

First record of the alpheid shrimp *Arete dorsalis* (Decapoda: Alpheidae) associated with the sea urchin *Echinostrephus molaris* from the Makran Coast, Pakistan

Quratulan Ahmed^{1*}, Ateeqa Baloch¹, Qadeer Mohammad Ali¹, Ivan Marin²

¹The Marine Reference Collection and Resources Centre, 75270, Karachi, Pakistan

²A.N. Severtsov Institute of Ecology and Evolution, Leninsky prospect, 33, Moscow 119071 Russia.

*Corresponding author: quratulanahmed_ku@yahoo.com

Received 05 June 2026 | Accepted 07 August 2026 | Published 02 September 2026

Abstract

The study reports the first occurrence of *Arete dorsalis* Stimpson, 1860 from Pakistan, based on four specimens collected on 14 December 2024 from Garyan Beach, Jiwani, along the Makran Coast. The shrimp was found living among the spines of the echinoid *Echinostrephus molaris*, representing the first documented association between these two species in the northern Arabian Sea. Morphological examination of all collected individuals showed complete conformity with published descriptions of *A. dorsalis*, confirming the identification with confidence. This discovery extends the species known distribution within the Indo-West Pacific and emphasizes the role of echinoid microhabitats in supporting cryptic alpheid diversity. The present finding contributes to the knowledge of Pakistan's marine decapod fauna and highlights the need for targeted surveys of host-associated organisms to better document the region's biodiversity.

Key words: *Arete dorsalis*, Alpheid Shrimp, biodiversity, rocky shore, Makran coast, Pakistan.

1. Introduction

The family Alpheidae Rafinesque, 1815, commonly known as snapping or pistol shrimps, represents one of the most diverse groups within the infraorder Caridea. They are characterized by their highly asymmetrical chelae, one of which is modified to produce a powerful snapping sound (Chow et al., 2021). Globally, the family comprises over 1,100 species in more than 38 genera (Anker et al., 2006), with the genera *Alpheus* and *Synalpheus* being the most speciose (De Grave, 2024). Members of the family inhabit a wide range of marine environments, including coral reefs, sandy and muddy substrates, and symbiotic associations with various invertebrates, particularly echinoids (Baner, 1966; Abele & Felgenhauer, 1982).

The genus *Arete* Stimpson, 1860, currently comprises five valid species: *A. acanthocarpus* (Miya & Miyake, 1968), *A. amboinensis* (De Man, 1910), *A. cornutus* (Anker, 2025) *A.*

dorsalis (Stimpson, 1860), and *A. indicus* (Coutière, 1903) (DecaNet, 2025). Among them, *A. dorsalis* Stimpson, 1860 was originally described by William Stimpson in 1860 during an expedition to the North Pacific Ocean from northwestern Australia and is known from scattered Indo-West Pacific localities (Banner & Banner 1968; Bruce 1990 a, b; Nomura et al. 1996).

Symbiotic associations between alpheid shrimps and echinoids are well documented, with sea urchin spines providing shelter and refuge for associated shrimps (Castro, 1971; Bruce, 1982; Gherardi, 1991). Such associations often involve morphological and behavioural adaptations in the shrimp, including colour mimicry, modified body shape, and specialized clinging structures (Bruce, 1976; Anker & Jeng, 2007). *Arete dorsalis* has previously been reported in association with several echinoid species across the Indo-West Pacific (Banner, 1959; Jacquotte, 1964; Suzuki, 1970; Sankarankutty, 1962; Bruce, 1982; Anker & Jeng, 2007; Ayyagari & Kondanudi, 2014; Woo & Kim, 2017; Baby et al., 2020).

Despite extensive coastlines and a rich echinoderm fauna, the marine biodiversity of Pakistan particularly the remote Makran Coast, remains underexplored. From Pakistan, the family Alpheidae is represented by 7 genera and 24 species (Kazmi et al., 2022). Within the genus *Arete*, only one species, *Arete indicus* Coutière, 1903, has been previously reported, known to be commensal with the sea urchin *Echinometra mathaei* (Ghory & Kazmi, 2021). While *Arete dorsalis* has not previously been documented from any locality along the northern Arabian Sea, the present study provides the first record of *A. dorsalis* from the Makran Coast of Pakistan, based on material collected from Garyan Beach, Jiwani. Moreover, we document its association with the echinoid *Echinostrephus molaris*, representing the first record of this specific symbiotic pairing in the northern Arabian Sea. This finding enhances the understanding of alpheid-echinoid associations and expands the known geographic distribution of *A. dorsalis* into Pakistani waters.

2. Materials and methods

Sea urchins (*Echinostrephus molaris*) were collected from the intertidal zone of Garyan Beach, Jiwani, along the Makran Coast of Pakistan (25°00'57"N, 61°46'40"E) (Fig. 1) during low tide during low (-0.12m / 14:57 hrs) on 14th December 2024. Each sea urchin was carefully examined in the field for the presence of associated alpheid shrimp. A total of four adult specimens of *Arete dorsalis* were collected from *Echinostrephus molaris*. Specimens of *A. dorsalis* were gently removed using fine forceps, photographed in situ, and preserved in 5% formalin prepared with seawater for laboratory analysis. In the laboratory, specimens were thoroughly rinsed with distilled water and transferred to 70% ethanol for detailed taxonomic examination. Morphological observations were examined under a stereo-zoom microscope (Wild 181300, Switzerland) at 10×–50× magnification and species was identified following standard keys. All specimens were catalogued (MRC&RC-UoK-CARI-259) and deposited in the Marine Reference Collection and Resource Centre (MRC&RC), University of Karachi.

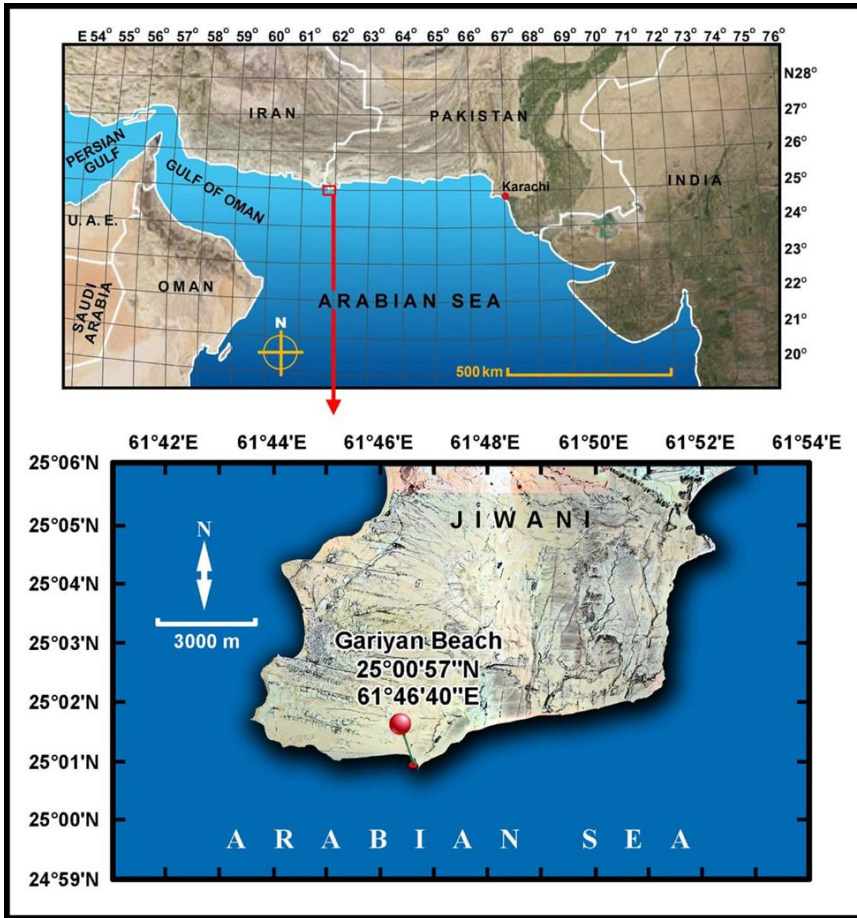


Figure 1. Study area Gariyan Beach, Jiwani, Makran Coast, Balochistan (25°00'57"N, 61°46'40"E).

3. Results

Systematic Accounts

Class: Malacostraca

Order: Decapoda Latreille, 1802

Family: Alpheidae Rafinesque, 1815

Genus: *Arete* Stimpson, 1860

Arete dorsalis (Stimpson, 1860)

(Fig. 2 & 3)

Material Examined: Catalogue no: (MRC&RC-UoK-CARI-259) Gariyan Beach, Jiwani, Makran Coast, Balochistan, 25°00'57"N, 61°46'40"E, collected during low tide (-0.12m / 14:57 hrs), 14th December 2024.

Description: Specimens measuring 13-17 mm long, dark purplish in life (Fig. 2B) and turning dark brown in alcohol (Fig. 2C). Body stout, smooth. Rostrum broadly elongated, sharply triangular, slightly exceeding the second antennular segment (Fig. 2D-E). Carapace smooth; extra-corneal tooth acute; supra- and infra-corneal teeth absent. Eyes fully exposed;

pterygostomial margin rounded; cardiac notch distinct. Antennules stout; first segment with serrated margin and strong ventro-inner carina; second segment twice length of first; stylocerite broad elongated, inward, not reaching third segment. Scaphocerite with slightly convex lateral margin; distal spine surpassing stylocerite; inner blade well developed. Basicerite spined; carpocerite short. Third maxilliped reaching antennular peduncle; ultimate segment long, tapering, with three distal spines and dense inner setae. Major first pereopod chela (Fig. 2F) longer than broad; palm smooth. Fingers short, gaping; movable finger without molar tooth, tip inward; immovable finger with broad superior tooth. Carpus swollen, cup-shaped; merus longer than broad, unarmed distally; ischium with two movable spines (proximal and distal) and a blunt subdistal tooth. Minor first pereopod chela (Fig. 2G) longer than broad, slenderer; fingers overlapping, not gaping; Palm smooth; carpus swollen; merus longer than broad, unarmed; ischium with two movable spines and a blunt tooth. Second pereopod with 4-segmented carpus; first segment longest. Third pereopod (Fig. 2I-J) with short biunguiculate dactylus; propodus with 10 ventral spines; merus with distal spine. ischium with minute spine. Fourth similar to third pereopod; ischium with tiny spine. Fifth pereopod narrower, ischium unarmed. Abdomen with rounded pleura (somites I–IV); sixth somite with articulated plate. Preanal plate acute. Telson longer than anterior width, with two dorsal spine pairs; sides straight; posterior margin slightly produced medially with lateral spines (Fig. 2H).

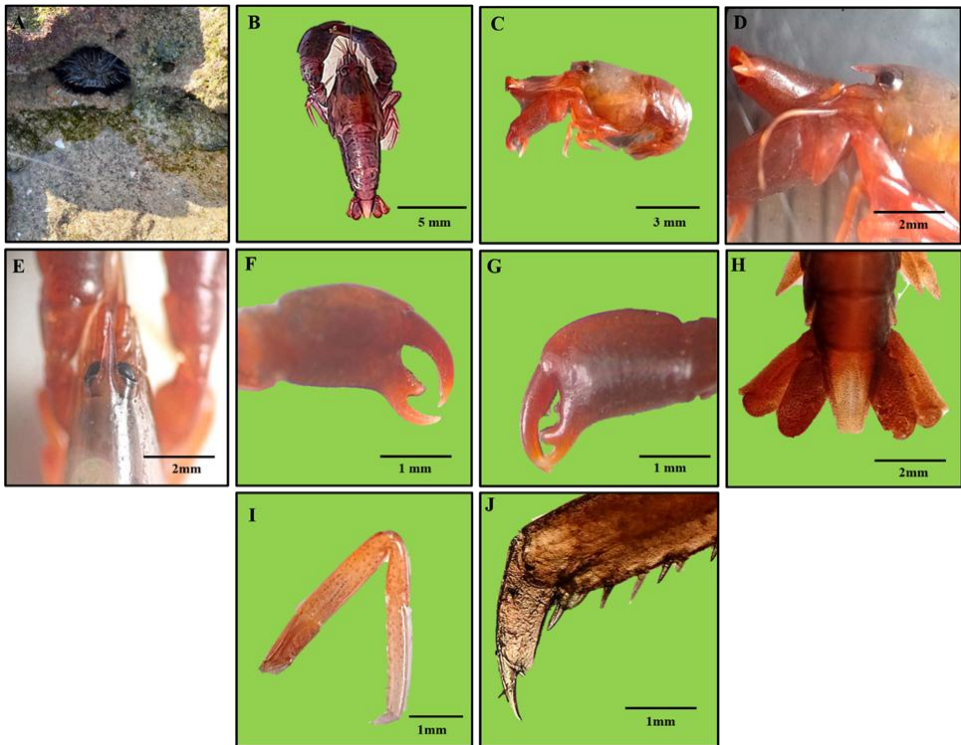


Figure 2. **A.** Sea urchin *Echinostrephus molaris* in natural habitats, **B.** *Arete dorsalis* live, **C.** *Arete dorsalis* preserved specimen, **D.** Frontal region, lateral view, **E.** Frontal region, dorsal view, **F.** Left chela, **G.** Right chela, **H.** Telson and Uropods, **I.** 3rd pereopod, **J.** 3rd pereopod, close up view,

Remarks: The identification of the specimens as *Arete dorsalis* was based on a combination of diagnostic morphological characters consistent with published descriptions, including the broadly triangular rostrum slightly exceeding the second antennular segment, the presence of an acute extracorneal tooth with the absence of supra- and infracorneal teeth, a four-segmented carpus on the second pereopod, biunguiculate dactyli on the ambulatory pereopods, and the characteristic morphology of the telson and first pereopods. Because *A. indicus* is the only species of the genus previously reported from Pakistan, a comparative assessment was undertaken (Table 1). Although both species share several generic features, the present specimens differ from *A. indicus* in body size, rostral shape, colour pattern, host association, and several appendage characters, supporting their identification as *A. dorsalis*.

Habitat: Found associated with the spines of *Echinostrephus molaris* (Fig. 2A).

Distribution: *Arete dorsalis* is widely distributed throughout the Indo-West Pacific region, with records from the east coast of Africa, the Red Sea, Gulf of Aden, Indian Ocean, Gulf of Mannar, Indonesia, Hong Kong, southern Japan, Australia, the Lakshadweep Archipelago, and parts of the Pacific Ocean (Stimpson, 1860; Sankarankutty, 1962; Banner & Banner, 1973; Thomas, 1974; Bruce, 1990a, 1990b; Hayashi, 1995; Nomura et al., 1996; Baby et al., 2020). This is the first confirmed record of *A. dorsalis* from Pakistan, extending the species' known distribution into the northern Arabian Sea.

Table 1. Diagnostic comparison between *Arete dorsalis* (present study) and the closely related species *Arete indicus*, previously reported from Pakistan.

Character	<i>Arete indicus</i>	<i>Arete dorsalis</i> (Present study)
Body length	About 7 mm	13-17 mm
Body colour	Deep purple with orange mid-dorsal band, blue stripes, and distinct eyespots on fourth abdominal segment	Uniform dark purplish in life; dark brown in alcohol; no orange dorsal band or eyespots observed
Carapace	Smooth	Smooth
Rostrum	Lanceolate, forming a low ridge; extending beyond second antennular segment	Broadly elongated, sharply triangular; slightly exceeding second antennular segment
Extracorneal tooth	Present	Present and acute
Supracorneal tooth	Absent	Absent
Infracorneal tooth	Absent	Absent
Second pereopod	Slender with minute chela; carpus 4-segmented	Carpus 4-segmented; first segment longest
Third pereopod	Biunguiculate dactylus; propodus with short spines	Biunguiculate dactylus; propodus with 10 ventral spines; merus with distal spine
Telson	Shorter than uropods	Longer than anterior width, with two dorsal spine pairs and posterior lateral spines
Host association	<i>Echinometra mathaei</i>	<i>Echinostrephus molaris</i>

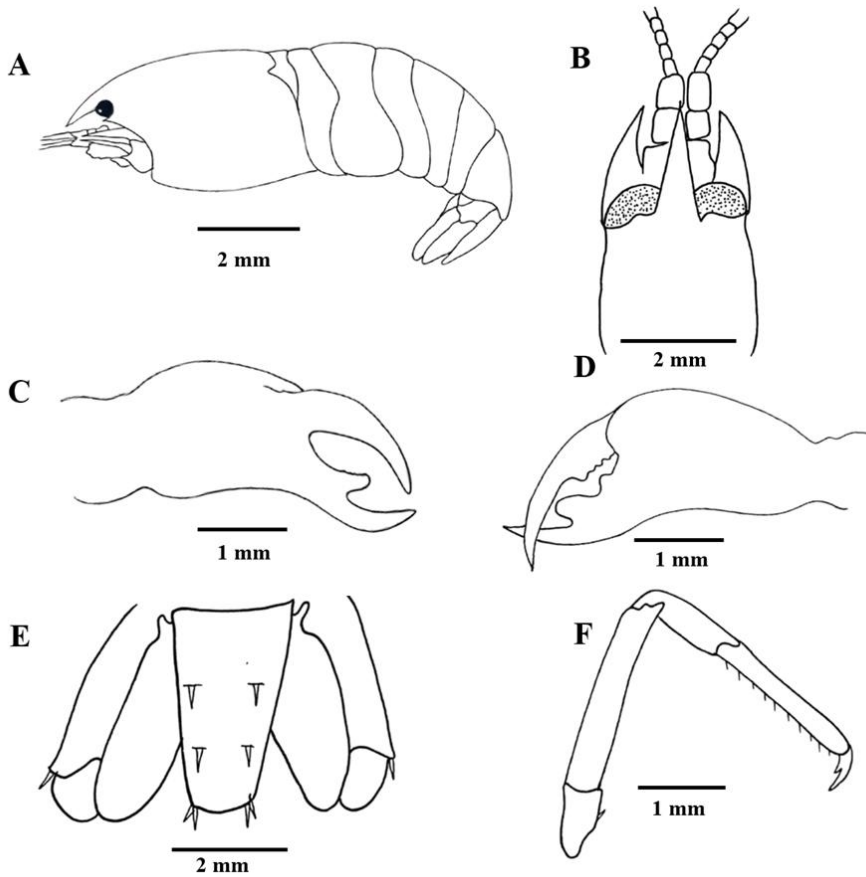


Figure 3. **A.** *Arete dorsalis*, lateral view, **B.** Frontal region, dorsal view, **C.** Left chela, **D.** Right chela, **E.** Telson and Uropods, **F.** 3rd pereopod.

4. Discussion

The present study reports *Arete dorsalis* Stimpson, 1860 for the first time from Pakistan, in association with the sea urchin *Echinostrephus molaris* from Garyan Beach, Jiwani, along the Makran Coast. This record extends the known distribution of the species into the northern Arabian Sea. The present finding fills a biogeographic gap and suggests that the Makran Coast may support a greater diversity of host-associated crustaceans than currently documented.

The Makran Coast, extending from the Strait of Hormuz along southern Iran to Pakistan, represents a biogeographically important transition zone between the Persian Gulf and the open Arabian Sea in the northwestern Indian Ocean (Ghanavati et al., 2021). In such dynamic systems, larval duration and reproductive timing play a critical role in shaping the phylogeographic structure of coastal invertebrates, particularly among meroplanktonic taxa (Gaines & Bertness, 1993; Gaines et al., 2007). Within this context, the discovery of *A. dorsalis* from the remote Makran Coast highlights its previously unrecognized occurrence in the region and supports previous observations that intertidal echinoids can serve as important microhabitats for host-associated decapods. The narrow crevices among the stout spines of

E. molaris appear to provide a suitable refuge for *A. dorsalis*, consistent with previous reports of associations between *Arete* species and echinoid hosts.

This finding suggests that targeted examination of echinoid hosts may facilitate the detection of cryptic symbiotic or commensal taxa that might otherwise remain overlooked. The absence of previous records from Pakistan may reflect limited sampling of rocky intertidal habitats and echinoid-associated microhabitats rather than the true absence of the species.

Prior to this record, *A. dorsalis* had been reported only from scattered Indo-West Pacific localities, including northwestern Australia, Indonesia, Taiwan, the Lakshadweep Archipelago, and the eastern coast of India (Banner & Banner, 1968; Bruce, 1990a, b; Nomura et al., 1996; Ayyagari & Kondamudi, 2014; Baby et al., 2020). Its absence in earlier regional faunal surveys (Kazmi et al., 2018; Ghory & Kazmi et al., 2022) may reflect cryptic behaviour or limited sampling of echinoid-associated microhabitats along the Pakistan coast.

Previous records of *Arete dorsalis* demonstrate a wide host range and a consistent association with diverse echinoids across the Indo-West Pacific. The earliest documented occurrence dates back to Ngarumaoa Island, where the species was reported in association with an unidentified black-green sea urchin (Banner, 1959). Since then, *A. dorsalis* has been recorded with several echinoid hosts, including *Centrostephanus tenuispinus* (Clark, 1914), *C. rogersii* (Agassiz, 1863), *Echinothrix calamaris* (Pallas, 1774), *E. diadema* (Linnaeus, 1758), *Helicoidaris tuberculata* (Lamarck, 1816), *H. erythrogramma*, *Stomopneustes tesvarioralis* (Lamarck, 1816), and *Tripneustes gratilla* (Linnaeus, 1758) throughout the Indo-West Pacific region (Bruce, 1982). Its commensal association with *S. variolaris* (Lamarck, 1816) has been repeatedly documented from the Madagascar region (Jacquotte, 1964), Japanese waters (Suzuki, 1970), the Gulf of Mannar, India (Sankarankutty, 1962) and from the Visakhapatnam coast, Bay of Bengal (Ayyagari & Kondamudi, 2014), *Mesocentrotus nudus* from Korean waters (Kin & Woo, 2017), and *Heterocentrotus manillatus* from the Lakshadweep Islands (Baby et al., 2020).

The present study documents the association of *Arete dorsalis* with *Echinostrephus molaris* for the first time in the northern Arabian Sea. The specimens observed in this study displayed a deep purplish hue in life, closely matching the pigmentation of *E. molaris*, suggesting that colour matching may enhance concealment while associated with its host. Similar colour resemblance has been reported in other alpheid shrimps (Bruce, 1976; Anker & Jeng, 2007), although its adaptive significance has not been evaluated in the present study.

Morphological characters of the examined material align closely with the established diagnostic features of *A. dorsalis*, including the elongate rostrum, fully exposed eyes, serrated antennular segment, and the distinctly asymmetrical first pereopods with a swollen carpus and gaping major chela, consistent with previous descriptions (Anker & Jeng, 2007; Ayyagari & Kondamudi, 2014; Kin & Woo, 2017; Baby et al., 2020). All key structures were well preserved, and the strong correspondence with published accounts provides clear confirmation of the species' identity.

5. Conclusion

In conclusion, the first record of *A. dorsalis* from the Makran Coast not only adds a new record of species to Pakistan's decapod fauna but also provides the first record of the association between *Arete dorsalis* and *Echinostrephus molaris* in the northern Arabian Sea. This highlights the need for more systematic surveys targeting host-associated invertebrates to better understand the actual diversity and ecological relationships along the northern Arabian Sea.

Acknowledgements

The authors would like to express their gratitude to the Pakistan Science Foundation (Project No. PSF/CRP/Consrn 636) for providing financial support for the collection of samples and also would like to acknowledge the Marine Reference collection and Resource Centre, University of Karachi, for provided services for sample collection and laboratory facilities for specimen identification.

Conflict of interests

The authors declare that they have no competing interests.

References

- Abele, L.G., & Felgenhauer, B.E. (1982). Eucaridea. In: Parker, S.P. (Ed.), *Synopsis and Classification of Living Organisms*. Vol. 2. McGraw-Hill, New York, pp. 294-326.
- Anker, A. & Jeng, M.S. (2007). Establishment of a new genus for *Arete borradalei* Coutière, 1903 and *Athanas verrucosus* Banner and Banner, 1960, with redefinitions of *Arete* Stimpson, 1860 and *Athanas* Leach, 1814 (Crustacea: Decapoda: Alpheidae). *Zoological Studies* 46, 454-464.
- Anker, A., Ah Yong, S. T., Noel, P. Y., & Palmer, A. R. (2006). Morphological phylogeny of alpheid shrimps: parallel preadaptation and the origin of a key morphological innovation, the snapping claw. *Evolution* 60(12), 2507-2528.
- Ayyagari, A., & Kondamudi, R. B. (2014). Symbiotic association between *Athanas dorsalis* (Alpheidae) and *Stomatopneustes variolaris* (Echinoidea) from Visakhapatnam coast, India. *American Journal of Marine Science* 2(3), 47-50.
- Baby, S. T., Ghosh, S., Rithin Raj, M., Prabhakaran, M. P., Gopi, M., Sumod, K. S. & Cubelio, S. S. (2020, June). Alpheid Shrimp *Arete dorsalis* and Its Association with the Slate Pencil Sea Urchin *Heterocentrotus mamillatus* in Lakshadweep Waters. *Proceedings of the Zoological Society* (Vol. 73, No. 2, pp. 201-204). New Delhi: Springer India.
- Banner, A. H. (1959). Contributions to the Knowledge of the Alpheid Shrimp of the Pacific Ocean: Part IV. Various Small Collections from the Central Pacific Area, including Supplementary Notes on Alpheids from Hawaii.
- Banner, A. H. (1966). The alpheid shrimp of Thailand: the alpheid shrimp of the Gulf of Thailand and adjacent waters. *The Siam Society Monograph Series* 3, 1-168.
- Banner, A.H., & Banner, D.M. (1968). Contributions to the knowledge of the alpheid shrimp of the Pacific Ocean, part XII: collections from the Marshall and Caroline Islands. *Journal of Microbiology* 4: 261-294.
- Banner, D. M. (1973). The alpheid shrimp of Australia. Part 1. The lower genera. *Records of the Australian Museum* 28, 291-382.
- Bruce, A. J. (1976). Shrimps and prawns of coral reefs, with special reference to commensalism. *Geology of Coral Reefs*, 37-94.
- Bruce, A. J. (1982). The shrimps associated with Indo-West Pacific echinoderms, with the description of a new species in the genus *Periclimenes* Costa, 1844 (Crustacea: Pontoninae). *Australian Museum Memoirs* 16, 191-216.
- Bruce, A. J. (1990a). Additions to the marine shrimp fauna of Hong Kong. In *Proceedings of the second international marine biological workshop: The marine flora and fauna of Hong Kong and southern China*, ed. B. Morton, 611-648. Hong Kong: Hong Kong University Press
- Bruce, A. J. (1990b). Redescriptions of five Hong Kong Caridean shrimps first described by W. Simpson, 1860. In *Proceedings of the second marine biological workshop: The*

- marine flora and fauna of Hong Kong and southern China, ed. B. Morton, 569–610. Hong Kong: Hong Kong University Press.
- Castro, P. (1971). The natantian shrimps (Crustacea, Decapoda) associated with invertebrates in Hawaii. *Pacific Science* 25, 395–403.
- Chow, L. H., De Grave, S., Anker, A., Poon, K. K. Y., Ma, K. Y., Chu, K. H., Chan, Y.T. & Tsang, L. M. (2021). Distinct suites of pre-and post-adaptations indicate independent evolutionary pathways of snapping claws in the shrimp family Alpheidae (Decapoda: Caridea). *Evolution* 75(11), 2898-2910.
- De Grave, S. (2024). "*Alpheidae* Rafinesque, 1815". WoRMS. World Register of Marine Species.
- DecaNet eds. (2025). DecaNet. *Arete* Stimpson, 1860. Accessed through: World Register of Marine Species at: <https://www.marinespecies.org/aphia.php?p=taxdetails&id=205377> on 2025-11-09
- Gaines, S. D., & Bertness, M. (1993). The dynamics of juvenile dispersal: why field ecologists must integrate. *Ecology* 74(8), 2430-2435. <https://doi.org/10.2307/1939593>
- Gaines, S. D., GaylorD, B., Gerber, L. R., Hastings, A., & Kinlan, B. P. (2007). Connecting places: the ecological consequences of dispersal in the sea. *Oceanography* 20(3), 90-99. <https://doi.org/10.5670/oceanog.2007.32>
- Ghanavati, E., Shah-Hosseini, M., & Marriner, N. (2021). Analysis of the makran coastline of Iran's vulnerability to global sea-level rise. *Journal of Marine Science and Engineering* 9(8), 891. <https://doi.org/10.3390/jmse9080891>
- Gherardi, F. (1991). Eco-ethological aspects of the symbiosis between the shrimp *Athanas indicus* (Coutière 1903) and the sea urchin *Echinometra mathaei* (de Blainville 1825). *Tropical Zoology* 4(1), 107-128.
- Ghory, F. S., & Kazmi, Q. B. (2021). A new record of *Aretes indicus* (Coutière 1903) (Alpheidae: Caridea) from northern Arabian Sea. *Arthropods* 10, 152-157.
- Hayashi, K.I. (1995). Prawns, shrimps and lobsters from Japan (83). Family Alpheidae - genus *Arete*. *Aquabiology* 17, 184-187
- Jacquotte, R. (1964). Notes de faunistique et de biologie marines de Madagascar, 2. Décapodesnageursassociés aux échinodermes dans la région de Tuléar (sud-ouest de Madagascar). *Recueil des Travaux de la Station Marine d'Endoume* 32, 179-182.
- Kazmi, Q.B., Naushaba, R., Moazzam, M., & Kazmi, M. A. (2022). *Pakistani Marine Faunal Biodiversity Inventory and Taxonomic Resources*. Zoological Society. p.721
- Koo, H., & Kim, W. (2017). Report on the Alpheid Shrimp *Arete dorsalis* (Decapoda: Caridea: Alpheidae) from Korea. *Animal Systematics, Evolution and Diversity* 33(1), 51.
- Nomura, K., Nagai, S., Asakura, A., & Komai, T. (1996). A preliminary list of shallow water decapod Crustacea in the Kerama Group, the Ryukyu Archipelago. *Bulletin of the Biogeographical Society of Japan* 51(2), 7-21.
- Sankarankutty, C. (1962). On the occurrence of *Athanas dorsalis* (Stimpson)(Decapoda-Alpheidae) in the Gulf of Mannar. *Journal of the Marine Biological Association of India* 4(2), 167-171.
- Sankarankutty, C. (1962). On the occurrence of *Athanas dorsalis* (Stimpson)(Decapoda-Alpheidae) in the Gulf of Mannar. *Journal of the Marine Biological Association of India* 4(2), 167-171.
- Stimpson, W. (1860). *Prodromus descriptionis animalium evertibratorum, quae in Expeditione ad Oceanum Pacificum Septentrionalem, a Republic Federata missa, Cadwaladore Ringgold et Johanne Rodgers Ducibus, observavit et descripsit. Pars VIII, Crustacea Macrura.* Proceedings of the Academy of Natural Sciences of Philadelphia.12: 22-47
- Stimpson, W. (1860). *Prodromusdescriptionisanimaliumevertibratorum, quae in ExpeditioneadOceanumPacificumSeptentrionalem, a Republic Federatamissa, Cadwaladore Ringgold et Johanne Rodgers Ducibus, observavit et descripsit. Pars VIII,*

- Crustacea Macrura. Proceedings of the Academy of Natural Sciences of Philadelphia 12: 22-47.
- Suzuki, H. (1970). Taxonomic review of four alpheid shrimps belonging to the genus *Athanas*, with reference to their sexual phenomena. Scientific Reports of the Yokohama National University, Section II 17, 1-38, 1970.
- Thomas, M. M. (1974). Decapod crustaceans new to the Laccadive archipelago. Indian Journal of Fisheries 21(2), 339-344.