 mm) (IEBR - FC NPx01-03), 4 females (41.0 × 32.0, 31.0 × 23.7, 31.8 × 23.8, 30.8 × 23.8 mm) (IEBR - FC NPx04-07), 11°09'11.7"N 107°46'22.6"E, La Ngan commune, Tanh Linh district, BinhThuan province, coll. Do Van Tu, 30/03/2014; *Neolarnaudia phymatodes* (Kemp, 1923), 4 males (72.8 × 54.3, 38.3 × 27.9, 37.4 × 28.0, 29.2 × 20.7 mm) (IEBR - FC NPx08-11), 1 female (58.8 × 42.3 mm) (IEBR - FC NPx12), 11°22'50.5"N 108°47'49.0"E, Nui Chua, Vinh Tan commune, TuyPhong district, BinhThuan, coll. Le Van Tho, Phan Doan Dang, 07/2014. *Neolarnaudia botti* Türkay & Naiyanetr, 1987, 5 males (39.9 × 29.6, 36.7 × 29.9, 31.9 × 31.4, 26.7 × 21.5, 20.9 × 16.4 mm) (IEBR - FC NBx01-05), 5 females (45.3 × 34.8, 44.2 × 34.4, 40.5 × 32.2, 36.8 × 29.1, 27.0 × 21.4 mm) (IEBR - FC NBx01-05), Serepok, Ban Don, Krong Na commune, Buon Don, Dak Lak, coll. Do Van Tu, 03/06/2013; *Neolarnaudia botti* Türkay & Naiyanetr, 1987, male (41.0 × 30.0 mm) (IEBR - FC NBx06), female (45.0 × 34.0 mm) (IEBR - FC NBx07), Dak Lak.

Description. Carapace wide with CW 1.4 times longer than CL, low, dorsal surface glabrous; only anterior branchial chamber near anterolateral margin with granules; regions well-defined; cervical groove deep; epigastric cristae distinct, not sharp, oblique, separated by distinct groove which open up into inverted V-shape posteriorly, separated from postorbital cristae by short and deep groove; postorbital cristae, breaking up into granules before epibranchial tooth; regions behind epigastric and postorbital cristae smooth (figs. 2A-B). Frontal margins with a rounded median emargination and thus bilobed; frontal region granular. Supra- and infraorbital margins granulated; orbital region relatively broad, smooth; suborbital, pterygostomian, subhepatic and subbranchial regions with granules; antennular fossae subrectangular (figs. 2B-D). External orbital angle broadly triangular, outer margin serrated, subequal to inner margin; cleft separating external orbital angle from epibranchial tooth shallow; epibranchial tooth

granular, relatively low, similar to those of the anterolateral margin; anterolateral margin strongly convex, distinctly serrated, distinctly cristate; posterolateral margins convergent posteriorly; branchial regions smooth (fig. 2B-C). Antennular fossae subrectangular. Epistome anterior margin with median triangular; posterior margin of with three lobes, median longest, triangular, lateral lobes slightly concave with some broad granules (fig. 2B).

Ischium of third maxilliped elongate rectangular, about 1.7 times longer than width (n = 12), vertical sulcus well defined; merus squarish with central surface sunken, about 0.5 times (n=12) length of ischium; dactylus reaching beyond the limit between ischium and merus; exopod longer than ischium, exceeding upper edge of ischium but not reaching midpoint of merus, with well-developed flagellum, about 0.7 times width of merus (fig. 2F).

Male cheliped carpus with two distinct spines, outer surface rugose, inner part granular to weakly rugose; merus without subterminal spine; fingers somewhat longer than palm, slightly hook-shaped distally, cutting edge regularly lined with teeth, lacking molariform, gap narrow (fig. 2C).

Ambulatory legs glabrous, stout; dactyli relatively elongate, slender; second pair longest, dactylus about 1.2 times length of propodus, about 6.4 times longer than proximal width, with low, sharp ridge; the merus of the first, second, third and fourth pairs is about 2.5, 3.2, 3.3, 2.6 times, respectively, longer than width (figs. 2A, C).

Thoracic sternum narrowly oval; suture between sternites 2 and 3 complete, distinct, gently concave medially; suture between sternites 3 and 4 discernible (fig. 2D).

Male abdominal cavity reaching imaginary line joining median points of cheliped bases, triangular; telson longer than width, lateral margin strongly concave, tip rounded, slightly longer than sixth segment; segment 6 with lateral margins almost straight (fig. 2D).



Figure 2. *Neolarnaudia phymatodes* (Kemp, 1923), male (CW 72.8 mm), IEBR-FC NPx01. A, carapace, dorsal view; B, frontal view; C, chela outer view; D, ventral view; E, sternoabdominal cavity showing G1s and G2s; F, left third maxilliped (scale bar = 5mm).

G1 slender, gently curved (figs 3A, C). Subterminal segment slightly curved in a dorso-ventral direction, groove for G2 on dorso-lateral surface medially; terminal segment relatively short, distally curved inwards, distally tapering, about 0.35 times length of subterminal segment, 3.3 times longer than width, covered with many pubescences, without dorsal flap (protuberance of ventral outer surface) (figs. 3B, D). G2 longer than G1, flagellum curving outwards, U-shaped, distal segment distinctly longer than half length of basal segment; basal segment outer margin expanded (fig. 3E).

Coloration: Carapace, chelipeds and ambulatory legs gray-brown to yellowish.

Habitat

This species lives in low order mountain streams in forested areas with shallow and slow moving water; substratum with mostly gravel and sand.

Distribution

This species is known from the type specimens collected from Daban, Phan Rang city, Ninh Thuan province and Dran town, Lam Dong province. We also found this species in La Ngan Commune, Tanh Linh District and Nui Chua, Vinh Tan Commune, Tuy Phong District, Binh Thuan Province.

Remarks

Neolarnaudia phymatodes has the diagnostic characters of *Neolarnaudia* including; the

carapace width distinctly longer than length, flattened; epigastric and postorbital cristae well-developed, separated by distinct groove; postorbital cristae cristate; regions behind epigastric and postorbital, cristae smooth; antenular fossae relatively narrower; external orbital angle broadly triangular, with outer margin subequal to inner margin; cleft separating external orbital angle from epibranchial tooth

shallow; epibranchial tooth relatively low; anterolateral margins strongly convex and cristate; posterolateral margins strongly convergent posteriorly; chela fingers lacking molariform teeth; epistome posterior with margin lateral parts straight; G1 slender, terminal segment almost straight. *Neolarnaudia phymatodesis* distinguished from *N. botti* by some characteristics shown in table 1.

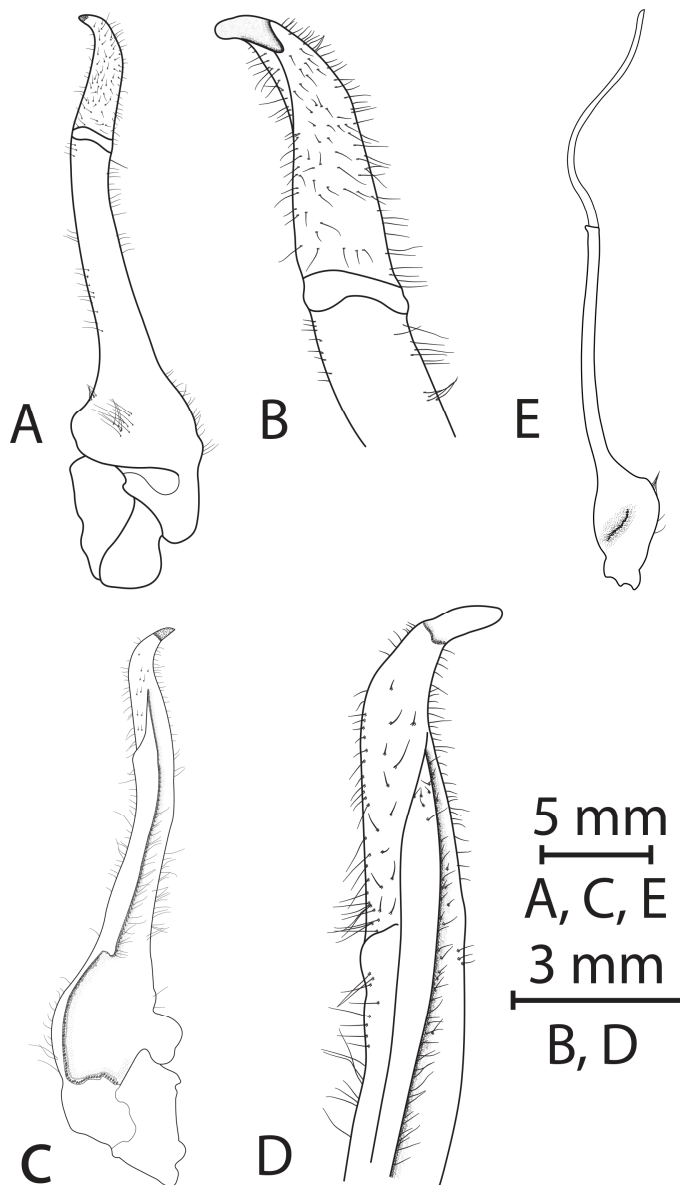


Figure 3. *Neolarnaudia phymatodesis* (Kemp, 1923), male (CW 72.8 mm), IEBR-FC NPx01.

A-D, right G1: A, ventral view; B, ventral view of terminal segment; C, dorsal view; D, dorsal view of terminal segment; E, right G2.

Table 1. Comparative morphological characteristics of *N. phymatodes* (Kemp, 1923) and *N. botti* Türkay & Naiyanetr, 1987

Characteristics	<i>N. phymatodes</i> (Kemp, 1923)	<i>N. botti</i> Türkay & Naiyanetr, 1987
Carapace	CW 1.4 times CL	CW 1.3 times CL
Frontal area	With many granules	With few granules
Epigastric cristae	Slightly oblique	Strongly oblique
Supraorbital margin	Granulated	Smooth
Suborbital region	Cover with many granules	Cover with few granules in lower part
Pterygostomian region	Cover with many granules	Cover with few granules in the angle near external orbital angle
Merus of third maxilliped	Cover with many granules	Smooth
Terminal segment of Gonopod 1	Strong curved inwards. cover with many pubescences	Very slightly curved inwards, cover with few pubescences
Telson	Lateral margin strongly concave	Lateral margin slightly concave

Conservation status

These species were assessed as Data Deficient because of the lack of information on its extent of occurrence, ecological requirements, population size, population trends, and long-term threats in the IUCN Red List (IUCN, 2001). Based on updated data, this species is known from only four sites with an estimated extent of occurrence 4, smaller than 20000 km². Along with the threats of deterioration and loss of habitat area going on in the areas of distribution, this species can be assessed as Vulnerable (VU B1) according to the IUCN Red List Categories and Criteria (IUCN, 2001).

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