

***Libystes* A. Milne-Edwards, 1867 (Crustacea: Decapoda: Portunidae):
re-establishment of *L. nitidus* A. Milne-Edwards, 1867,
reinstatement of *L. alphonsi* Alcock, 1900 and a description
of a new species from the Red Sea**

***Libystes* A. Milne-Edwards, 1867 (Crustacea: Decapoda: Portunidae):
переописание *L. nitidus* A. Milne-Edwards, 1867, восстановление
L. alphonsi Alcock, 1900 и описание нового вида
из Красного моря**

Vassily A. Spiridonov¹, Seyit Ali Kamanli², Tohru Naruse³,
Paul F. Clark⁴

Василий А. Спиридонов¹, Севит Али Кяманли², Тору Нарусе³,
Поль Ф. Кларк⁴

^{1†} Shirshov Institute of Oceanology of Russian Academy of Sciences, Nakhimovskiy Prospekt, 36, Moscow 117997, Russia.

^{1†} Институт океанологии им. Ширшова Российской академии наук, Нахимовский проспект, 36, Москва 117997, Россия.

² Department of Biology, Burdur Mehmet Akif Ersoy University, Burdur 15030, Turkey. E-mail: alikamanli06@gmail.com

³ Tropical Biodiversity Research Center, University of the Ryukyus, 870 Uehara, Taketomi, Okinawa 907-1541, Japan. E-mail: naruse@lab.u-ryukyuu.ac.jp

⁴ Department of Life Sciences, The Natural History Museum, Cromwell Road, London SW7 5BD, England. E-mail: p.clark@nhm.ac.uk

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КЛЮЧЕВЫЕ СЛОВА: таксономия, конфокальный лазерный сканирующий микроскоп, морфология самцов G1 и G2, западная часть Индийского океана.

ABSTRACT. Western Indian Ocean *Libystes* A. Milne-Edwards, 1867 taxonomy is confused, in need of clarification and ultimately revision. The type species of *L. nitidus* A. Milne-Edwards, 1867, is an extant dry female specimen from Zanzibar. Subsequently, this species has been recorded from various localities across the Indo-West Pacific including Bandéli, Mayotte, Comores; Djibouti, Red Sea; Bushire, Persian Gulf; Manila Bay and north of Lubang Island, Philippines; Sumatra; Kaohsiung, Taiwan and Honolulu, Hawaiian Islands. The main issue that resulted in this exaggerated distribution was that the species was described from a female and male gonopods were not correctly illustrated until 1962. Two additional *Libystes* species were collected by the Royal Indian marine survey ship “*Investigator*”, namely *L. edwardsi* Alcock, 1900 and *L. alphonsi* Alcock, 1900. Although *L. edwardsi* is uniquely distinguished by the anterolateral carapace teeth and therefore its validity has never been questioned, *L. alphonsi* has been synonymized with *L. nitidus*. More importantly however, especially with the latter, the morphology of the male gonopods of these two Alcock species is unknown. Furthermore, there have been no further records of *L. alphonsi* from the Indian Ocean. In a revision of the portunid crabs of the Arabian Gulf

and adjacent area, the authors neither supported *L. alphonsi* as a junior synonym of *L. nitidus* or the view that this Alcock [1900] species was valid. Instead, they assigned *L. alphonsi* to *L. aff. nitidus* A. Milne-Edwards, 1867. The establishment of *L. aff. nitidus* allowed the authors to highlight the continued problems associated with Western Indian Ocean *Libystes* taxonomy which included issues with two males deposited the Natural History Museum, London collected from the Red Sea and Maldives. Therefore the purpose of this present study is to review the species complex associated with *L. aff. nitidus*. The resulting study includes a clarification of characters that diagnose *L. nitidus*, reports a male *L. alphonsi* specimen from the Maldives which is fully described and presence of a new *Libystes* species from the Red Sea. In addition, the present study questions the identification of several Western Indian Ocean *Libystes* specimens some of which may be undescribed species.

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РЕЗЮМЕ. Таксономия *Lybistes* A. Milne-Edwards, 1867 из западной части Индийского океана запутана, нуждается в уточнении и, в конечном счете, в пересмотре. Типовой вид *L. nitidus* A. Milne-Edwards, 1867 представлен сохранившимся сухим экземпляром самки из Занзибара. Впоследствии этот вид был отмечен в различных районах индо-Западной части Тихого океана, включая Бандели, Майотту, Коморские острова; Джибути, Красное море; Бушир, Персидский залив; Манильский залив и север острова Лубанг, Филиппины; Суматра; Гаосюн, Тайвань и Гонолулу, Гавайские острова. Основная проблема, приведшая к такому широкому ареалу данного вида, заключалась в том, что вид был описан по самке, тогда как гоноподы самцов не были хорошо проиллюстрированы вплоть до 1962 г. Два других вида рода *Libystes*, а именно *L. edwardsi* Alcock, 1900 и *L. alphonsi* Alcock, 1900, были собраны Королевским индийским морским исследовательским судном «Исследователь» (the Royal Indian marine survey ship “Investigator”). Хотя *L. edwardsi* хорошо отличается переднебоковыми зубцами карапаса и его валидность никогда не подвергалась сомнению, *L. alphonsi* ранее считался синонимом *L. nitidus*. Однако, что еще более важно, особенно в последнем случае, морфология гоноподов самцов этих двух видов была неизвестна. Также, не было известно о находках *L. alphonsi* из Индийского океана. При пересмотре коллекции крабов-портунид Персидского залива и прилегающей территории авторы не поддержали *L. alphonsi* ни в качестве младшего синонима *L. nitidus*, ни мнение Алькока [1900], что этот вид является валидным. Вместо этого они обозначили *L. alphonsi* как *L. aff. nitidus* A. Milne-Edwards, 1867. Учреждение *L. aff. nitidus* позволило авторам осветить сохраняющиеся проблемы, связанные с систематикой *Lybistes* западной части Индийского океана, которые включали таксономические вопросы по двум самцам из Красного моря и Мальдивских островов, хранящимся в Музее естественной истории в Лондоне. В связи с этим, целью настоящего исследования является обзор видового комплекса, связанного с *L. aff. nitidus*. В результате исследования были выявлены морфологические признаки, которые позволяют диагностировать *L. nitidus*, описать самца *L. alphonsi* с Мальдивских островов, а также описать новый вид рода *Libystes* из Красного моря. Кроме того, в настоящем исследовании ставится под сомнение идентификация нескольких образцов *Lybistes* в Западной части Индийского океана, некоторые из которых могут быть еще неописанными видами.

Introduction

Libystes A. Milne-Edwards, 1867 is considered to be a strongly morphologically modified portunid crab

genus [Schubart, Reuschel, 2009; Spiridonov *et al.*, 2014; Evans, 2018; Spiridonov, 2020] because these crabs are poorly adapted for or incapable of swimming [Steudel, 1998]. Currently, six *Libystes* species are recognized [Ng *et al.*, 2008]: *L. edwardsi* Alcock, 1900, *L. lepidus* Miyake et Takeda, 1970, *L. nitidus* A. Milne-Edwards, 1867, *L. paucidentatus* Stephenson et Campbell, 1960, *L. vietnamensis* Tien, 1969, and *L. villosus* Rathbun, 1924. But *Libystes* taxonomy remains problematic with particular reference to the type species. *Libystes nitidus* was described on the basis of a single female from Zanzibar [A. Milne-Edwards, 1867] and has been reported from various localities across the Indo-West Pacific including Bandéli, Mayotte, Comores [Barnard, 1954]; Djibouti [Nobili, 1906]; Bushire, Persian Gulf [Stephensen, 1946]; Manila Bay and north of Lubang Island, Philippines [Moosa, 1981]; South Sumatra (Mortensen leg. 1922, determined by Odhner 1924 in the Zoological Museum, Copenhagen [Stephensen, 1946: 169]); Kaohsiung, Taiwan [Balss, 1922; Lin, 1949; Huang, Yu, 1997] and Honolulu, Hawaiian Islands [Edmondson, 1954]. Published illustrations and descriptions have caused doubt that all these *L. nitidus* records are conspecific [Apel, Spiridonov, 1998: 178].

Three *Libystes* species have been described from the Western Indian Ocean, Red Sea and Persian Gulf: *L. edwardsi*, *L. nitidus*, and *L. alphonsi*. Of these three taxa, *L. edwardsi* is the most readily identifiable comprising a number of teeth on the anterolateral carapace margin and a relatively broad dactylus on the 5th pereopod [Alcock, McArdle, 1903: pl. LXI, fig. 1] (Fig. 1). But to date the first male pleopod (G1) of this species has not been illustrated. In comparison however, the taxonomy *L. nitidus* and *L. alphonsi* appears to be particularly confused.

Libystes nitidus was initially described by A. Milne-Edwards [1867: 285] and although subsequently figured by him [A. Milne-Edwards, 1868: 83, pl. 20, figs 5–7], the morphology of the G1 was not represented. Indeed, it was much later that Stephensen [1946: fig. 45D] (Fig. 2A) illustrated the G1 from brachyuran material collected by the Danish Scientific Expedition to the Iranian Gulf and he identified as *L. nitidus*. While working up a collection of decapods from the Madagascar region, Barnard [1954: 99–100, fig. 2a–e] recognised a non-ovigerous female from Bandéli, Mayotte, Comores, measuring 8×13.5 mm, as *L. nitidus*. This female was included in the monograph of Madagascar portunids by Crosnier [1962: 14, figs. 5–10], but this specimen obviously presented him with some problems because after his initial description of the Mayotte crab, he added an addendum discussing its identity [Crosnier, 1962: 148]. A male *Libystes* specimen had been collected on the west coast of Madagascar at Tuléar (now Toliary) and, according to Crosnier [1962: 148], it differed from the described Mayotte female with regard to four features. The Madagascan male possessed an anterolateral carapace margin that was a little more evenly rounded; granules were absent

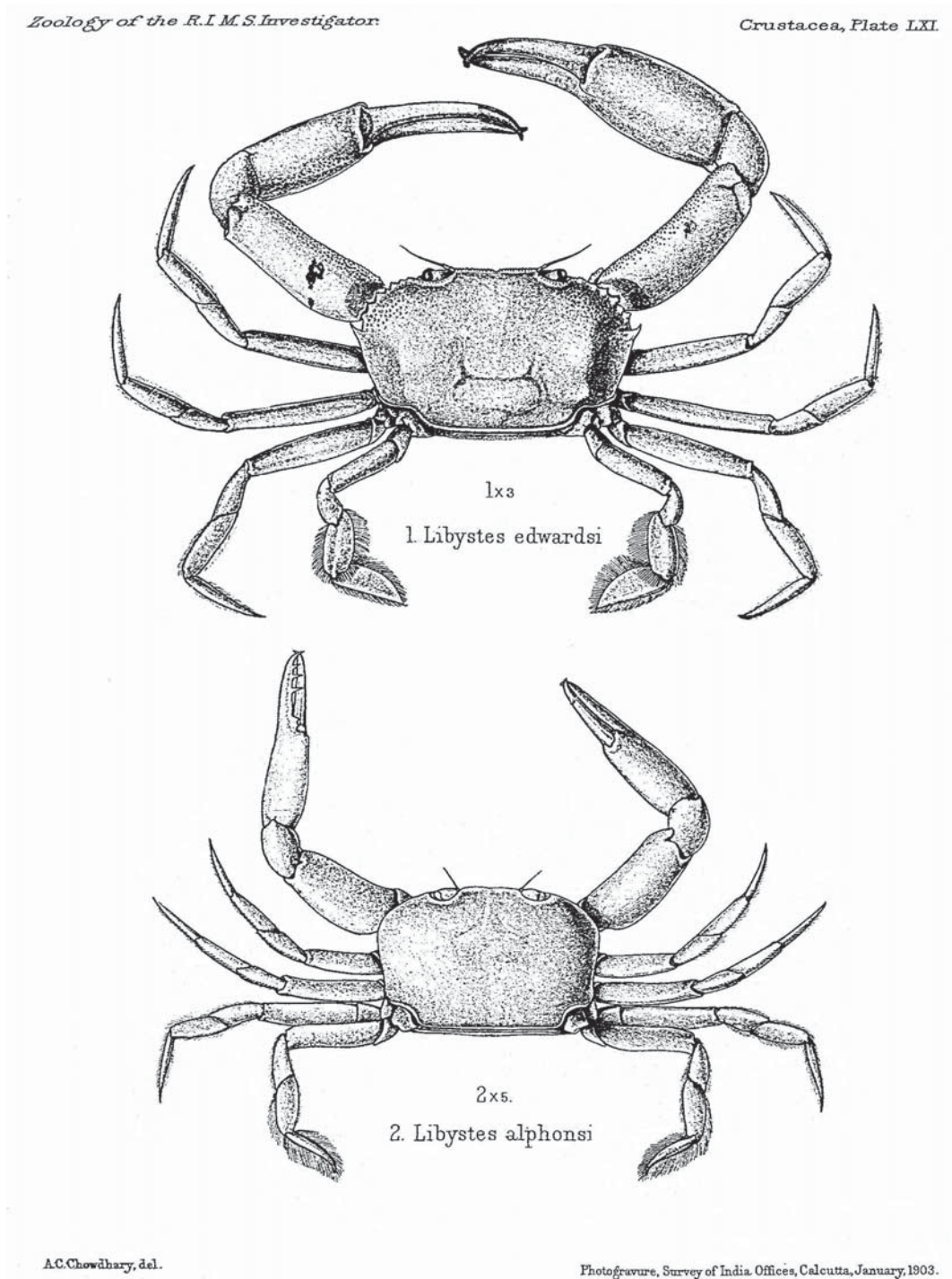


Fig. 1. Dorsal view of *Libystes edwardsi* Alcock, 1900 and *L. alphonsi* Alcock, 1900, from Alcock & McArdle [1903].

Рис. 1. Дорсальный вид *Libystes edwardsi* Alcock, 1900 и *L. alphonsi* Alcock, 1900, из Alcock & McArdle [1903].

from the frontal margin, the dorsal face of the carapace near the margins and the propodi of the chelipeds; there were fewer setae on the thoracic legs 2–4; and in the middle of the fixed finger (propodus) of the larger cheliped was an extremely strong triangular tooth. Furthermore, Crosnier [1962: 148] (Figs 3, 4) examined the type female of *L. nitidus* deposited in Museum

d'Histoire Naturelle, Paris and remarked that general shape of the carapace corresponded extremely well with Tuléar male. As a consequence, Crosnier [1962: fig. 252] (Fig. 5A) figured the whole G1 and the distal tip of the Madagascan male and compared this with the gonopod illustrated by Stephensen [1946: fig. 45D] (Fig. 2A) of his Persian Gulf male also identified as *L.*

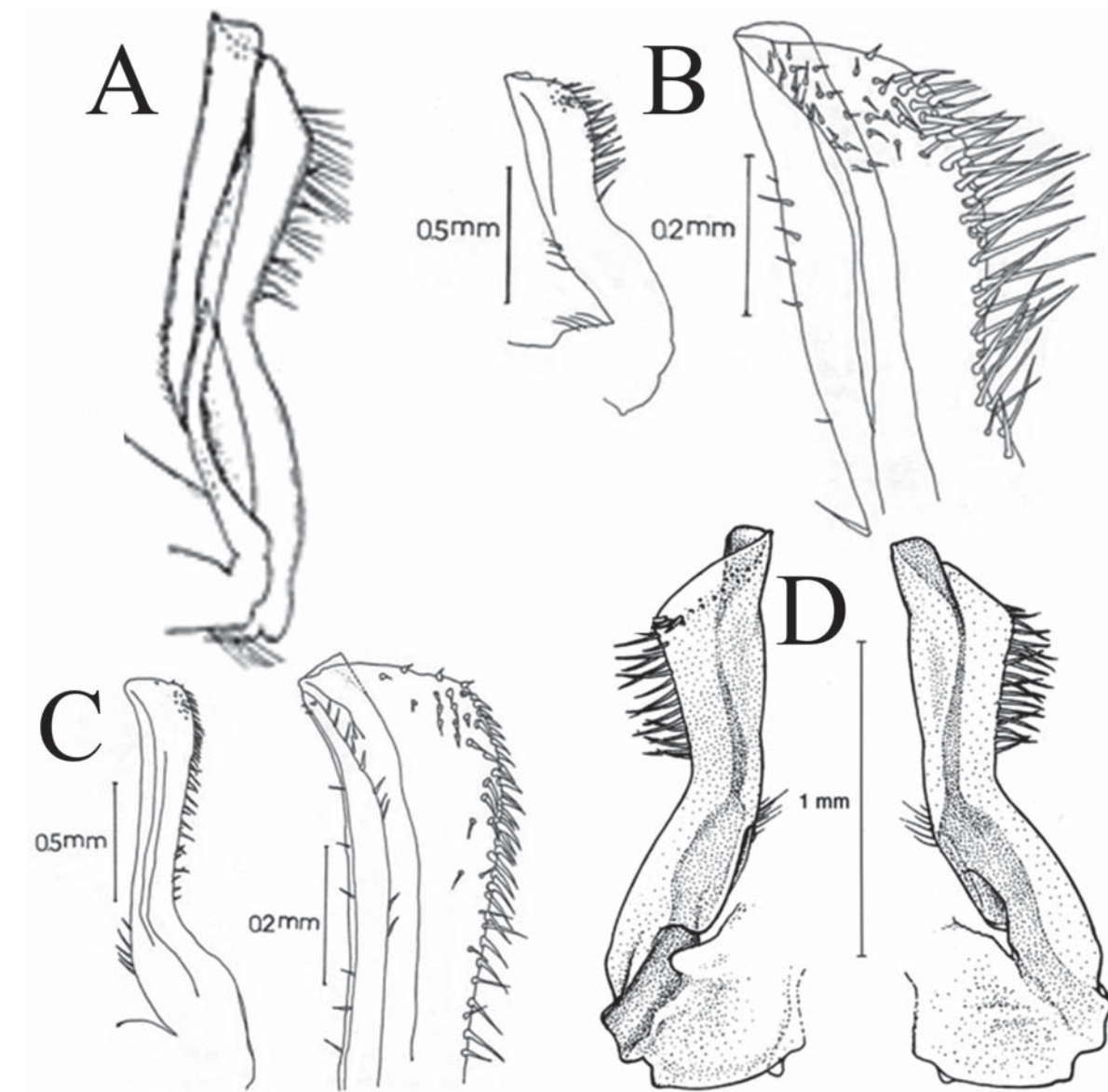


Fig. 2. G1 illustrated in the literature. A — *Libystes nitidus* [Stephensen, 1946: fig. 45D], stn 25A, 63 nautical miles W. $\frac{1}{4}$ S of Bushire, Iranian Gulf, 49 m, 14.03.1937; B — *L. nitidus*, Serène [1966: figs 1–2], G1, juv. 5×3 mm; C — *L. nitidus*, Serène [1966: figs 3–4], G1, adult 7×4; D — *L. aff. nitidus* [Apel, Spiridonov, 1998: fig. 6], left G1, ZMUC CRU-3267.

Рис. 2. G1, проиллюстрированный в литературе. *Libystes nitidus*; A — [Stephensen, 1946: fig. 45D], ст. 25A, 63 морских мили к западу от Бушира, Иранский залив, 49 м, 14.03.1937; B — *L. nitidus* [Serène, 1966: fig. 1–2], G1, юв. 5×3 мм; C — *L. nitidus* [Serène 1966: fig. 3–4], G1, половозрелый 7×4 мм; D — *L. aff. nitidus* [Apel, Spiridonov, 1998: fig. 6], левый G1, ZMUC CRU-3267.

nitidus. Crosnier [1962: 148] noted that the G1 of the Persian Gulf male was aberrant (Persian Gulf *L. nitidus* G1 (Fig. 2A) vs. Madagascan *L. nitidus* G1 (Fig. 5A, B). This taxonomic issue with regard to the true identity of *L. nitidus* was revisited by Serène [1966: 994]. According to him, the illustrations by Barnard [1954: fig. 2a–e] and Crosnier [1962: figs 5–10] of *L. nitidus* general morphology were better than the figures of A. Milne-Edwards [1868: pl. 20, figs 5–7]. Serène [1966] noted that Crosnier [1962: fig. 252] (Fig. 5A) published the first pleopod of a 19mm male specimen, while the male pleopod published by Stephensen [1946: fig. 45D] (Fig. 2A) for a 7mm male was aberrant.

Indeed, Serène [1966: figs 5, 6] (Fig. 5D) confirmed that he had pleopods that were identical to figure of Crosnier [1962: fig. 252] (Fig. 5A) for male specimens with a carapace width measurement of 9mm and above. For male specimens with a carapace width of 7mm or less, the G1 was different [Serène, 1966: figs 1–4] (Fig. 2B, C). For Serène [1966], however, these dissimilar pleopods were just the shape of young and immature *L. nitidus*.

The description by Alcock [1900: 306–307] of *L. alphonsi* is brief, although he considered the most distinguishing feature of his new species was the subquadri-lateral carapace which was later figured by Alcock,



Fig. 3. *Libystes nitidus* A. Milne-Edwards, 1867; label of type specimen as noted by Crosnier [1962].

Рис. 3. *Libystes nitidus* A. Milne-Edwards, 1867; этикетка типового экземпляра, как отмечено Кронье [1962].

McArdle [1903: pl. LXI, fig. 2] (Fig. 1). But in a footnote, Tesch [1918: 178] questioned the validity of this new species based upon a juvenile female and comment that *L. alphonsi* was probably *L. nitidus*. This was also the view of Edmondson [1954: 226]. Later, Ng *et al.* [2008] listed *L. alphonsi* as a junior synonym of *L. nitidus*, but followed it with a question mark. One more point with regard to this Alcock [1900] species is

that the morphology of the G1 is unknown to date for *L. alphonsi*. Later, in their revision of the portunid crabs of the Arabian Gulf and adjacent area, Apel & Spiridonov [1998: 76] neither supported *L. alphonsi* as a junior synonym of *L. nitidus* or the view that this Alcock [1900] species was valid. Instead, they [Apel, Spiridonov, 1998: 76] assigned *L. alphonsi* to *L. aff. nitidus* A. Milne-Edwards, 1867.

The establishment of *L. aff. nitidus* by Apel & Spiridonov [1998: 76] allowed these authors to highlight the continued problems associated with Western Indian Ocean *Libystes* taxonomy. In particular, they re-examined the Zoologisk Museum, University of Copenhagen (ZMUC) male specimen (CRU-3267) of Stephensen [1946] from the Iranian (Persian) Gulf and figured the G1 again [Apel, Spiridonov, 1998: fig. 6d, e] (Fig. 2D). This G1 according to them showed great similarity to the Sudanese Red Sea male specimen deposited in the collections of the Natural History Museum, London (NHM 1934.1.17.114) and with the pleopods illustrated by Serène [1966: figs 1–4] (Fig. 2B, C). Furthermore, they considered that the G1 of the ZMUC male from the Iranian (Persian) Gulf [Apel, Spiridonov, 1998 fig. 6d, e] (Fig. 2D) was distinct from the Maldives male (NHM 1991:156), which according to them corresponded quite well with pleopods illustrated by Crosnier [1962: fig. 252] (Fig. 5A) and by Serène [1966: figs 5–6] (Fig. 5D). In addition, Apel & Spiridonov [1998] challenged the view of Serène [1966: figs 1–4] (Fig. 2B, C) with regard to the male

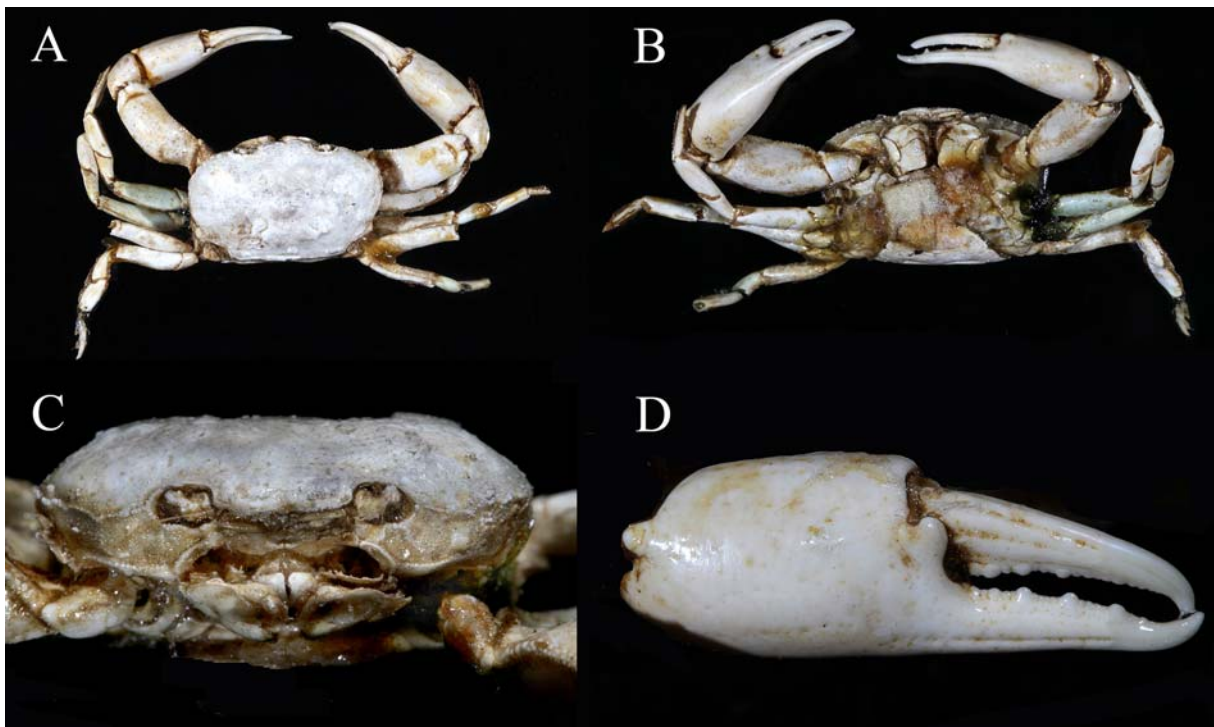


Fig. 4. *Libystes nitidus* A. Milne-Edwards, 1867, Muséum d'Histoire Naturelle, type female specimen, reg. 2039; A — dorsal view; B — ventral view; C — frontal view; D — right chela.

Рис. 4. *Libystes nitidus* A. Milne-Edwards, 1867, Музей естественной истории, типовая самка, рег. 2039; А — вид сверху; В — вид спереди; С — вид снизу; D — правая клешня.

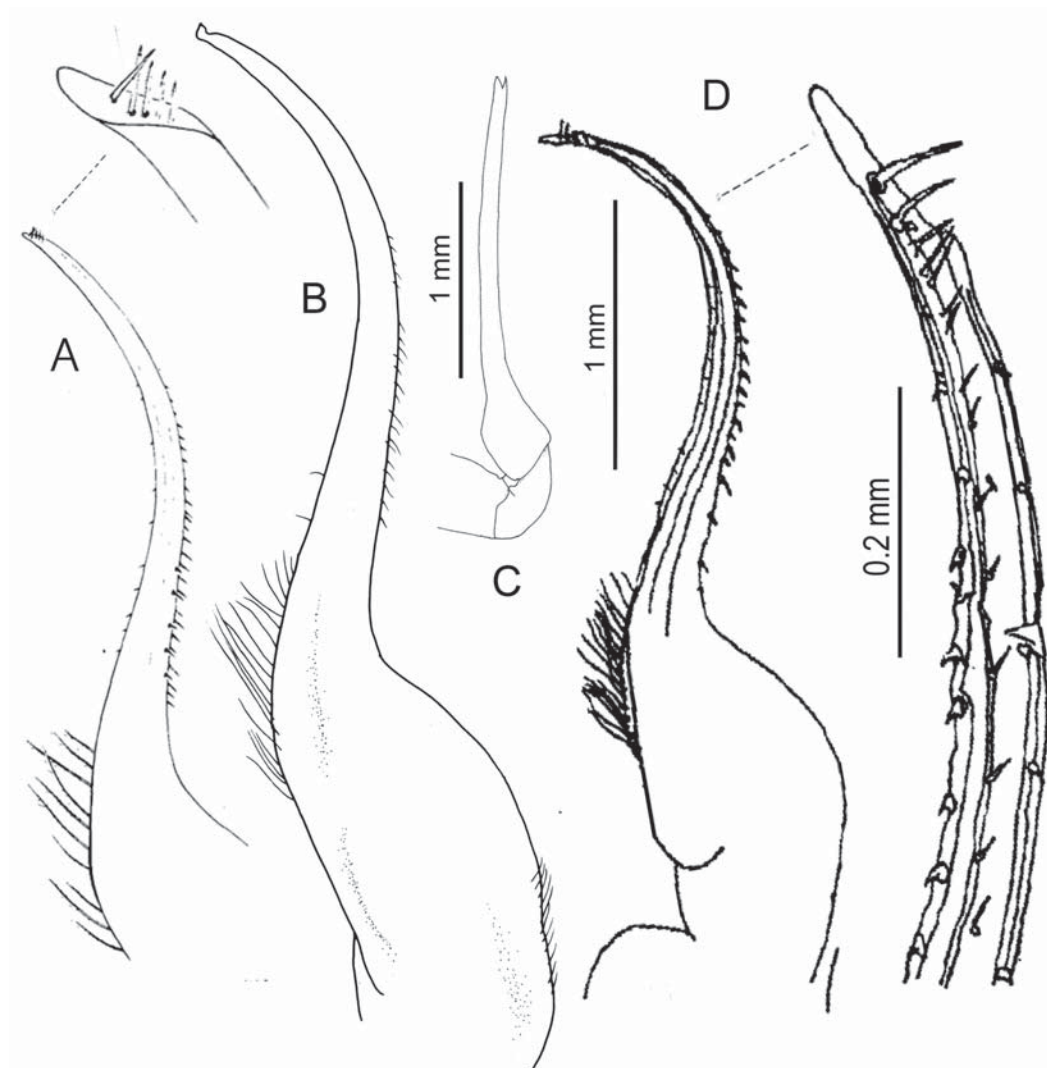


Fig. 5. *Libystes nitidus*, G1 and G2 illustrated in the literature. A — [Crosnier, 1962: fig. 252] entire $\times 30$, distal tip $\times 130$; same specimen examined in the present study (B, C, MNHN B5727, 20.0 \times 12.2 mm); B — G1, entire; C — G2, entire; D — [Serène, 1966: figs 5, 6] juv. 11.5 \times 7 mm, entire and distal tip.

Рис. 5. *Libystes nitidus*, G1 и G2, проиллюстрированные в литературе. А — [Crosnier, 1962: fig. 252], общий вид $\times 30$, дистальная часть $\times 130$; тот же образец, настоящее исследование (B, C, MNHN B5727, 20.0 \times 12.2 мм); B — G1, общий вид; C — G2, общий вид; D — [Serène, 1966: fig. 5, 6], 11.5 \times 7 мм, общий вид и дистальная часть.

pleopod illustrated as Stephensen [1946: fig. 45D] (Fig. 2A) as being just the shape of young and immature *L. nitidus*. In their opinion, this viewpoint of Serène [1966] was not tenable, since the differences between the two forms were too fundamental to be age-dependent. Furthermore, the large specimen from the Red Sea (NHM 1934.1.17.114) and the small male from the Iranian (Persian) Gulf (ZMUC CRU-3267) had almost identical first gonopods. Apel & Spiridonov [1998] continued their G1 observations by stating that the intermediate-sized specimen from the Maldives (NHM 1991:156) differed completely from the other two crabs (NHM 1934.1.17.114; ZMUC CRU-3267). Consequently, they [Apel, Spiridonov, 1998] were convinced that in the past Indian Ocean specimens assigned to *L. nitidus*, comprised more than one species. Moreover, Crosnier

[1962] had compared his male specimen from Madagascar to the holotype (a female) from Zanzibar and concluded they were conspecific. This supposition according to Apel & Spiridonov [1998] indicated that the specimens they had examined from the Arabian Gulf and the Red Sea by were not conspecific to the holotype of *L. nitidus*. There was one more outstanding taxonomic issue for Apel & Spiridonov [1998] with regards to Western Indian Ocean *Libystes* taxonomy; the recognition of *L. alphonsi* as the junior synonym of *L. nitidus* and the need for this to be discussed in the current context. In their synonym of *L. aff. nitidus*, Apel & Spiridonov [1998] highlighted the inclusion of *L. alphonsi* prefixed with a question mark. They also noted that there was no information exists regarding the G1 morphology of *L. alphonsi*.

With regard to the taxonomic status of Western Indian Ocean *Libystes*, Apel & Spiridonov [1998] considered that the situation of all the forms listed under their *L. aff. nitidus* remained unclear and a revision was required. Furthermore, they did not believe themselves to be in a position to clarify their status and therefore did not either assign the specimen from their Iranian (Persian) Gulf study to one of the known *Libystes* Western Indian Ocean species or describe it as a new species to science. Therefore, the primary purpose of this present study is to re-establish the status of *L. nitidus*; re-examine the NHM Red Sea registered specimen 1934.1.17.114 with a view to considering this male as an undescribed species new to science and attempt to identify the Maldives male specimen (NHM 1991:156.1). This research may help determine the distribution of Western Indian Ocean *Libystes* species.

DEDICATION. We were collaborating with Vassily to complete this manuscript when he was admitted into hospital with covid from which he later tragically died. Vassily was always a wonderful person with whom to work because he was a scholar, a true gentleman, had a great sense of humour and was an expert in his field of brachyuran taxonomy. He will be dearly missed by many friends and colleagues from around the world.

This study is dedicated to Vassily Spiridonov.

Material and methods

MORPHOLOGICAL OBSERVATION. The material examined is deposited in Muséum national d'Histoire naturelle, Paris (MNHN); The Natural History Museum, London (NHM); and Florida Museum of Natural History, University of Florida (UF). Morphological description follows the terminology adopted by Crosnier [1962], Apel & Spiridonov [1998], Spiridonov *et al.* [2014] and Davie *et al.* [2015]. The following measurements were taken in mm with digital calipers: carapace length (cl) from the middle of posterior carapace margin to the middle of frontal margin, maximum carapace breadth (cw), frontal breadth, maximum orbital breadth, maximum carapace height. Pereiopods and their articles were measured along their longest and broadest extensions. The size of the specimen is indicated by cw×cl. Abbreviations used: Gonopod 1 — G1; Gonopod 2 — G2; ovigerous — ovig.; collected by — coll.

CONFOCAL LASER SCANNING MICROSCOPE (CLSM). The gonopods were stained using a 1:1 mixture of Congo red and acid fuchsin [Kamanli *et al.*, 2017] and store in the dark for ca. 48 h at room temperature, ca. 20° C. The samples were checked regularly over this period to prevent overstaining and were eventually transferred into the deionised water for about 15 min before mounting. Glass slides with self-adhesive reinforcement rings [Kihara, Falavignada Rocha, 2009] were used to raise the cover slip and prevent the samples from being crushed by the cover slip. The number of reinforcement rings was increased according to the size of the samples [Michels, Büntzow, 2010]. Five reinforcement rings were used for the first gonopod and three for the second. Two-three droplets of 100% glycerine were pipetted into the cavities and the gonopods were individually transferred into the mountant. After adding a cover slip, the samples were scanned using a Nikon A1-Si CLSM with four lasers at different wavelengths (405 nm, 488 nm,

561 nm, 640 nm). The gonopods were scanned using 10× and 20× dry objectives with numerical apertures of 0.3 and 0.75 respectively. The tips of the gonopods were scanned using the 20× dry objectives. Whereas the whole appendage was scanned using either 10× or 20× dry objectives (depending on size of the appendage) and applying the “large images” software option of the microscope. This option scans the sample in discrete areas and automatically stitches the tiles together [Kamanli *et al.*, 2017]. The final confocal data were then processed using a combination of freeware software programs ImageJ (<http://imagej.nih.gov/ij/>) [Schneider *et al.*, 2012] and Drishti (version 2.6.4) (<https://sf.anu.edu.au/Vizlab/drishti/>) [Limaye, 2012] respectively [Kamanli *et al.*, 2017]. ImageJ was used to standardise the stack data and to merge the channels at different wavelengths. Drishti was used for surface rendering and to obtain the final image. Lastly, Adobe Photoshop (CS6) was used to adjust the final images including deleting remaining debris, regulating colour balance, levels and brightness/contrast, re-arranging the scale bars, changing the canvas and image size and saving as TIFF format.

Taxonomy

Suborder Pleocyemata Burkenroad, 1963
 Infraorder Brachyura Linnaeus, 1802
 Section Eubrachyura de Saint-Laurent, 1980
 Subsection Heterotremata Guinot, 1977
 Superfamily Portunoidea Rafinesque, 1819
 Family Portunidae Rafinesque, 1819
 Subfamily Carupinae Paulson, 1875
 Genus *Libystes* A. Milne-Edwards, 1867

Libystes A. Milne-Edwards, 1867: 285; Nobili, 1906: 297; Alcock, 1900: 304–305; Tesch, 1918: 177–178; Balss, 1922: 133; Sakai T., 1939: 372; 1976: 324; Stephenson, Campbell, 1960: 85–86; Crosnier, 1962: 13–14; Serène, 1966: 992; Guinot, 1967: 253; Stephenson, 1972: 29; Dai *et al.* 1986: 181; Dai, Yang, 1991: 200; Apel, Spiridonov, 1998: 174; Ng *et al.*, 2008: 217 (list); Naderloo, 2017: 189; Spiridonov, 2020: 140.

Libystes [sic] Cano, 1889b: 225; Sakai T., 1939: 371 (key).

DIAGNOSIS. Carapace broad, with subquadrilateral or subelliptical shape without distinct regions; front not clearly separated from supraorbital angles, about one third or less of carapace breadth, quite straight, at most slightly notched medially, but not forming any distinct lobes or teeth; anterolateral border entire or bearing teeth; orbits shallow, upper border entire. Basal antennal article short, antennal flagellum standing loosely in orbital hiatus. Epistome posterior margin medially bilobed. Third maxilliped with merus broader than long, strongly produced anteroexternal angle. Chelipeds subequal, moderately stout to elongate, more massive and longer than 2nd to 5th pereiopods, merus without tooth on anterior margin. Ambulatory legs slender, unarmed; last pair of pereiopods with propodus and dactylus either flattened and paddle-like or only propodus somewhat flattened and dactylus sinuate, not forming a paddle-like article. Penis coxal, long. Pleon of male subtriangular, covering whole width between last pereiopods, pleomeres 3–5 usually fused, suture between 4th and 5th pleomeres sometimes still visible. G1 slender to robust; G2 less than half length of G1, distally furcate. (modified from [Apel, Spiridonov, 1998: 174]).

TYPE SPECIES. *Libystes nitidus* A. Milne-Edwards, 1867: 285, by monotypy; gender masculine [Opinion 85, Direction 37].

Libystes nitidus A. Milne-Edwards, 1867
Figs 3–6.

Libystes nitidus A. Milne-Edwards, 1867: 285, 1868: 83, pl. 20, figs 5–7; Tesch, 1918: 178 (key); Crosnier, 1962: 14 (partim), 148, fig. 252; Serène, 1966 (partim): figs 5–6; Guinot, 1967: 253 (partim); Melville, Smith 1987: 266; Ng *et al.*, 2008: 217 (list).

Libystes aff. *nitidus* Apel, Spiridonov, 1998 (partim); Apel, 2001: 73 (partim).

Nec *Libystes nitidus* Laurie, 1915: 463 = *L. vadosus* sp.n.

Nec *Libystes nitidus* Barnard, 1954: 99–100, fig. 2a–e; Crosnier, 1962: 14 (partim), figs 5–10 = *Libystes vadosus* sp.n.

Nec *Libystes nitidus* Spiridonov, 2020: 148, fig. 5H = *L. alphonsi* Alcock, 1900.

Nec *Libystes nitidus* Guinot, 1967: 253 (partim) = *L. alphonsi* Alcock, 1900.

Nec *Libystes nitidus* Stephensen, 1946: 168–169, fig. 45C–F = undescribed species, see remarks for *L. vadosus* sp.n.

Nec *Libystes nitidus* Nobili, 1906: 297; Crosnier, 1962: 14 (partim, Djibouti), Serène, 1966 (partim): figs 1–4; Guinot, 1967: 253 (partim, Djibouti) = *L. vadosus* sp.n.

Nec *Libystes nitidus* Titgen, 1982: 250 (list) = undescribed species, see remarks for *L. vadosus* sp.n.

Nec *Libystes nitidus* Zarenkov, 1971: 180 = new species described by Spiridonov *et al.*, 2021?

? *Lybistes* [sic] *nitidus* Cano, 1889a: 80, 91, 102; 1889b: 225–226 (These record from Hawaii may be due to mislabel; see Castro 2011: 66).

? *Libystes nitidus* Edmondson, 1946: 276; 1954: 225–226, fig. 4a, b (see Castro, 2011: 66).

? *Libystes nitidus* Yang *et al.*, 2012: 72, fig. 27.

? *Libystes nitidus* Balss, 1922: 113.

? *Libystes nitidus* Rathbun, 1906: 830, 834 (see Castro, 2011: 66).

MATERIAL EXAMINED. Holotype: ♀, 22.0×15.0 mm, Zanzibar, coll. A. Grandidier, MNHN B2039 (photographs only). Others: 2♂♂, 10.6×6.4, 13.3×8.2 mm, 1♀, 9.0×5.6 mm, 1 ovig. ♀, 17.3×10.5 mm, Madagascar, MNHN B5726; 1♂, 20.0×12.2 mm, Madagascar, MNHN B5727; 1♀, 12.9×7.8 mm, Madagascar, MNHN B5728; 1♂, 14.4×8.8 mm, 1 ovig. ♀, 16.5×10.0 mm, Tuléar, coll. M. Derijard, MNHN B.

REDESCRIPTION. (Based on 2♂♂, MNHN B5727, MNHN B). Carapace 1.64 times as broad as long, oval, dorsally and laterally convex, with short sparse pile in anterior part, and laterally along posterior margin, otherwise smooth, without any distinct regions, dorsal surface with pair of short granular ridges located nearly perpendicular to poorly developed posterolateral re-entrants (Fig. 6A, B). Front entire, straight to slightly concave medially, smoothly deflected, partly covering antennular fossae (Fig. 6A–C), about 28% of maximum carapace breadth. Orbits quasi-elliptoidal, comprising 55–60% of frontal breadth. Frontorbital margin ca. 56–60% of maximum carapace breadth.

Anterolateral margins convex, lined with tiny granules, with 3 or 4 equidistantly placed larger granules. Posterior margin as broad as carapace length (Fig. 6A), comprising 57–58% of maximum carapace breadth. Carapace height to breadth ratio equals 0.45–0.47. Subhepatic regions convex, granular. Suture between subhepatic and pterygostomial regions distinct, running to posterolateral margin, dense rows of fine granules on its both sides. Pterygostomial region smooth, pilose mesially and laterally, with particularly long pile in lateral part (Fig. 6B, C).

Thoracic sternum broad, smooth, slightly concave, sternal sutures 2/3 distinct, ¾ shallow. Sternites 5 to 8 smooth, sternal sutures 4/5, 5/6, 6/7, 7/8 well expressed for most sternite breadth, except relatively broad median cavity. Sternal sulci absent. Sternite 5 with locking button on anterome-

sial part fitting to a socket on underside of 6th pleomere; sternite 8 exposed posteriorly, only small lateral portion visible from ventral view, anterior half of lateral part occupied by penial furrow with anterior wall at sternite margin; penis reaching to about 60% of sternite width (Fig. 6E); sutures between sternites and episternites distinct; end of posterior episternite nearly touches lateral margin of third pleomere.

Eye bulb-like, filling entire orbits, base of cornea narrowed (Fig. 6B, C). Antennular fossae pear-shaped, basal antennular segment with distinct transverse rib on mid-part of ventral surface. Antennular flagellum relatively robust, folded transversely, extending to lateral margin of orbit when unfolded. Basal antennal article with small distolateral extension, longer than broad, standing in orbital hiatus; second article slightly shorter than basal segment, cylindrical, flagellum thin.

Epistome posterior margin medially with broad, low, bilobed projection (Fig. 6B). First maxilliped with a well-developed movable setose mesial lobe, located parallel to mesial margin of endognath. Third maxillipeds tightly covers buccal cavern, except for V-shaped median hiatus; ischium broader than long; merus about as long as ischium, distolateral corner round, expanded, distal margin convex (Fig. 6C).

Chelipeds smooth, right cheliped stronger than left one. Major chela merus 2.60–2.70 times longer than broad, quasi-cylindrical, without spines; carpus without spines, obtuse angular prominence at place of usual anterointernal spine, outer surface convex (Fig. 6D); chelae strong, homoiodontic; manus strongly swollen, height to thickness ratio 1.36–1.43, without spines; fingers slightly shorter than manus; immovable finger straight, with one large tooth medially; movable finger weakly curved downwards, leaving ovoid gape when closed, cutting edge with a few low proximal teeth. Minor chelipeds shorter, thinner, both fingers slightly longer than manus, straight except for claw-like tips, no gap when closed.

Pereiopods 2–4 slender, of similar length, generally smooth but emarginated by setae at anterior and posterior margins; ischium short; merus longest, widest subproximally, narrowed distally carpus widening distally; propodus without distinct grooves and costae, emarginated by dense and long hairs; dactylus grooved, ensiform, setosed, nearly as long as and 2 times less broad than propodus, emarginated by dense setae. Pereiopods 5 articulates to hold superdorsal position, slightly shorter than pereiopods 2–4, merus sinuous, articles of carpus to dactylus broader than dactyli of pereiopods 2–4, scalpel-shaped, with fringe of long sparse setae.

Male pleon subtriangular, smooth, pleomeres 2–5 fused without suture, pleomeres 2 and 3 each produced laterally.

G1 slender, elongated, sinuous (Fig. 5B), curved around locking buttons, left and right G1 crossing mesially *in situ*. G2 less slightly longer than half length of G1, tubular, terminally furcate, both mesial, lateral processes in similar length (Fig. 5C).

FEMALE CHARACTERISTICS. Chelipeds smaller than male, left and right chelae subequal; major chela immovable finger occlusal margin lined with similar-sized 3–5 teeth.

Female pleon subtriangular, pleomere 5 and 6 fused, pleomere 5 and 6 each longer than other pleomere. Vulva horizontally long prolate spheroid, occupying longitudinally more than three-quarters of thoracis sternite 6 (Fig. 6F).

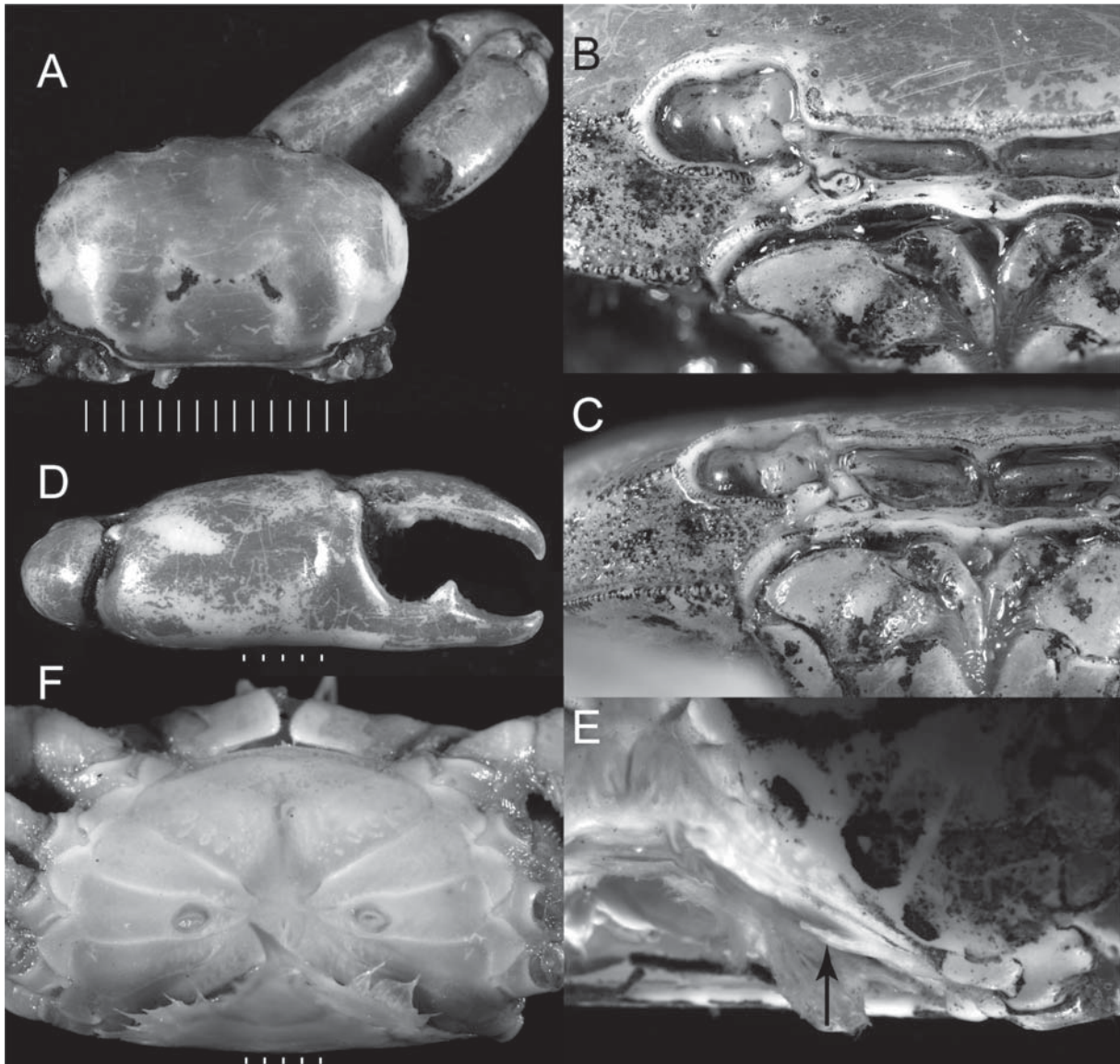


Fig. 6. *Libystes nitidus* A. Milne-Edwards, 1867, Madagascar. A–E — MNHN B5727, ♂, 20.0×12.2 mm; F — MNHN B5728, ♀, 12.9×7.8 mm. A — carapace, dorsal view; B — right side of cephalothorax, anterior view; C — right side of cephalothorax, anteroventral view; D — right chela (major chela), outer view; E — posterior part of thoracic sternum, left-side, showing left penis (arrow); F — thoracic sternum, posteroventral view, showing vulvae. Scale bars in mm.

Рис. 6. *Libystes nitidus* A. Milne-Edwards, 1867, Мадагаскар. А–Е — MNHN B5727, ♂, 20.0×12.2 мм; F — MNHN B5728, ♀, 12.9×7.8 мм. А — карапакс, вид сверху; В — правая сторона цефалоторакса, вид спереди; С — правая сторона цефалоторакса, антеровентральный вид; D — правая клешня (большая клешня), вид снаружи; E — нижняя часть торакальных стернитов, левая сторона, показан левый пенис (стрелка); F — торакальные стерниты, постеровентральный сзади, показаны вульвы. Масштаб в мм.

REMARKS. The following specimens were examined; the holotype of *L. nitidus* from photographs (MNHN B2039; Fig. 4), the male examined by Crosnier [1962: fig. 252] from Tuléar (now Toliary), Madagascar (MNHN B5727; Figs 5B, C, 6A–E), and the non-ovigerous female examined by Barnard [1954: fig. 2a–e] and Crosnier [1962: figs 5–10] from Bandéli, Mayotte, Comores (MNHN B5729; Fig. 11). As Crosnier [1962] noted, the holotype and the male from Tuléar (MNHN B5727) agree well in their carapace characters. Furthermore, they share bulb-like shape of the eye (Figs. 4C, 6B, C), convex distal margin of the merus of third maxilliped (Figs 4B, 6C), and relatively wide and short

median projection on the posterior margin of the epistome (Figs 4C, 6B). The female specimen from Mayotte (MNHN B5729), however, differs from the holotype and the male from Tuléar (MNHN B5727) in having subconical eye (Fig. 11C), almost straight distal margin of merus of third maxilliped (Fig. 11D), and relatively narrow and long median projection on the posterior margin of the epistome (Fig. 11C). These features instead indicate that the female specimen from Mayotte (MNHN B5729) is *L. vadosus* sp.n.

Crosnier [1962: 148] differentiated *L. nitidus* (MNHN B5727) from the Mayotte specimen (as *L. aff. nitidus*, now *L. vadosus* sp.n., MNHN B5729) by the following charac-

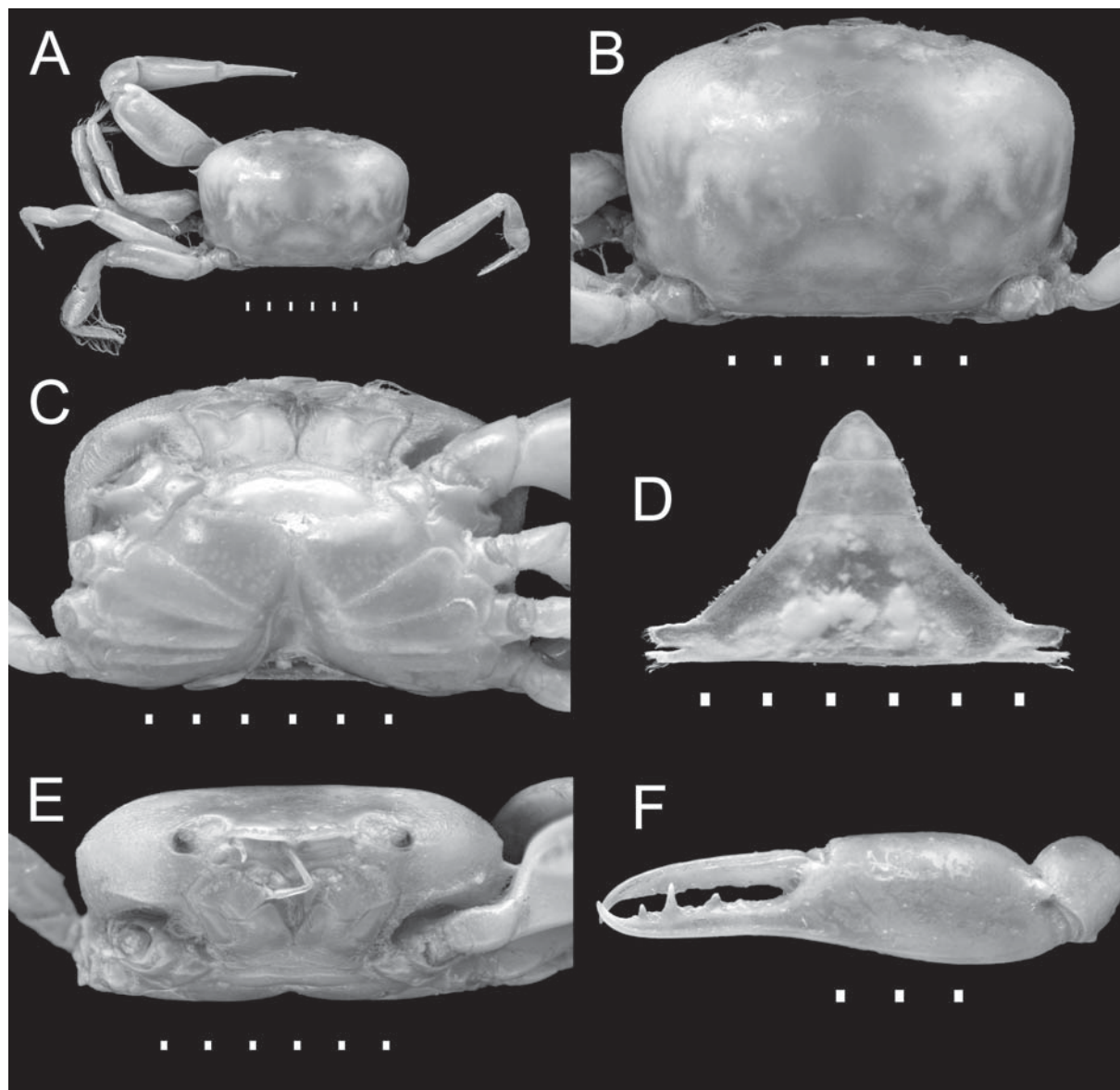


Fig. 7. *Libystes alphonsi* Alcock, 1900, ♂, Fadiffolu Atoll, Maldives, Indian Ocean, NHM 1991.156.1, 9.5×6.2 mm; A — dorsal view; B — dorsal view; C — ventral view; D — ventral view of pleon; E — frontal view; F — frontal view of left chela. Scale bars in mm. Taken by Kevin Webb, NHM Photo Unit.

Рис. 7. *Libystes alphonsi* Alcock, 1900, ♂, Атолл Фадиффолу, Мальдивы, Индийский океан, NHM 1991.156.1, 9,5×6,2 мм; А — вид сверху; Б — вид сверху; В — вид снизу; Г — вид плеона снизу; Е — вид спереди; F — вид левой клешни спереди. Масштаб в мм. Снимок сделан Кевином Уэббом, фотоблако NHM.

ters: an anterolateral carapace margin that was a little more evenly rounded; granules were absent from the frontal margin, the dorsal face of the carapace near the margins and the propodi of the chelipeds; there were fewer setae on the thoracic legs 2–4; and in the middle of the fixed finger (propodus) of the larger cheliped was an extremely strong triangular tooth. Among these characters, the granules of the frontal margin are also seen in smaller individuals of *L. nitidus*, and the strong triangular tooth of the fixed finger of the larger chela is not present in female *L. nitidus*. With regard to the G1 morphology illustrated by Stephensen [1946: fig. 45D] (Fig. 2A) being just the shape of young and immature *L. nitidus* as postulated by Serène [1966: figs 1–4] (Fig.

2B, C), is not accepted by the present study. The supposition of Apel & Spiridonov [1998] is supported in that the G1 of the Arabian Gulf [Stephensen, 1946: fig. 45D] (Fig. 2A) and the Red Sea (NHM 1934.1.17.114; Fig. 12) are not conspecific with that of *L. nitidus* [Crosnier, 1962, fig. 252; Serène, 1966: figs 5, 6] (Fig. 5A, B, 5D respectively). Consequently the Persian Gulf male of Stephensen [1946: fig. 45D] (Fig. 2A) and the Red Sea specimen collected by Crossland (NHM 1934.1.17.114; Fig. 12) are considered to be undescribed species. In his Crustacea Decapoda of the Red Sea, Zarenkov [1971: 180] suggests that *L. nitidus* is recorded from the Canary Islands, however this cannot be confirmed by the present study as the specimen(s) will require re-examination.

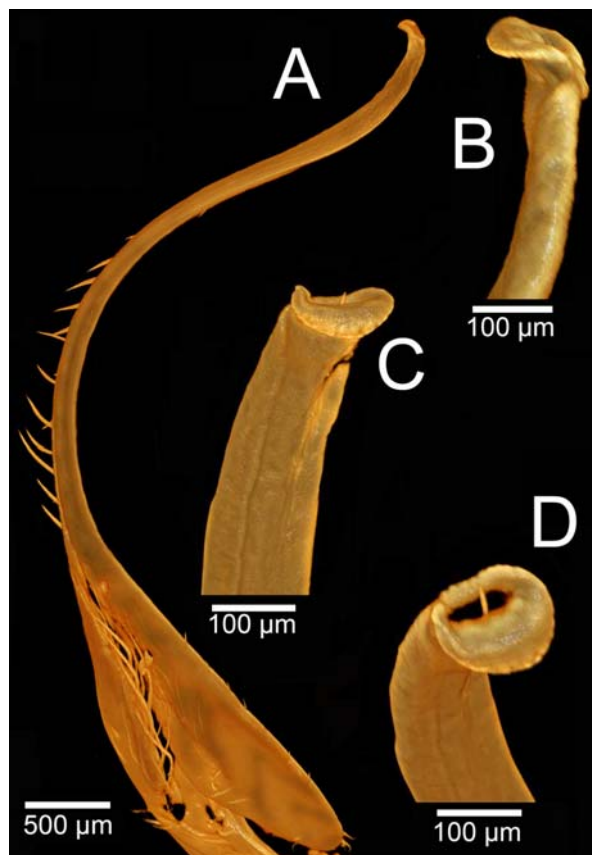


Fig. 8. *Libystes alphonsi* Alcock, 1900, ♂, Stn 142B, Fadiffolu Atoll, Maldives, Indian Ocean, 5°23'12"S 73°37'06"E, coll. H.E.M.S. *Mabahiss*, 30.03.1934, 37 m, John Murray Expedition, NHM 1991.156.1, confocal laser scanning microscope image of G1; A — whole; B–D — various aspects of distal tip.

Рис. 8. *Libystes alphonsi* Alcock, 1900, ♂, ст. 142B, атолл Фадиффолу, Мальдивы, Индийский океан, 5°23'12"С 73°37'06"Е, колл. судно *Мабахисс* (H.E.M.S. *Mabahiss*), 30.03.1934, 37 м, экспедиция Джона Мюррея, NHM 1991.156.1, изображение G1 в конфокальном лазерном сканирующем микроскопе; А — общий вид; В–D — разный вид дистального кончика.

Stephenson [1946: 169] wrote that his Iranian specimen has three granules on the anterolateral margins of the carapace. In comparison however, the Persian Gulf photograph of Naderloo [2017: 190, fig. 20.24] identified as *L. nitidus* does not display this character, consequently there is uncertainty whether his illustration is the same as that of Stephenson [1946] or another species.

Zarenkov [1971: 180] identified a 3.0 mm juvenile male as *L. nitidus* from St. 599, ca. south of the Hanish Islands, 13°36'42.0"N 42°42'06.6"E, Red Sea, taken from a depth of 49 m. This material requires re-examination because it unlikely to be *L. nitidus* (see above) and too deep to be assigned to *L. vadosus* sp.n., but instead could be the new species as described by Spiridonov *et al.*, 2021.

TYPE LOCALITY. Zanzibar [A. Milne-Edwards, 1867: 285].

DISTRIBUTION. Zanzibar [A. Milne-Edwards, 1867: 285]; Tuléar (now Toliary), Madagascar [Crosnier, 1962: 148].



Fig. 9. *Libystes alphonsi* Alcock, 1900, ♂, stn 142B, Fadiffolu Atoll, Maldives, Indian Ocean, 5°23'12"S 73°37'06"E, coll. H.E.M.S. *Mabahiss*, 30.03.1934, 37 m, John Murray Expedition, NHM 1991.156.1, confocal laser scanning microscope image of G2; A — whole; B — distal tip.

Рис. 9. *Libystes alphonsi* Alcock, 1900, ♂, ст. 142B, атолл Фадиффолу, Мальдивы, Индийский океан, 5°23'12"С 73°37'06"Е, колл. судно *Мабахисс* (H.E.M.S. *Mabahiss*), 30.03.1934, 37 м, экспедиция Джона Мюррея, NHM 1991.156.1, изображение G2 в конфокальном лазерном сканирующем микроскопе; А — общий вид; Б — дистальный кончик.

Libystes alphonsi Alcock, 1900 Figs 1, 7–9.

Libystes Alphonsi Alcock, 1900: 306–307.

Libystes alphonsi — Alcock, McArdle, 1903: pl. 61, fig. 2; Tesch, 1918: 178 (key), Stephenson, Campbell, 1960: 86 (key); Serène, 1966: 993; Stephenson, 1972: 29.

Libystes nitidus — Tesch, 1918: 178 (footnote); Guinot, 1967: 253 (partim); Stephenson, 1972: 29 (?); Ng *et al.*, 2008: 217 (list ?), Spiridonov, 2020: 144, fig. 5H.

Libystes cf. *nitidus* Apel, Spiridonov, 1998: 178 (partim); Apel, 2001: 73 (partim).

MATERIAL EXAMINED. 1♂, 9.5×6.2 mm, stn 142B, Fadiffolu Atoll, Maldives, Indian Ocean, 5°23'12"S 73°37'06"E, coll. H.E.M.S. *Mabahiss*, 37 m, John Murray Expedition, NHM 1991.156.1., 30.03.1934.

DIAGNOSIS. Carapace (Figs 1, 7A, B) ca. 1.5 times as broad as long; subquadrilateral; dorsally smooth, without definition of regions; anterolateral margins smooth, entire, without teeth or granulations, region posterior to lateral margin angle setose; front slightly bilobed, ca. 30% cw. Cheliped (Fig. 7F) right chela missing; Alcock [1900: 306] comments that "chelipeds are nearly equal and similar"; left chela, dactylus finger as long as palm of propodus, fixed finger of propodus with 3 distinct teeth, medial tooth longest, palm of propodus slender; coxa without spines; merus 2

times longer than broad, without spines, with distal granulation on anterior margin. Pereiopods smooth, without spines; dactylus of pereopod 5 broader than dactyli of pereopods 2–4, ensiform (Fig. 7A); margins of propodus and dactylus with fringe of long sparse setae. Male pleon (Fig. 7D) subtriangular, smooth, pleomeres 3–5 fused, suture absent between pleomeres 4 and 5. G1 (Fig. 8) slender, similar to *L. nitidus*, but the tip only slightly deflected, with only 1 terminal seta/spinule (Fig. 8C, D). G2 (Fig. 9) slender, terminally furcate.

REMARKS. *Libystes alphonsi* is known from a single (4.0×7.0 mm) type specimen of unreported sex from the Andaman Sea. Tesch [1918], Edmondson [1954], Apel & Spiridonov [1998] and Ng *et al.* [2008] considered *L. alphonsi* a synonym of *L. nitidus*. The opinion of Serène [1966: 994] however, appears to have been overlooked in this matter. He briefly examined the 7mm type specimen of *L. alphonsi* deposited in the collections of the Zoological Survey of India at Calcutta (now Kolkata), and confirmed the differences with *L. nitidus* as indicated by Alcock [1900]. Serène [1966: 994] however, did not confirm the sex of the type specimen from the Andamans.

The holotype of *L. alphonsi* [Alcock, McArdle, 1903: pl. 61, fig. 2] (Fig. 1) differs from a similar-sized female of *L. nitidus* (MNHN B5726, female, 9.0×5.6 mm) in the anterolateral margin of the carapace being entire; Figs 1, 7A, B (vs. the presence of 3–4 equidistantly placed granules; Fig. 6A) and subparallel posterolateral margins; Figs 1, 7A, B (vs. gently convergent posteriorly; Fig. 6A).

The present male specimen from the Maldives is similar to *L. alphonsi* in carapace shape (Figs 1, 7A, B). The female holotype (15×24 mm) of *L. nitidus* originates from Zanzibar [A. Milne-Edwards, 1867; Apel, Spiridonov, 1998]. Crosnier [1962] reported a male from Madagascar (MNHN B5727; Fig. 6A–E) which he compared to the holotype (MNHN B2039; Fig. 4) and found then to be conspecific. The G1 illustrated by Crosnier [1962: fig. 252] (Fig. 5A) is in some respects similar to the gonopod of *L. alphonsi* (Fig. 8). Even taking into account differences of positioning the gonopod when it was drawn or photographed however, there are some important differences. In the present specimens, the spines on the neck are longer, stronger and more rarely spaced, the distal tip is broader, the tip is somewhat deflected, and only a single seta/spinule (Fig. 8) (vs. five in the drawing by [Crosnier, 1962: fig. 252] (Fig. 5A) can be recognized). The G1 of the unreported origin specimen identified as *L. nitidus* and illustrated by Serène [1966: figs 5, 6] (Fig. 5D) is similar in the gonopod morphology to specimen of Crosnier [1962: fig. 252] (Fig. 5A) and also differs from the present specimen identified as *L. alphonsi* (Fig. 8).

Libystes alphonsi differs from *L. vadosus* sp.n. in having a quadrilateral carapace, with subparallel posterolateral margins [Alcock, 1900: 306; Alcock, McArdle, 1903: pl. 61, fig. 2] (Figs 1, 7A, B) (vs. a quasi-elliptoidal carapace, with posterolateral margins strongly convergent posteriorly; (Figs 10A, 11A) for *L. vadosus* sp.n.) the possession of the median hollow dividing the frontal region in the mid line [Alcock, 1900: 306; Alcock, McArdle, 1903: pl. 61, fig. 2] (Figs 1, 7A, B) (vs. the absence of the median hollow on the frontal region; (Figs 10A, 11A) for *L. vadosus* sp.n.) and carapace ridges on the posterior region are not mentioned in the description of Alcock [1900] nor figured by [Alcock, McArdle, 1903: pl. 61, fig. 2] (Fig. 7A, B) (vs. carapace ridges present on the posterior region (Figs 10A, 11A) for *L. vadosus* sp.n.).

TYPE LOCALITY. Andamans [Alcock, 1900: 307].
DISTRIBUTION. Maldives (NHM 1991.156.1); Andamans [Alcock, 1900: 307].

Libystes vadosus sp.n.
Figs 10–13.

Libystes nitidus Nobili, 1906: 297 (?); Laurie, 1915: 463; Serène, 1966 (partim) figs 3, 4; Crosnier, 1962: 14 (partim, Djibouti); Guinot, 1967: 253 (partim, Djibouti).

Libystes aff. *nitidus* Apel, Spiridonov, 1998: 176 (partim) NHM 1934.1.17.114; Apel, 2001: 73 (partim).

Nec *Libystes* aff. *nitidus* Apel, Spiridonov, 1998: 176 (partim) ZMUC CRU-3267 = undescribed species (see Spiridonov *et al.*, 2021).

Nec *Libystes* aff. *nitidus* Apel, Spiridonov, 1998: 176 (partim) NHM 1991.156.1 = *L. alphonsi* Alcock, 1900.

Nec *Libystes nitidus* A. Milne-Edwards, 1867.

MATERIAL EXAMINED. Holotype: ♂, 12.5×7.5 mm, stn VI, Mersa Ar-rakiya, Sudan, Red Sea, 20°15'N, coll. W.A. Crossland, 1905, NHM 1934.1.17.114.

Paratypes: 1♀ 9.5×6.0 mm, Thuwal, King Abdullah University of Science and Technology, south beach, Saudi Arabia, Red Sea, 22.29213, 39.09000, silty sand flat, coll. A. Anker, J. Moore & P. Norby, March 2013, UF37082; 1♀ 8.9×5.6 mm, (same data as UF37082), UF37083.

Non types: 1♂, 7.3×4.2 mm, Mbouanasta, Mayotte Island, Comoros Islands, 12.947371, 45.099797, 1 m, reef flat, under rocks in sand/silt, coll. A. Anker & F. Michonneau, 29.05.2008, UF13560; 1♀, 13.8×8.2 mm, Comoros Islands, MNHN B5729; Nosy Be, E of Hellville, at CNRO complex, Madagascar, 13.4069, 48.2917, 0 m, intertidal mud to silty sand flat with some rocks, coll. A. Anker & Roberto, 19.05.2008, UF14507; La Saline, Trou d'eau, Reunion Island, Mascarene Islands, 21.1008, 55.2437, coll. N. Hubert & F. Michonneau, 27.07.2007, UF12587.

Other material examined for comparison: *Libystes* sp. [Spiridonov *et al.*, 2021], 1♂, DSII-Stn. 25 A, 63 nm SW of Bushehr, Iran, 49 m, 14 March 1937, coll. G. Thorson, det. Stephensen, ZMUC CRU-3267 (see remarks for *L. vadosus* sp.n.).

DIAGNOSIS. Carapace about 1.7 times as broad as long, oval, dorsally and laterally convex, dorsally smooth, without anterolateral angular prominences; with pair of short granular ridges located nearly perpendicular to poorly developed posterolateral re-entrants. Front straight, without any median notch, about 30% of maximum carapace breadth. Chelipeds smooth, nearly symmetrical. Merus 2.8 times longer than broad, without spines. Chelae long, more than half of chelipeds length in male, slightly swollen, without spines, homoiodontic. Dactylus of pereopod 5 broader than dactyli of pereopods 2–4, aciniform, with fringe of long sparse setae. Male pleon subtriangular, smooth, pleomeres 3–5 fused, suture present between pleomeres 4 and 5. G1 robust, elongated, directed towards sixth thoracic sternite but not touching each other; proximal part tubular, laterally convex, neck broadening towards tip; tip about as broad as proximal part, opening relatively narrow, tubular, directed anterolaterally, closed on sternal face and semi-opened on pleonal face; row of numerous spines increasing in size along mesial face and on lateral portion of sternal face, merging to spinules and spines, occupying lateral third of pleonal face; patch of small spinules beneath opening on lateral margin of pleonal face continuing as row along opening on sterna face; sparse thin spinules beneath tip along slit and mesial margin.

DESCRIPTION. (Based on holotype). Carapace 1.7 times as broad as long, oval, dorsally and laterally convex, with short sparse pile in anterior part, and laterally along posterior margin, otherwise smooth, without distinct regions, dorsal surface with pair of short granular ridges located nearly

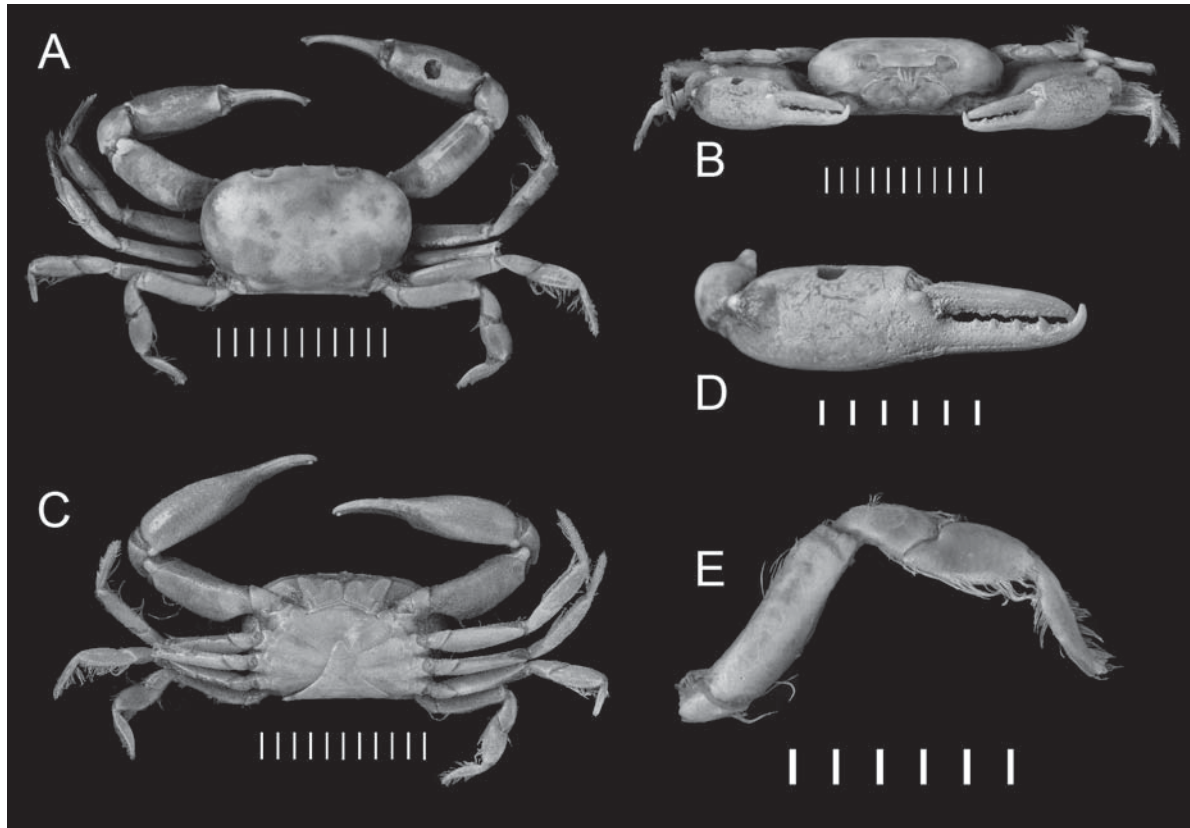


Fig. 10. *Libystes vadousus* sp.n., holotype, ♂, Red Sea, Sudan, NHM 1934.1.17.114, 12.5×7.5 mm; A — dorsal view; B — frontal view; C — ventral view; D — frontal view of the right chela; E — left 4th pereiopod, dorsal view. Scale bars in mm. Taken by Kevin Webb, NHM Photo Unit.

Рис. 10. *Libystes vadousus* sp.n., голотип, ♂, Красное море, Судан, NHM 1934.1.17.114, 12,5×7,5 мм; А — вид сверху; В — вид спереди; С — вид снизу; D — вид правой клешни спереди; Е — левый 4-й переопод, вид сверху. Масштаб в мм. Снимок сделан Кевином Уэббом, фотоблоком NHM.

perpendicular to poorly developed posterolateral re-entrants (Fig. 9A). Front entire, straight, smoothly deflected, partly covering antennular fossae, without median notch (Fig. 9A, B), about 40% of maximum carapace breadth. Orbits quasi-elliptoidal, comprising about as half as frontal breadth. Frontorbital margin comprises about 53% of maximum carapace breadth.

Anterolateral margins convex, without angular prominences. Posterior margin as broad as carapace length (Fig. 10A), comprising 58% of maximum carapace breadth. Carapace height to breadth ratio equals 0.4. Subhepatic regions convex, granular. Suture between subhepatic and pterygostomial regions well expressed, running to posterolateral margin, dense rows of fine granules on its both sides. Pterygostomial region granular, relatively convex, pilose, with particularly long pile in laterally (Fig. 10B).

Thoracic sternum broad, smooth, slightly concave, sternal sutures 2/3, 3/4 not expressed. Sternites 5 to 8 smooth, sternal sutures 4/5, 5/6, 6/7, 7/8 well expressed for most sternite breadth, except relatively broad median cavity. Sternal sulci absent. Sternite 5 with locking button on anteromesial part fitting to a socket on underside of 6th pleomere; sternite 8 exposed posteriorly, only small lateral portion visible from ventral view, anterior half of lateral part occupied by penial furrow with anterior wall at sternite margin; penis reaching to about 60% of sternite width; sutures be-

tween sternites and episternites practically fused; end of posterior episternite nearly touches lateral margin of third pleomere.

Eye robust, subconical, filling entire orbits, base of cornea not narrowed (Fig. 10A, B). Antennular fossae pear-shaped, most extended mesially, somewhat constricted laterally, basal antennular segment with distinct transverse rib on mid-part of ventral surface. Antennular flagellum relatively robust, folded transversely, extending to lateral margin of orbit when unfolded. Basal antennular article with small distolateral extension, longer than broad, standing in orbital hiatus; second article slightly shorter than basal segment, cylindrical, flagellum thin.

Epistome posterior margin medially with narrow, long, bilobed projection. First maxilliped with a well-developed movable setose mesial lobe, located parallel to mesial margin of endognath. Third maxillipeds tightly cover buccal cavern, except for V-shaped median hiatus and space between distal margin of merus and lateral part of posterior margin of epistome; ischium broader than long; merus about as long as ischium, distolateral corner round, expanded, distal margin almost straight (Fig. 10B).

Chelipeds about 1.65–1.7 times longer than other pereiopods, smooth, nearly subequal, right cheliped little longer than left one. Merus 2.8 times longer than broad, quasi-cylindrical, without spines, granulation on entire anterior

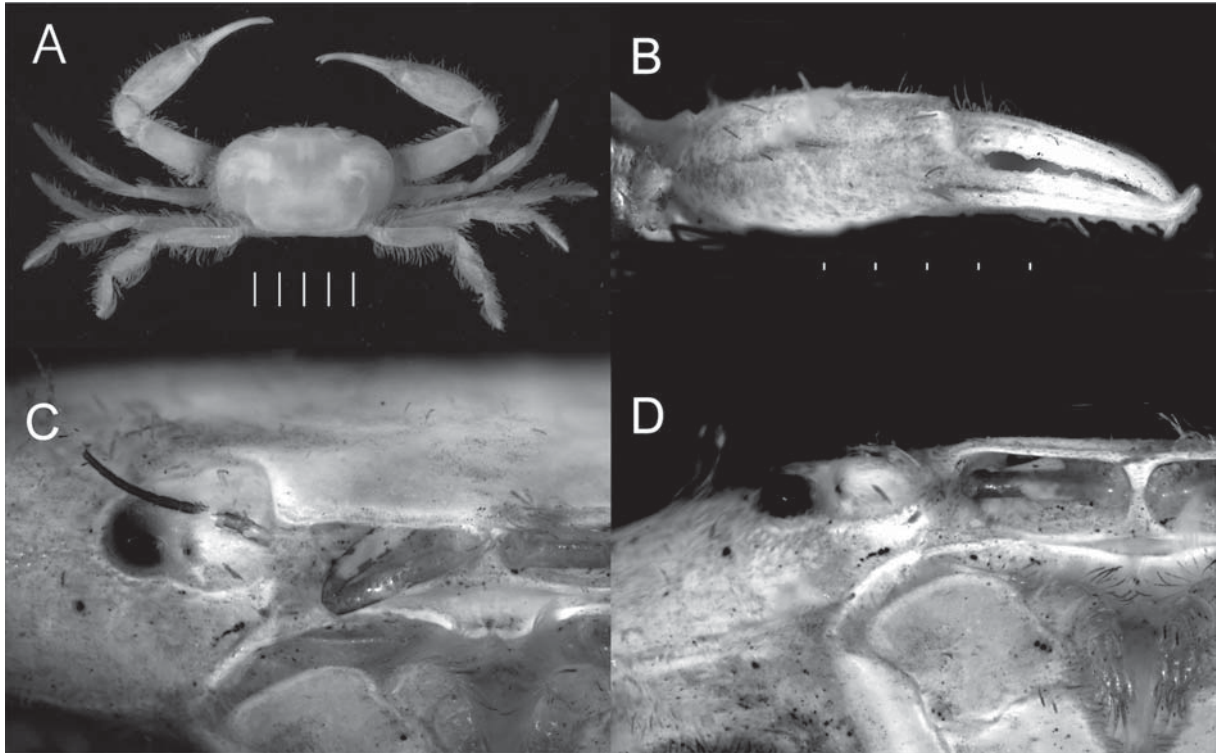
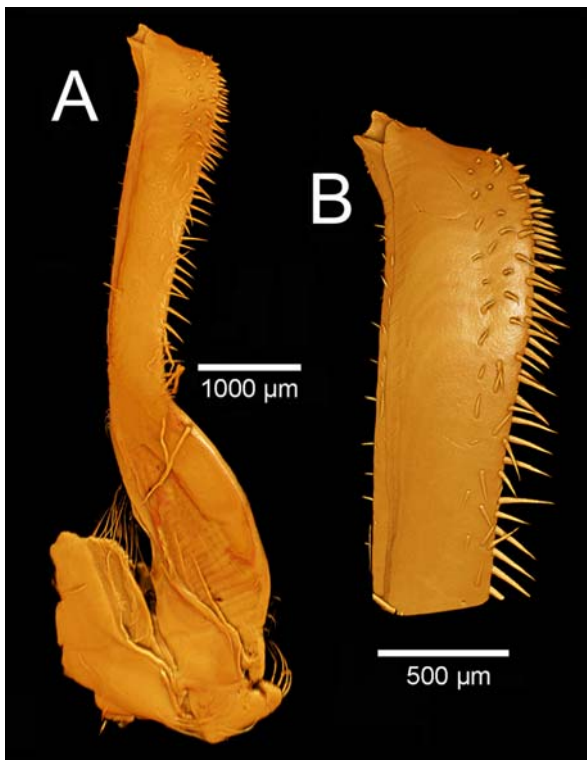


Fig. 11. *Libystes vadosus* sp.n., ♂, Mayotte Island, Comoros Islands, UF13560, 7.3×4.2 mm; A — whole, dorsal view; B — right chela, outer view; C — right side of cephalothorax, anterior view; D — right side of cephalothorax, anteroventral view. Scale bars in mm.

Рис. 11. *Libystes vadosus* sp.n., ♂, остров Майотта, Коморские острова, UF13560, 7,3×4,2 мм; А — общий вид сверху; В — правая хела, внешний вид; С — правая сторона цефалоторакса, вид спереди; D — правая сторона цефалоторакса, антеровентральный вид. Масштаб в мм.



margin. Carpus without spines, obtuse angular prominence at place of usual anterointernal spine, outer surface convex (Fig. 10A, B). Chelae long, about 57% of chelipeds length, homoiodontic. Manus slightly swollen but not much broader than rest of cheliped, height to thickness ratio 1.2, without spines. Fingers slender, elongate, slightly longer than manus, strongly over-crossed apically when closed; cutting edge of movable finger with five sparsely set, low, moderately sharp conical teeth, interspacing with 5 longer and narrower teeth on cutting edge of immovable finger. Pre-distal tooth longest and spiniform. Space between main teeth beset with small papilliform granules (Fig. 10B, D).

Pereopods 2–4 slender, of similar length, generally smooth but emarginated by setae at anterior and posterior margins; ischium short; merus longest, about 3 times as long as broad; carpus about 2.7 times as long as broad, widening distally; propodus about 3 times as long as broad, without distinct grooves and costae, emarginated by dense, long hairs; dactylus grooved, ensiform, setosed, nearly as long as and 2 times less broad than propodus, emarginated by dense setae (Fig. 10A–C). Pereopods 5 articulates to hold super-

Fig. 12. *Libystes vadosus* sp.n. holotype, ♂, stn VI, Sudan, Red Sea, NHM 1934.1.17.114, confocal laser scanning microscope image of G1; A — whole; B — distal tip.

Рис. 12. *Libystes vadosus* sp.n., голотип, ♂, ст. VI, Судан, Красное море, NHM 1934.1.17.114, изображение G1 в конфокальном лазерном сканирующем микроскопе; А — общий виде; В — дистальный кончик.

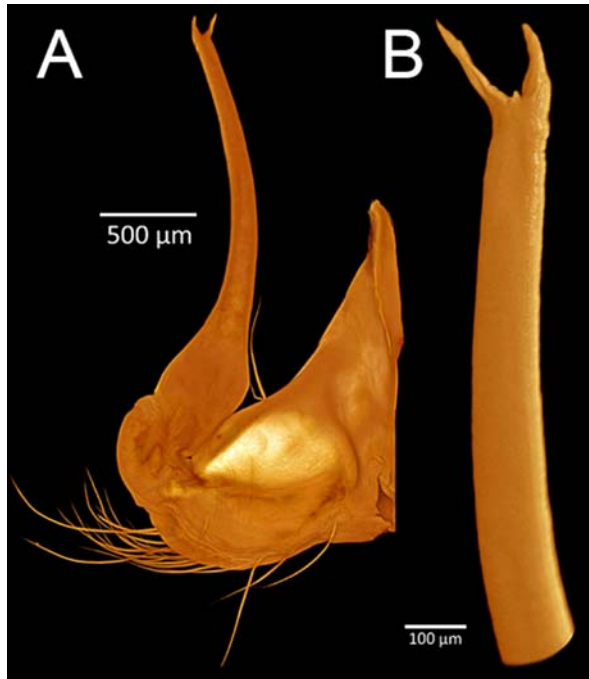


Fig. 13. *Libystes vadosus* sp.n. holotype, ♂, stn VI, Sudan, Red Sea, NHM 1934.1.17.114, confocal laser scanning microscope image of G2; A — whole; B — distal tip.

Рис. 13. *Libystes vadosus* sp.n., голотип, ♂, ст. VI, Судан, Красное море, NHM 1934.1.17.114, изображение G2 в конфокальном лазерном сканирующем микроскопе; А — общий вид; В — дистальный кончик.

dorsal position, slightly shorter than pereopods 2–4, articles from ischium to propodus similar to those of anterior pereopods; dactylus broader than dactyli of pereopods 2–4, ensiform, with fringe of long sparse setae (Fig. 10A, E).

Male pleon subtriangular, smooth, pleomeres 3–5 fused, suture present between pleomeres 4 and 5 (Fig. 10C).

G1 robust, elongated, directed towards sixth thoracic sternites but not touching each other; basal lobe small, with 5 long setae; proximal part of shaft tubular, laterally convex; neck broadening towards tip (Fig. 12A); tip about as broad as proximal part, opening relatively narrow, tubular, directed antero-laterally, closed on sternal face and semi-opened on pleonal face; row of numerous spines increasing in size and becoming less densely set proximally along mesial face; this row extends to lateral portion of sternal face and merges to band of spinules and spines, occupying lateral third of pleonal face, spinules relatively small and densely set at tip, being larger and sparsely set proximally; patch of small spinules beneath opening on lateral margin of pleonal face continuing as row along opening on sterna face; sparse thin spinules beneath tip along slit and mesial margin (Fig. 12B). G2 less than half length of gonopod 1, tubular, terminally furcate, without spinules, mesial process about 1.3 times longer than lateral, acuminated (Fig. 13).

FEMALE CHARACTERISTICS. Chelipeds slightly smaller than male, left and right chelae subequal. Female pleon subtriangular, pleomeres 5 and 6 fused, pleomeres 5 and 6 each longer than other pleomeres. Vulva horizontally long prolate spheroid, occupying longitudinally more than three-quarters of thoracic sternite 6.

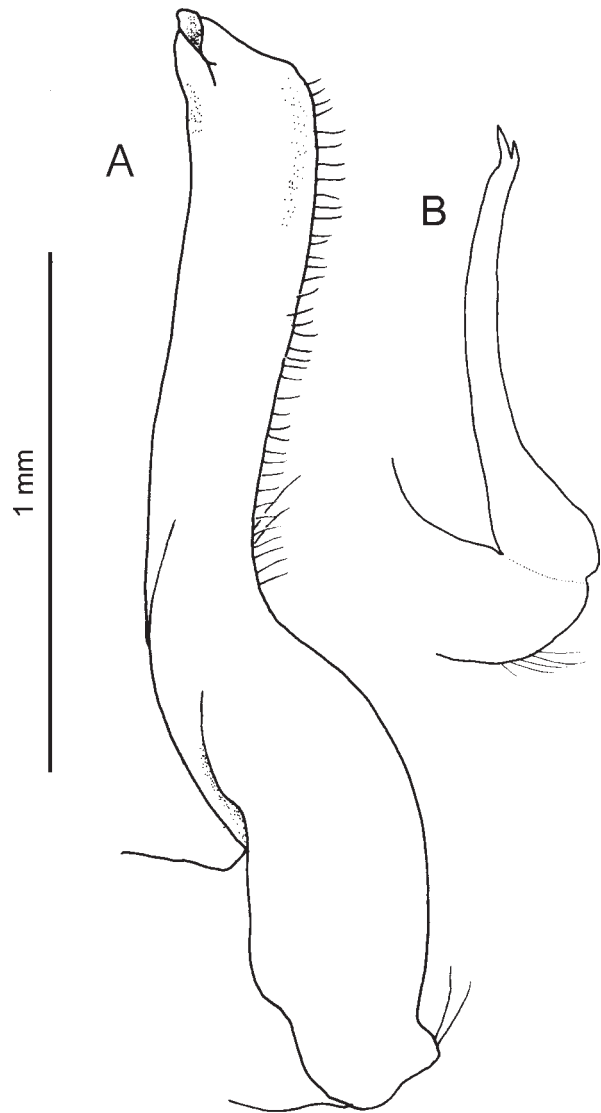


Fig. 14. *Libystes vadosus* sp.n. ♂, Mayotte Island, Comoros Islands, UF13560, 7.3×4.2 mm; A — left G1, ventral view; B — left G2, ventral view.

Рис. 14. *Libystes vadosus* sp.n., ♂, остров Майотта, Коморские острова, UF13560, 7.3×4.2 мм; А — левый G1, вид снизу; В — левый G2, вид снизу.

SIZE. Holotype measures 12.5×7.5 mm. Laurie [1915] reported size of other specimens of *Libystes* which likely belonged to *Libystes vadosus* sp.n. Males: 6.0×4.0–13.00×7.75; females 8.5×5.75–12.0×7.75.

REMARKS. Serène [1966] examined several specimens that he identified as *L. nitidus*, but did not present any data on the illustrated specimens and their provenance. Details of his illustration however, indicate that Serène [1966] might have examined the present specimen collected by Crossland from Sudan although this cannot be confirmed. He considered that the variation observed in gonopod morphology was related to age/size [Serène, 1966: figs. 1–4] (Fig. 2B, C) vs. [Serène, 1966: figs 5–6] (Fig. 5D). In the opinion of Apel & Spiridonov [1998: 178], and the present study, this viewpoint is not tenable since the differences between the

two Serène [1966] forms are too fundamental to be age-dependent. The specimens with the robust gonopod illustrated by him [Serène, 1966: figs 1–4] (Fig. 2B, C) shows great similarity to the G1 morphology to *L. aff. nitidus* from the Red Sea *Libystes* (sensu Apel & Spiridonov, 1998: fig. 6d, e] (NHM 1934.1.17.11; Fig. 2D) and the Iranian male ZMUC CRU-3267 identified by Stephensen [1946: fig. 45D] (Fig. 2A) as *L. nitidus*. The Sudanese, Red Sea specimen, NHM 1934.1.17.11, is here considered to be an undescribed species and name *L. vadosus* sp.n.

What Apel & Spiridonov [1998: 176–177, fig. 6a–e] refer to an unresolved species complex named *L. aff. nitidus* comprised a Sudanese, Red Sea male, NHM 1934.1.17.11 (now *L. vadosus* sp.n. and the male from Iranian (Persian) Gulf, ZMUC CRU-3267. *Libystes vadosus* sp.n. shares with the Iranian male ZMUC CRU-3267 a broad carapace, a straight frontal margin, posterolateral granular carapace ridges, the morphology of last pereopod, and a general robust morphology of the G1. It differs however, from the Iranian male ZMUC CRU-3267 by rounded, without prominences anterolateral margins (Fig. 10A) (vs. anterolateral margins with three prominences as illustrated by Apel & Spiridonov [1998: fig. 6a]; ZMUC CRU-3267), practically homoiochellic chelipeds (Fig. 10B) (vs. slightly heterochelic chelipeds as described by Apel & Spiridonov [1998: 176]; ZMUC CRU-3267), by the presence of indistinct sutures on the fused male pleonal terga 3–5 (Fig. 10C) (vs. male pleonal terga 3–5 fused without any traces of borders between sutures visible as described by Apel & Spiridonov [1998: 176]; ZMUC CRU-3267), G1 is relatively elongated (Fig. 12A) (vs. stout, with a longer neck as illustrated by Stephensen [1946: 168, fig. 45D] (Fig. 2A) and Apel & Spiridonov [1998: 176, fig. 6d, e] (Fig. 2D); ZMUC CRU-3267), entire lateral face of G1 bears spinules (Fig. 12) (vs. only ca. 4/5 of the lateral face of G1 covered by spinules as illustrated by Stephensen [1946: 168, fig. 45D] (Fig. 2A) and Apel & Spiridonov [1998: 176, fig. 6d, e] (Fig. 2D); ZMUC CRU-3267), the G1 spinules themselves are relatively shorter (Fig. 12) (vs. G1 spinules are longer as illustrated by Stephensen [1946: 168, fig. 45D] (Fig. 2A) and Apel & Spiridonov [1998: 176, fig. 6d, e] (Fig. 2D); ZMUC CRU-3267), G1 possesses a distinct series of short spinules along the mesial face of the gonopod neck (Fig. 12) (vs. short mesial spinules absent on G1 as illustrated by Stephensen [1946: 168, fig. 45D] (Fig. 2A) and Apel & Spiridonov [1998: 176, fig. 6d, e] (Fig. 2D); ZMUC CRU-3267), and the apical G1 opening is spout-like and exposed anterolaterally (Fig. 12) (vs. the apical G1 is more broadly open and exposed anteriorly as illustrated by Stephensen [1946: 168, fig. 45D] (Fig. 2A) and Apel & Spiridonov [1998: 176, fig. 6d, e] (Fig. 2D); ZMUC CRU-3267). The present study suggests that the Iranian male specimen ZMUC CRU-3267 and related material are re-examined for evidence of yet another undescribed Western Indian Ocean species (see Spiridonov *et al.*, 2021).

From *L. nitidus* sensu Crosnier [1962], *L. vadosus* sp.n. the G1 morphology is totally different being relatively short, straight and robust (Fig. 12) (vs. long, slender and sinuous and illustrated by Crosnier [1962: fig. 252] (Fig. 5A); Serène [1966: figs 5, 6] (Fig. 5B) and the present study (Fig. 5B) for *L. nitidus*), is a small species with a width to length carapace ratio of 1.64 (vs. 1.7 for the female holotype of *L. nitidus* is which is much larger species) and short posterior ridges at posterolateral carapace re-entrants (vs. short posterior ridges not mentioned in the description nor illustrated

for the type specimen by A. Milne-Edwards [1867, 1868: pl. 20, fig. 5] for *L. nitidus*).

ETYMOLOGY. “*vadosus*” is a Latin adjective meaning “shallow water”.

ECOLOGY. According to Crossland [1907] most of the material of his expedition collected in the Sudanese Red Sea was obtained by divers and by trawling on coral mud. One of the *Libystes* specimens was collected at depth about 1 fathom (less or about 2 m) among corals [Laurie, 1915].

TYPE LOCALITY. Mersa Ar-rakiya, Sudan, Red Sea, 20°15' N [Crossland, 1907; Laurie, 1915: 463].

DISTRIBUTION. Sudan and Saudi Arabia, Red Sea [Laurie, 1915: 463; present study]; Djibouti [Nobili, 1906: 297; Barnard, 1955: 100; Crosnier, 1962: 14; Guinot, 1967: 253]; Mayotte Island, Comoros Islands; Nosy Be, Madagascar; Reunion Island, Mascarene Islands.

Discussion

In summary this present study has reconsidered the taxonomy *L. nitidus* and *L. alphonisi* from the Western Indian Ocean. *Libystes nitidus* A. Milne-Edwards 1867 is redescribed and currently restricts its distribution to Zanzibar and Toliary (Tuléar), Madagascar only. *Libystes alphonisi* Alcock, 1900 is reinstated as a valid species; its morphology is redescribed, confocal laser scans of both male gonopods presented and its distribution is reported from the Maldives and Andaman Islands. From the *Libystes aff. nitidus* species complex of Apel & Spiridonov [1998], a new species, *L. vadosus* sp.n., is described from the Red Sea to also include confocal laser scans of both male gonopods. *L. vadosus* sp.n. is also recorded from Mbouanasta, Mayotte Island; Comoros Islands; Nosy Bé, East of Hellville, Madagascar and La Saline, Trou d'eau, Reunion Island, Mascarene Islands. Although this study has not resolved all the issues with Western Indian Ocean *Libystes* taxonomy, the authors of the present work consider they have made a significant contribution by defining *L. nitidus* and *L. alphonisi*, questioning the status of material from the Persian Gulf and describing *L. vadosus* sp.n. from the Red Sea.

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