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Record of Deep-Sea Shrimp of *Pasiphaea sivado* Species Group (Decapoda:Caridea:Pasiphaeidae) in the Western Indian Ocean Collected by R/V Anton Bruun (IIOE Cruise)

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Abstract: This paper deals with a deep sea pelagic shrimp species of the genus *Pasiphaea* in *Pasiphaea sivado* species group which was collected by the vessel Anton Bruun (IIOE cruise) in the northwestern waters of the Indian Ocean from Cruise 4A station 185 20°39'N, 64°41'E, night 3173, dated 30, October 1963. No specimen of *Pasiphaea sivado* group has been reported from the given coordinates of the Indian Ocean. The present record would seem to be the first record of *P. sivado* from these coordinates and therefore constitutes new data on the biogeographical distribution of *Pasiphaea sivado* species group. As already documented that the deep sea is the largest biome on earth and hosts the majority of as yet undescribed or not correctly reported species. This specimen might turn out a new species yet to be discovered. Careful examination of more material collected in the northwestern Indian Ocean could result in the recognition of taxonomically cryptic species, as in the case of the pelagic shrimp *Pasiphaea sivado*. This specimen is illustrated and its comparative descriptive information, taxonomic comments and horizontal distribution is given. The introduction includes a summary of work done by other scholars on the zooplankton species, based on information obtained from the samples collected by Anton Bruun in the Indian Ocean. A large number of papers relating to synthesis of zooplankton of IIOE in Indian ocean region have appeared since IIOE was originally envisioned, one of the first multi-national ocean research projects.

Keywords: *Pasiphaea sivado*, Vessel Anton Bruun (IIOE Cruise), Northwestern Waters of the Indian Ocean, Description

1. Introduction

From 1959 to 1965 nine countries participated in a cooperative scientific investigation of the Indian Ocean. They were Australia, India, Japan, Pakistan, South Africa, the United Kingdom, the United States, the USSR, and West Germany. This investigation, known as the International Indian Ocean Expedition (acronym IIOE), carried out many projects, one of which was a survey of the zooplankton of the upper 200 m. The International Indian Ocean Expedition (IIOE) of 1960-1965 was arguably the first attempt to describe the quantitative geographic distribution and abundance of zooplankton as a multinational program in which 19 ships from nine countries participated. The expedition began on April, 1960 and came to an end in April, 1965. These Zooplankton samples collected during International Indian Ocean Expedition 1960-65 were by far the largest and the most important collections from the Indian Ocean in the world. Ships collected 1548 plankton samples using the Indian Ocean Standard Net (IOS) [11]. Plankton samples collected over this period during nine cruises, in the northern and western Indian Ocean. Most of the samples were collected in uniform numbers with stations, using the Indian Ocean Standard net. The net was towed vertically at a depth of 200 m to the surface. During the International Indian Ocean Expedition one of its ships, the R/V Anton Bruun, undertook nine cruises in the northern and western Indian Ocean.

The staff of the Indian Ocean Biological Centre (IOBC) at Cochin, now Kochi, India, sorted a large collection of

Sergestids which was loaned to and studied at the Marine Reference Collection and Resource Centre, University of Karachi, Pakistan. The findings were first presented as PhD dissertation [70], then covered by [29, 30, 71, 72, 73] on these sergestids.

Other published reports covering pelagic fauna collected by Anton Bruun during 1960-1965 survey are –on caridean shrimps (reports on Pasiphaeide not included) [5, 6, 10]; on other decapods [2, 10, 11, 30, 34, 35, 38, 67, 68]; on amphipods [4, 17]; on pelagic and benthic cumaceans [51]; on copepod distribution [14, 16, 28, 45, 56, 64]; on holoplanktonic heteropod mollusks [1]; on cephalopods [27, 47]; on pelagic polychaetes [13]; on chaetognaths [44]; on cnidarians [41]; on pelagic fish, snakes and shrimps [50]; on fish *Psednos carolinae* [63]; on shark *Paragaleus randalli* [9] (see references).

As mentioned earlier the International Indian Ocean Expedition obtained a large collection of samples of sergestids, were studied at the Marine Reference Collection and Resource Centre, University of Karachi. While returning the collection of sergestids to the Smithsonian Institution, Washington a single unreported pasipheid specimen belonging to the genus *Pasiphaea* was noticed in one sample. Careful examination revealed that this species was near to *Pasiphaea sivado* [53], which has not been reported from the given coordinates. Identification was not satisfactorily determined. The same is being reported here.

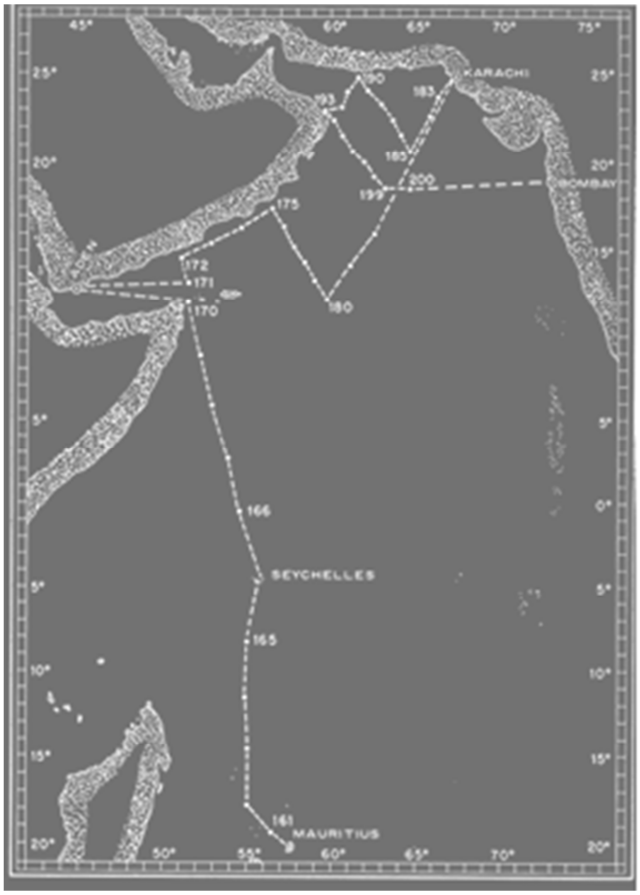

Figure 1. *Cruise track, R/V ANTON BRUUN, Cruise 4A.*

2. Material

One specimen probably female (individual was not sexed before sending it back by checking the presence/absence of appendix masculina on the endopod of the second pleopod, as is usual in caridean shrimps. But it looks a female as all five pleopod protopods are thinner and elongated [59].

Cruise Anton Bruun 4A station 185 20°39'N, 64°41'E, night 3173, dated 30, October, 1963.

3. Results

Pasiphaea sivado species group

Synonyms

Alpheus sivado [53].

Pasiphaea brevirostris [43].

Pasiphaea distincta [18].

Pasiphaea sivado [7, 11, 15, 24, 25, 46, 49, 52, 57, 58, 60, 61, 62, 70, 79, 80].

Pasiphaea neapolitana [25]. Pasiphaea savignyi [43].

Not Pasiphaea sivado [53]. [29].

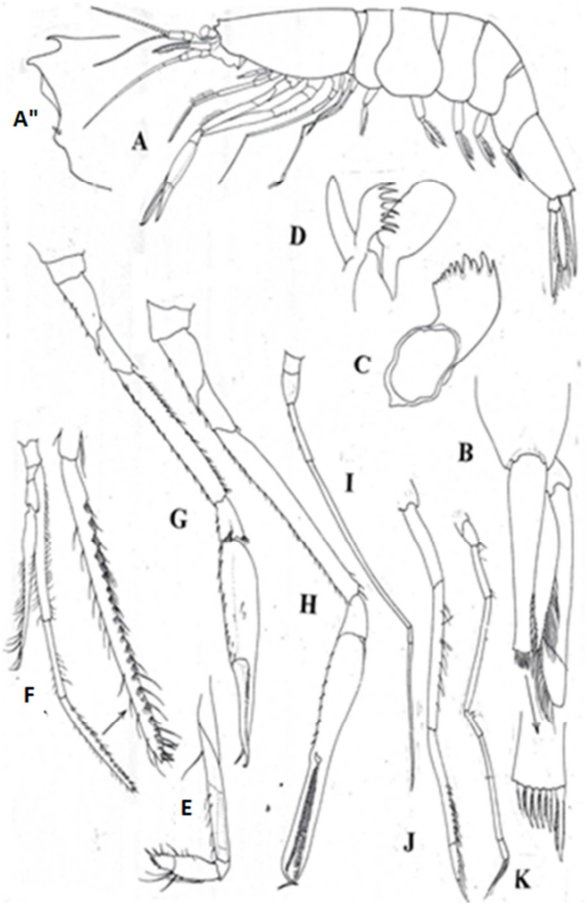

Figure 2. *Pasiphaea sivado A. entire; A". rostrum and front; B. telson and right uropod; C. maxillula; D. mandible; E. second maxilliped; F. third maxilliped; G. first leg; H. second leg; I. third leg; J. fourth leg; K. fifth leg.*

Description: Carapace with prominent branchiostegal spine (figure 2A). Rostrum short, triangular and upturned with pointed apex; arising behind anterior margin of carapace (figure 2A). Only sixth abdominal segment with poster dorsal

spine. Stylocerite twisted, acutely pointed with spine at apex. Outer margin of scaphocerite slightly convex, apical spine stout, exceeding lamellar portion. Mandible (figure 2C) without palp or molar process, but with incisor process. Maxillula (figure 2D) large; proximal endite small, obliquely truncate distally with one or few short simple setae (broken in present specimen); distal endite with 7 acute teeth; endopod oblong, with stout simple seta (missing here) on mesial margin near distal end. Second maxilliped (figure 2E) simple, pediform; epipod and exopod absent. Third maxilliped (figure 2F) about 1.25 x length of scaphocerite; exopod present. All pereiopods (figure 2G-J) with well-developed exopods (missing here), but no epipods. Pereiopods 1 and 2 with slender chelae, cutting edges pectinate. Pereiopods 1-5 with exopods. Basis of pereiopod 2 with single spine; merus denticulate, with 19-22 spines, occasionally less. Pleonites without dorsal carina; pleonite 6 with posterior directed spine on posterior dorsal border. Telson (figure 2B) slightly convex at apex, with eight terminal spines outer pair longest (left one missing in the present specimen); inner pairs shorter than outer, abruptly decreasing in size. Uropod elongate; exopod much longer than endopod. (Modified from 19).

Horizontal distribution

Eastern Atlantic and the Mediterranean: from Scotland and Norway, south to Canary Islands and east to Turkey, Morocco, eastern Mediterranean, Japan. Also reported from the Red Sea and Bay of Bengal, India, but these records are probably based on other species**.**

4. Discussion

The family Pasiphaeidae has a worldwide distribution, includes about 100 species, distributed in seven genera, of which *Pasiphaea* is the most species-rich genus represented by 72 species [54]. This family is one of the systematically controversial families in Caridea. Thus, in the genus *Pasiphaea*, the identification of species is sometimes a hard task, because several species still await rediscovery or redescription**.** Even the molecular phylogeny of Pasiphaeidae reveals systematic incongruence of the current classification and suggests the classification within the family to be urgently revised [40].

Three informal species groups were recognized in the genus, viz., the *P. sivado* [53] group [18], the *P. cristata* [3] group [20] and the *P. alcocki* [74] group [21] based on the posterior margin of the telson, spinulation pattern of the first pereiopod and the number of pleurobranchs on the eighth thoracic somite. However, these three informal species groups do not cover all the species in the genus. The *P. sivado* group is characterized by the possession of a sharp poster dorsal tooth on the sixth pleonite, the truncate posterior margin of the telson, the presence of two or more spines on the ventral margin of the first pereiopod, and the pleurobranch on the eighth thoracic somite reduced or absent [37]. In the *Pasiphaea sivado* group [21] the carapace is usually not carinate dorsally, the abdominal somites 1–5 are not carinate dorsally [54]. *P. sivado* is the best known and the representative species of the genus as well as this species group. [21, 22].

The present specimen collected at 20°39'N, 64°41'E in the Indian Ocean is close to species *P. sivado*, sharing the following characters: rostrum triangular with pointed apex, arising behind frontal margin of carapace; sixth pleonite armed with poster dorsal median tooth; posterior margin of telson truncate, armed with four pairs of spines differing in having inner pairs though shorter than outer, but not gradually decreasing in size. It matches with *Pasiphaea japonica* [48], *Pasiphaea arabica* [69] and *Pasiphaea exilimanus* [37], in the absence of pair of terminal spinules on the telson end. The dorsal margin of the sixth abdominal somite is produced as a "pointed end", not as a true spine like *P. trúncata* [55] and *P. longitaenia* [36]. *Pasiphea orientalis* [57] exhibits strong affinity to species of the *P. sivado* group though [22] did not include it in that group) by [37] sharing the following characters: rostrum triangular with pointed apex, arising behind frontal margin of carapace; sixth pleon armed with poster dorsal median tooth; posterior margin of telson truncate, armed with four pairs of spines..

We have based our identification on rostral shape (although the rostrum is said to be rather variable in shape depending on growth, or presence or absence of ellobiopsid parasites [19]. Several *Pasiphaea* species have been recorded from the Western Indian Ocean [7, 23]. Mistakenly given from Pakistan as *P. sivado* [29], actually it was *P. alcocki* which was recorded from Sindh [74], now included in Pakistan coast.

5. Conclusion

The present specimen fits in the group of *Pasiphaea* which do not have v-shape notch in the middle of telson. It is documented that the only *Pasiphae*a that has no v-notch in the tip of the telson is *P. sivado* as given in the figure by [33]. More material is required from these coordinates to establish the species identification.

Anyhow the present record of the *P. sivado* group does not fall within the geographical range given in the literature for this species group. It is a new record or may turn out a species of *Pasiphaea* new to science.

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References

[1] Aravindakshan, P. N (1972). Preliminary report on the geographical distribution of the species of Carinariidae and Pterotracheidae (Heteropoda, Mollusca) from the International Indian Ocean Expedition. International Indian Ocean Expedition. Collected reprints VIII Published upon the recommendation of the Scientific Committee on Oceanic Research (SCOR) and the Intergovernmental Océanographie Commission (IOC). UNESCO, Paris: 67-77.

[2] Baba, K. N. M. Tirmizi (1979) A NEW CHIROSTYLID (CRUSTACEA, DECAPODA, ANOMURA) FROM DEEPER PARTS OF THE JAPANESE WATERS AND OFF THE EAST COAST OF AFRICA. Proceedings of the Japanese Society of Systematic Zoology No. 17: 52-57.

[3] Bate, C S. (1888). Report on the Crustacea Macrura collected by the Challenger during the years 1873-76. *Report on the Scientific Results of the Voyage of H. M. S. Challenger During the Years 1873–76. Zoology*. 24 (part 52): i-xc, 1-942, pl. 1-150.

[4] Bowman, T E and McGuinness, M M (1982. Epipelagic amphipods of the family Hyperiidae from the International Indian Ocean Expedition, 1959-1965. Smithsonian contributions to zoology; no. 359: 1-64.

[5] Bruce AJ (1967). Notes on some Indo-Pacific Pontoniinae III-IX. Descriptions of some new genera and species from the western Indian Ocean and the South China Sea. Zoologische Verhandelingen 87: 1-73.

[6] Bruce A J (1971). Pontoniinid shrimps from the Ninth Cruise of the R/V Anton Bruun, IIOE, 1964: 1. Palaemonella Dana and Periclimenes Costa. Smithsonian. Contribution to Zoology, 82: 1-3.

[7] Burukovsky RN (1993). Shrimps of genus Pasiphaea (Crustacea, Decapoda, Pasiphaeidae) from the western part of the Indian Ocean. Byull Moskovsk Obsch Ispyt Prir Otdel Biol 98 (2):.33–40 (in Russian).

[8] Carus J. V. (1885). Prodromus Faunae Mediterraneae sive descriptio animalium maris mediterranei incolarum quam comparata silva rerum quatenus innotuit adiectis locis et nominibus vulgaribus eorunque auctoribus in commodum zoologorum. I. Coelenterata, Echinodermata, Vermes, Arthropoda. Stuttgart, E. Schweizerbart'sche Verlagsh, vol. 1: 1-525.

[9] Compagno, L JV. Compagno, F. Krupp and K. E. Carpenter (1996). A New Weasel Shark of the Genus Paragaleus from the Northwestern Indian Ocean and the Arabian Gulf Carcharhiniformes: Hemigaleidae. FAUNA OF SAUDI ARABIA 15: 391-401.

[10] Crosnier A (1988). Les Eupasiphae (Crustacea Decapoda Pasiphaeidae) du sud-ouest de l'océan Indien. Description d'E. paucidentata sp. nov. Bulletin du Muséum National d'Histoire Naturelle, Paris, 4e sér., 10, 1988, section A, n° 4: 785-797.

[11] Crosnier A, and J. Forest (1973) Les crevettes profondes de l'Atlantique Oriental Tropical. Faune Tropicale 19: 1-409.

[12] Currie RI (1963). The Indian Ocean Standard Net. *Deep-Sea Research* 10: 27-32.

[13] Dales R and G Peter (1972). A synopsis of pelagic Polychaeta. Journal Natural History., 6: 55-92.

[14] Fleminger A and K Hulsemann (1973) Relationship of Indian Ocean epiplanktonic calanoids to the World Ocean. In B. Zeitzschel (ed.). Ecological study and Analysis. and synthesis. 3. Springer-Verlag. Berlin. p. 339-347.

[15] Forest J., (1966). Campagnes du <> aux Baléares: juin 1953 et août 1954. Crustacés Décapodes. Vie et Milieu, série B, océanographie, 16 (1) 1965 (1966): 325-413.

[16] Gopalakrishnan TC, Balachandran T (1992). North-south diversity of Scolecithricidae species. Copepoda: Calanoida in the Indian Ocean. In: Desai BN (Ed), Oceanography of the Indian Ocean, p. 167-175.

[17] Guerra-Garcia J M (2002). Two new species of Deutella Mayer, 1890 (Crustacea: Amphipoda: Pariambidae) collected by the R. V. 'Anton Bruun' during the International Indian Ocean Expedition 1963-1964. Zootaxa. 74: 1-18.

[18] Guérin-Méneville, FE. (1829-1844). *Iconographie du Règne Animal de G. Cuvier, ou représentation d'après nature de l'une des espèces les plus remarquables, et souvent non encore figurées, de chaque genre d'animaux, avec un texte descriptif mis au courant de la science. Ouvrage pouvant servir d'atlas à tous les traités de zoologie*. Tome 2. Planches des animaux invertébrés. J. B. Baillière, Paris and London.

[19] Hayashi K (1999). Crustacea Decapoda: revision of Pasiphaea sivado (Risso, 1816) and related species, with descriptions of one new genus and five new species (Pasiphaeidae), pp. 267-302. In, A. Crosnier (ed.), Résultats des Campagnes MUSORSTOM. Vol. 20. Mémoires du Muséum national d'Histoire naturelle. Vol. 180.

[20] Hayashi K (2004). Revision of the Pasiphaea cristata Bate, 1888 species group of Pasiphaea Savigny, 1816, with descriptions of four new species and referral of P. australis to Alainopasiphaea Hayashi, 1999 (Crustacea: Decapoda: Pasphaeidae), pp. 319-373. In, B. A. Marshall and B. Richer de Forges (eds.), Tropical Deep-sea Benthos. Vol. 23. Mémoires du Muséum national d'Histoire naturelle. Vol. 191.

[21] Hayashi K (2006a). Revision of the Pasiphaea alcocki species group (Crustacea, Decapoda, Pasiphaeldae), pp. 193-241. In, B. Richer de Forges and J.-L. Justine (eds.), Tropical Deep-sea Benthos, Vol. 24. Mémoires du Muséum national d'Histoire naturelle. Vol. 193.

[22] Hayashi K (2006b). A new species of the Pasiphaea sivado species group from Taiwan (Decapoda, Caridea, Pasiphaeidae). Zoosystema 28 (2): 341-346.

[23] Hayashi K and Yaldwyn J C (1998). A new species of the genus Pasiphaea from the South Indian Océan (Crustacea, Decapoda, Pasiphaeidae). Zoosystema 20 (3): 511-519.

[24] Heller C. (1863). Die Crustaceen des südlichen Europa. Crustacea Podophthalma, mit einer Uebersicht über die horizontale Verbreitung sämmtlicher europäischer Arten. Wien, Wilhelm Braumüller: i-xi + 1-336.

[25] Hope, FG. (1851). Catalogo dei crostacei Italiani e di moltri altri del Mediterraneo. Napoli Stabilimento Tipografico di Fr. Azzolino Vico Gerolomini, 48 pp., 2 figs.

[26] IWASAKI, N, (1990). PASIPHAEID SHRIMPS FROM THE EASTERN NORTH ATLANTIC AND THE CARIBBEAN SEA, WITH THE DESCRIPTION OF A NEW SPECIES OF PASIPHAE (CRUSTACEA: DECAPODA: PASIPHAEIDAE). *Zoologische Mededelingen, 63 - 15: 187-203.*

[27] Jereb P, Clyde F and E. Roper (2006). Cephalopods of the Indian Ocean. A review. Part I. Inshore squids (Loliginidae) collected during the International Indian Ocean Expedition. ROCEEDINGS OF THE BIOLOGICAL SOCIETY OF WASHINGTON 119 (1): 91–136.

[28] Chaturanga LR, Saraswathy and M, Gopalakrishnan TC (1973). Distribution of Copepoda in the Indian Ocean," Ecological Studies: Analysis and Synthesis, Vol. 3, Springer-Verlag, Berain and New York: 331-333.

[29] Kazmi Q B and Kazmi M A (2012). BIODIVERSITY AND BIOGEOGRAPHYOF CARIDEAN SHRIMPS OF PAKISTAN, Higher Education Commission Pakistan, 400 pages.

[30] Kazmi Q B and F. A. Siddiqui (2021). Some undocumented decapodans from the Indian ocean in the galatheid Collection of iioe (1963-64) by the ship Anton brunn (Abstract only) 40th Pakistan Congress of Zoology (international), Zoological Society of Pakistan Department of Zoology, Sindh Agriculture University, Tandojam.

[31] Kazmi Q B and Yousuf F (2000). Species distribution of planktonic shrimps of family Sergestidae in the Indian Ocean collected by International Indian Ocean Expedition (IIOE). National Symposium on Arabian Sea as a Resource Of Biological Diversity. Poster. Abstract: 45.

[32] Kazmi Q B, Yousuf F and Shaukat S S (2005). ON ABUNDANCE AND OCCURRENCE OF SERGESTIDS SERGESTES AND SERGIA (CRUSTACEA: DECAPODA) IN THE SAMPLES COLLECTED DURING INTERNATIONAL INDIAN OCEAN EXPEDITION (IIOE). INTERNATIONAL JOURNAL Of BIOLOGY AND BIOTECHNOLOGY, 2 (2): 313-319.

[33] Kemp S W (1910). The Decapoda collected by the "Huxley" from the North Side of the Bay of Biscay in August, 1906. Journal of the marine biological Association of the United Kingdom, G. B., n. sér. 8 (5): 407-420.

[34] Kensley B (1969). Decapod Crustacea from the south-west Indian Ocean. Annals of the South African Museum 52: 149-181.

[35] Kensley B (1977). The South African Museum's Meiring Naude cruises. Part 5. Crustacea, Decapoda, Reptantia and Natantia. Annals of the South African Muséum 74: 13-44.

[36] Kensley, B., H. A. Tranter & D. Griffin, J. G. (1987). Deepwater decapod Crustacea from eastern Australia (Penaeidea and Caridea). Records of the Australian Museum 39: 263-331.

[37] Komai T, Lin C W and Chan TY (2012). Bathypelagic shrimp of the genus Pasiphaea (Decapoda: Caridea: Pasiphaeidae) from waters around Taiwan, with descriptions of four new species. Journal of Crustacean Biology 32: 295–325.

[38] Kuberang, Chakraborty R D, Purushothaman P and Maheswarudu G (2018). First record of deep-sea caridean shrimp Acanthephyra fimbriata Alcock and Anderson, 1894 (Crustacea: Decapoda: Acanthephyridae) from southwest coast of India. Crustacean Fisheries Division, Central Marine Fisheries Research Institute, Ernakulum North. Zootaxa 4531 (2): 288–294.

[39] Lagardère J.-P. (1971). Les crevettes des côtes du Maroc. Travaux de l'Institut Scientifique Chérifien et de la faculté des sciences, sér. Zool., n° 36: 6-140.

[40] Liao Y S, De Grave, T W Hoa, B HY Ipc, L. M. Tsangd, Tin-Yam Chan and Ka Hou Chu (2017). Molecular phylogeny of Pasiphaeidae (Crustacea, Decapoda, Caridea) reveals systematic incongruence of the current classification. http://dx.doi.org/10.1016/j.ympev.07.021.

[41] Leen van Ofwegen (1987). Melithaeidae (Coelenterata: Anthozoa) from the Indian Ocean and the Malay Archipelago. Zoologische Verhandelingen 239, 19-vi-1987: 1-57, figs. 1-35, table 1.

[42] Menon, PG andDI Williamson (1971). Decapod Crustacea from the International Indian Ocean Expedition The species of Thalassocaris (Caridea) and their larvae Journal of. Zoology, London. 165, 27-51.

[43] Milne Edwards, H., (1836). Les Crustacés. In: Cuvier, G., Le Règne Animal distribué d'après son organisation, pour servir de base à l'histoire des animaux, et d'introduction à l'anatomie comparée, ed. 4: vol 17: 1-278; vol 18 Plates 1-80. Paris.

[44] Nair R, Nair VR (1978). Bathymetric distribution of Chaetognaths in the Indian ocean. Indian Journal Marine Science, 7, 276-282.

[45] Nair V R (2010). Copepod's sub sorted from the zooplankton collected during the International Indian Ocean Expedition (IIOE) from 14 cruises on R/V Anton Bruun, R/V Argo, RRS Discovery, and R/V Natal in the Indian Ocean from 1962-1964 (IIOE project). Biological and Chemical Oceanography Data Management Office (BCO-DMO). Dataset version 2010-11-22.

[46] Noël P. Y. (1992). Clé préliminaire d'identification des Crustacea Decapoda de France et des principales autres espèces d'Europe. Collection Patrimoines Naturels, Secrétariat Faune-Flore, Muséum National d'Histoire Naturelle, Paris, 9: 1-145.

[47] Okutan, T (1975). PRELIMINARY NOTE ON PLANKTONIC OEGOPSIDA CEPHALOPOD LARVAE OBTAINED BY THE INTERNATIONAL INDIAN OCEAN EXPEDITION. Marine biological Association of India. 15 (1): 213-217.

[48] Omori, M., (1976). The Glass Shrimp, Pasiphaea japonica sp. nov. (Caridea, Pasiphaeidae), a sibling species of Pasiphaea sivado, a with notes on its biology and fishery in Toyama Bay, Japan. Bulletin of the National Science Museum, Tokyo 2: 249-266.

[49] Pesta O. (1918). Die Decapodenfauna der Adria. Versuch einer Monographie. Franz Deuticke, Liepzig und Wien,: i-x + 1- 500.

[50] Pruter A T (1964). Trawling results of R. V. Anton Brunn in the Arabian sea and Bay of Bengal. Commercial Fisheries Review, 26 (11): 27–36.

[51] Radhadevi, A and Kurian, C V (1980). Report on the International Indian Ocean Expedition Collections of Cumacea in the Smithsonian Institution Washington. Journal of the Marine Biological Association of India, 22 (1&2): 110-122.

[52] Rice AL (1967). Crustacea. (Pelagic adults) Order Decapoda, V. Caridea. Families Pasiphaeidae, Oplophoridae, Hippolytidae and Pandalidae. Fiches d'Identification du Zooplancton, 112 (1967). Conseil International pour l'Exploration de la Mer, Kopenhagen.

[53] Risso, A (1816). Histoire Naturelle des Crustacés des Environs de Nice. *Librairie Grecque-Latine-Allemande, Paris.* 175 pp., 3 plates.

[54] Rodrigues T G A, Alves-júnior F and Cardoso I A (2018) A new species of Pasiphaea Savigny, 1816 (Crustacea, Decapoda, Pasiphaeidae) from the southwestern Atlantic. Zootaxa 4418 (5): 493–498.

[55] Rathbun, M. J. (1906). The Brachyura and Macrura of the Hawaiian islands. *Bulletin of the United States Fish Commission.* 23 (3): 827-930, Pls. I-XXIV.

[56] Saraladevi K., Stephen R., Rao T. s. S., 1979. Distribution of Haloptilus (Copepoda: Calanoida) in the Indian Ocean, Indian J. Mar. Sci., 8, 159-165.

[57] Savigny, JC (1816). Memoires sur les animaux sans vertebres. *Paris.* 2: 1-239.

[58] Schmitt, W. L. (1931). Two new species of shrimp from the Straits of Formosa. *Lingnan Science Journal.* 10: 265-268; Plate 32.

[59] Simão DS, Gil J L P and Abelló P (2017). Sexual dimorphism and associated population characteristics in the benthopelagic shrimp Pasiphaea sivado (Crustacea: Caridea: Pasiphaeidae) Scientia Marina 81 (1): 57-66, Barcelona.

[60] Sivertsen, E and Holthuis L (1956). Crustacea Decapoda (the Penaeidea and Stenopodidea excepted). Rep. Sc. Exp. "Michael Sars" N Atl. Deep-Sea Exp. 1910, 5 (12): 1-56, 4 plates.

[61] Smaldon G (1979). British coastal shrimps and prawns. Keys and notes for the identification of the species. Synopses of the British fauna, 15.

[62] Smaldon G (1993). Coastal shrimps and prawns. Synopses of the British fauna, 15. (Second edition revised and enlarged by L. B. Holthuis and C. H. J. M. Fransen).

[63] Stein D L (2005). Descriptions of four new species, redescription of Paraliparis membranaceus, and additional data on species of the fish family Liparidae (Pisces, Scorpaeniformes) from the west coast of South America and the Indian Ocean Zootaxa 1019: 1–25.

[64] Stephen R, Saraladevi K, Meenkshikunjamma PP, Gopalakrishnan TC and Saraswathy M (1992). Calanoid Copepods of the International Indian Ocean Expedition Collections, Proceedings of the Oceanography of the Indian Ocean: 143-156.

[65] Stephensen K., (1923). Decapoda Macrura excluded Sergestidae (Penaeidae, Parasiphaeidae, Hoplophoridae, Nematocarcinidae, Scyllaridae, Eryonidae, Nephropsidae). Report on the Danish Oceanographical Expedition 1908- 1910 to the Mediterranean and adjacent seas, vol. 2 part D3: 1-85.

[66] Tirmizi NM and Javed W (1980). Two new species and one new record of Phylladiorhynchus Baba from the Indian Ocean (Decapoda, Galatheidae). Crustaceana, 39, 255–262.

[67] Tirmizi, NM and W. Javaid (1992). Two New Species of Munida Leach, 1820 (Decapoda, Anomura, Galatheidae) from the Indian Ocean. Crustaceana Vol. 62, No. 3: 312-318.

[68] Tirmizi, NM and W. Javaid (1993). INDIAN OCEAN GALATHEIDS. BCC&T, University of Karachi. pp 147.

[69] Timofeev, V. V., (1997). New findings of shrimp species of the genus Pasiphaea (Crustacea, Decapoda, Pasiphaeidae) with description of Pasiphaea arabica sp. n. from the western Indian Ocean [in Russian]. Zoologicheskii Zhurnal 76: 142-146.

[70] Williams A B, Abele LG, Felder D L, Hobbs, Jr., HH, Manning RB, McLaughlin PA and Pérez Farfante I (1988). Common and scientific names of aquatic invertebrates from the United States and Canada: decapod crustaceans. American Fisheries Society Special Publication 17. 77 pp. + 12 figs.

[71] Williamson D I (1962). CRUSTACEA DECAP0DA: LARVAE III. CARIDEA, Families Oplophoridae, Nematocarcinidae and Pasiphaeidae. CONSEIL INTERNATIONAL POUR L'EXPLORATION DE LA MER. Zooplankton Sheet 92.

[72] Williamson D I (1968). REPORT ON THE PLANKTONIC STAGES OF DECAPOD CRUSTACEA (EXCLUDING PENAEIDAE) IN THE COLLECTIONS AT THE INDIAN OCEAN BIOLOGICAL CENTRE. INFORMATION PAPERS, INTERGOVERNMENTAL OCEANOGRAPHIC COMMITTEE. UNESCO/NS/IOC/INF 140: 1-5.

[73] Windsor A, Mendoza JCE and Deeds JR (2019). Resolution of the Portunus gladiator species complex: taxonomic status and identity of Monomia gladiator (Fabricius, 1798) and Monomia haanii (Stimpson, 1858) (Brachyura, Decapoda, Portunidae). ZooKeys 858: 11–43.

[74] Wood-Mason, J and Alcock, A. (1891-1893). Natural history notes from H. M. Indian Marine Survey Steamer 'Investigator,' Commander R. F. Hoskyn, R. N., commanding.—Series II., No. 1. On the results of deep-sea dredging during the season 1890–91. *Annals and Magazine of Natural History, ser. 6.* 8 (43), 16–34; 8 (44), 119–138, pls. VII–VIII; 8 (46), 268–286; 8 (47), 353–362; 8 (48), 427–452, pl. XVII; 9 (52), 265–275, pls. XIV-XV; 6 (53), 358–370; 11 (62), 161–172, pls. X-XI.

[75] Yousuf F (2006)."Systematic study and distribution of planktonic shrimps of family Sergestidae in the Indian Ocean Collected by International Indian Ocean (IIOE)". Unpublished dissertation.

[76] Yousuf F and Kazmi Q. B (2005). First record of *Sergestes* belonging to *edwardsii* species group (Sergestidae, Crustacea) from the Indian Ocean. ZOOTAXA New Zealand 1092: 47-63.

[77] Yousuf F and Kazmi Q B (2008). New records for two sergestids: *Segestes orientalis* Hansen, 1919 and *Sergia umitakae* Hashizume and Omori, 1995 (Crustacea, Decapoda, Sergestidae) Turkish Journal of. Zoology 32: 327-335.

[78] Yousuf F and Kazmi Q. B (2016). First subsequent record of Sergestes hamifer Alcock and Anderson, 1894 (Sergestidae, Crustacea) Collected from the Indian Ocean. Indian Journal of Fisheries and Biological Sciences 3 (3): 5-8.

[79] Zariquiey Alvarez, R., 1957. Las Pasiphaeas del Mediterráneo occidental. Decápodos españoles XILL, Trabajos del Museo de Zoología, Barcelona, nueva serie Zoologica, 2 (5): 1-31, figs 1-4, pis 1-3. ZARIQUIEY ALVAREZ, R., 1968. — Crustáceos decápodos ibéricos. Investigación Pesquera, 32: 1-510, figs 1-164.

[80] Zariquiey Álvarez R., (1968). Crustáceos decápodos ibéricos. Investigación Pesquera, Barcelona, 32: i-xv, 1-510.