ISSN 2321–340X

Journal of Aquatic Biology & Fisheries | Vol. 7 | 2019 | pp. 8 - 14

BRACHYURAN CRAB DIVERSITY IN AN ISOLATED MANGROVE PATCH OF THE COCHIN BACKWATERS, CENTRAL KERALA, INDIA

Apreshgi, K.P and Kurian Mathew Abraham*

Department of Aquatic Biology and Fisheries, University of Kerala, Kariavattom, Thiruvananthapuram - 695 581, India
**Email: kurianma@gmail.com*

Abstract: The mangroves along the Kerala coast are patchy. The present study area is an isolated mangrove patch at Puthuvype in the Cochin backwaters of Ernakulum district, Kerala. The mangroves at Puthuvype are subjected to destruction due to various human-related activities, especially industrialization. Brachyuran crabs have been considered as ecologically important and are the conspicuous members of a mangrove ecosystem. Many reports on the marine fauna of the Cochin backwaters are available. Studies particularly related to the diversity and population structure of crabs in the Puthuvype area, however, are always in demand. We herein studied the brachyuran crab diversity of the Puthuvype mangrove patch using diversity indices and present the data on the population of each species. Altogether, 12 species of brachyuran crabs in four families (4 portunids, 3 grapsids, 3 sesarmids, and 2 ocypodids) were encountered from the study area between February 2015 and January 2016. The population was highest for *Parasesarma plicatum* (Latreille, 1803) and lowest for *Pseudosesarma glabrum* Ng, Rani & Bijoy Nandan, 2017; both are sesarmids, and each requires specific ecological adaptations that might have influenced their distribution and abundance. Other species showed a limited population. The diversity of crabs was relatively high during monsoon and post-monsoon seasons and was low during pre-monsoon. Salinity variation might be responsible for the differences in crab diversity during these seasons. Generally, the crab diversity in the studied area seems to be rich and balanced. Conservation actions are required to protect the fauna of the Puthuvype area in general and the crabs in particular.

Key words: Abundance, Conservation, Crustacea, Decapoda, Diversity indices, Population

INTRODUCTION

Kerala has a good growth of mangroves all along the coast but these forests are patchy, and some vegetation is subjected to destruction due to various developmental activities (Sreelekshmi *et al*., 2018). Sreelekshmi *et al*. (2018) reported 18 species of true mangroves and many associates from Kerala. Mangrove patches along the Kerala coast (west coast of India) are less complex as compared to the dense complex networks of mangroves in the east coast of the country (Naskar and Mandal, 1999). The animal diversity in mangrove ecosystem of Kerala, however, was reported to be high (Radhakrishnan *et al*., 2006; Araty Sasikumar, 2009; Bhat and Sreekanth, 2018). On the other hand, studies on the diversity of brachyuran crabs from the mangrove ecosystems of Kerala are inadequate (Apreshgi, 2014).

Brachyurans are the most diverse group and 6793 marine brachyuran crabs were recorded throughout the world (Ng *et al*, 2008). A total of 910 marine brachyuran crabs were reported from Indian waters (Trivedi *et al*, 2018) and 183 species from Kerala. He also observed that the east coast of India has more diversity than the west coast. Reports on crab diversity of mangrove ecosystems of Kerala were meager and practically no authentic reports are available for true brachyuran mangrove crabs (Apreshgi, 2014). Crabs are the conspicuous members of any mangrove fauna and are ecologically significant (Macnae, 1968). The distribution of crabs is influenced by several ecological factors like vegetation, substratum, food, salinity, and the presence of other animals (Aspey, 1978; Icely and Jones, 1978; Rabalais and Cameron, 1985; Ewa-Oboho, 1993; Thurman, 1998; Caésar *et*

al., 2005; Pandya and Vachharajani, 2010). True brachyuran crabs of this mangrove belt were not reported yet especially their population and diversity indices, instead reports were mainly diverse including estuarine (Radhakrishnan *et al*., 2006), marine (Trivedi *et al*., 2018) and freshwater (Rajesh *et al*., 2017) crabs.

Cochin backwaters are characterized by wide salinity gradient and varying habitat types like low lying swamps, tidal creeks and the mangrove patches, which support diverse flora and fauna, including the brachyuran crabs (Devi, 2015). From the Cochin backwater system alone, 11 species of true mangroves and 32 species of mangrove associates have been recorded (Sahadevan *et al*., 2017). Many marine fauna also thrives in the Cochin backwaters, including brachyuran crabs (Devi, 2015; Sahadevan, 2016). While Apreshgi (2014) reported 14 species of brachyuran crabs from selected mangrove ecosystems of Kerala, Devi (2015) recorded 23 species in the Cochin backwaters alone.

The major mangrove patch in the Cochin backwaters is found along the Puthuvype area, and the isolated mangrove patch in Puthuvype is mainly located towards the north of the industrial development site. Although several reports on the mangrove fauna of the Cochin backwaters are available (e.g., Radhakrishnan *et al*., 2006; Sahadevan, 2016), brachyuran crabs of the mangrove belt in Puthuvype area were not dealt yet, especially for their study on diversity and population structure. Some systematic studies, however, were recently conducted on the brachyuran crabs near this area (Ng *et al*., 2017). Apreshgi *et al*. (2016) were studied the DNA barcoding of two fiddler crabs *Uca annulipes* and *Uca perplexa* from Puthuvype mangroves, Cochin backwaters. The measurement of biological diversity is important from the conservation point of view (Humphries *et al*., 1995). Based on these above facts, the present study is carried out to know the diversity of brachyuran crabs using diversity indices from the isolated mangrove patch at Puthuvype of the Cochin backwaters, central Kerala, India.

MATERIAL AND METHODS

Study area

The study area, Puthuvype (9°592 05.73 N and 76°132 54.23 E), is a part of Vypeen (or Vypin) island (Fig.1), which is an upcoming major industrial area and falls under the Coastal Regulation Zone (CRZ) in Kochi city, Ernakulam district of Kerala (see Sahadevan *et al*., 2017). Vypeen is an isolated island with Kodungallur strait in the north, Cochin backwaters and Cochin Port in the south (where the Periyar River debouches), Kochi city in the east, and the Arabian Sea in the west. The mangrove cover of the study area can be divided into three categories: 1) moderately dense vegetation; 2) interspersed vegetation with settlements; 3) vegetation under degradation due to developmental activities.

Data collection

Crab specimens were collected every month by hand-picking or using stick and twine or using traps at night from the study area during February 2015 and January 2016. The study area consists of three different sites. Crabs were collected only from a marked area of 25 m^2 at each of these sites throughout the study period. Most of the crabs, especially undamaged and berried females, were released back to their natural habitat after data collection. Only a few specimens (4 or 5 specimens of each abundant species and 1 or 2 individuals of each rare species) were preserved and brought to the laboratory for photography and confirmation of identification. The identification was done using available identification keys and systematic literature (Pillai, 1951; Sakai, 1976; Sethuramalingam and Ajmal Khan, 1991; Dev Roy and Das, 2000). The validity and systematic position of each species were verified from Ng *et al*. (2008, 2017), with an update from the database of the World Register of Marine Species (WoRMS Editorial Board, 2018).

Data analysis

The annual mean abundance (individuals. 25 m^{-2}) of each species was calculated based on the total number of specimens gathered over the study period (February 2015 to January 2016). For the diversity analysis, three prominent seasons were considered, viz., pre-monsoon (February–May), monsoon (June–September), and post-monsoon (October–January). For a species, the mean abundance of the respective months of each season was used for diversity analysis. The diversity analysis was carried out using different indices.

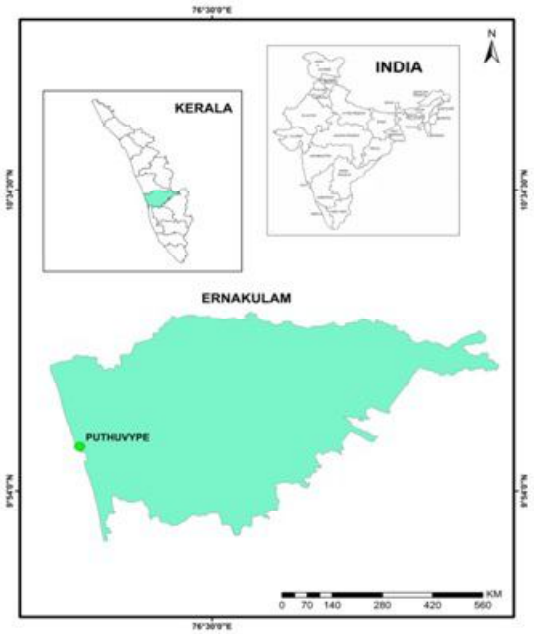

Fig. 1. Map of the study area (Puthuvype, Cochin backwaters, Ernakulum district, Kerala, India).

RESULTS AND DISCUSSION

The isolated mangrove patch at Puthuvype in the Cochin backwaters is home to 12 species of brachyuran crabs under four families: *Scylla olivacea* (Herbst, 1796), *S. serrata* (Forskål, 1775), *S. tranquebarica* (Fabricius, 1798), and *Thalamita crenata* (Rüppell,1830) (Portunidae); *Metopograpsus latifrons* (White, 1847), *M. messor* (Forskål, 1775), and *M. thukuhar* (Owen, 1839) (Grapsidae); *Neosarmatium malabaricum* (Henderson, 1893), *Parasesarma plicatum* (Latreille, 1803), and *Pseudosesarma glabrum* Ng, Rani & Bijoy Nandan, 2017 (Sesarmidae); *Austruca annulipes* (H. Milne Edwards, 1837) and *Austruca perplexa* (H. Milne Edwards, 1852) (Ocypodidae) (Fig. 2).

The annual mean abundance was highest for *P. plicatum* (211 individuals. 25 m^{-2}) followed by *A. annulipes* (201 individuals.25 m^{-2}) and *A. perplexa* (211 individuals.25 m^{-2}) whereas it was lowest for *P. glabrum* (6 individuals. 25 m^{-2}) followed by *M. latifrons* (8 individuals. 25 m^{-2}) (Table 1). The population of the remaining species was limited (annual mean abundance = 16–30 individuals. 25 m^{-2}) in the studied area (Table 1). Most of the crabs showed low variation in population among the species of the same family. It is only the sesarmid species that demonstrated an extreme variation as regards to their abundance. This could be due to the specific habit or habitat preferences of each species even if they coexist. For instance, *N. malabaricum* mainly inhabits elevated landward areas in order to avoid frequent tidal inundation and actively translocates fallen mangrove leaves into its burrows (cf. Davie, 1994: Shanij *et al*., 2016a) whereas *P. plicatum* prefers feeding on leaf litter on the forest floor itself (Shanij *et al*., 2016a) and shelters in exposed mangrove trunks during high tide rather than moving to elevated areas (Shanij *et al*., 2016 b). The contrasting habitat preferences between these two species could be one of the factors influencing their distribution and abundance. On the other hand, *P. glabrum* is a recently described sesarmid species, and its ecological requirements are still to be explored in detail (see Ng *et al*., 2017). *Pseudosesarma glabrum* is nevertheless abundant during the post-monsoon and mainly feeds on mangrove litter during the low tide when there is more freshwater inflow (Ng *et al*., 2017).

The diversity and evenness indices of brachyuran crabs were highest during monsoon season and lowest during pre-monsoon whereas the dominance index showed a reverse trend (Table 2). Although the diversity of crabs during monsoon and post-monsoon seasons are rich and comparable, the relatively higher value of evenness index during monsoon season indicates that the crabs are more evenly distributed during monsoon than post-monsoon (Table 2). Salinity is known to affect crab diversity (Varadharajan *et al*., 2013). Salinity rise in a mangrove ecosystem can affect its faunal diversity, including that of the crabs (Sandilyan *et al*., 2010). The high crab diversity during monsoon and post-monsoon seasons could be attributed the presence of more number and variety of brackish water dependant species that are likely to disappear during the high saline periods (pre-monsoon). Soundarapandian *et al*. (2008) also observed high crab population during monsoon and post-monsoon from the Pichavaram mangroves on the east coast of India. Overall, the annual diversity of brachyurans at Puthuvype seems to be balanced, as indicated by the high evenness index and the low dominance index (Table 2).

Fig. 2. Dorsal habitus of brachyuran crabs collected from the mangroves at Puthuvype, Cochin backwaters: (1) *Scylla olivacea*, Herbst, 1796 (2) *Scylla Serrata*, Forskal, 1775 (3) *Scylla tranquebarica* Fabricus, 1798 (4) *Thalamita crenata*, Ruppell, 1830 (5) *Metopograpsus latifrons*, White, 1847 (6) *Metopograpsus messor*, Forskal, 1775 (7) *Metopograpsus thukuhar*, Owen, 1839 (8) *Neosarmatium malabaricum*, Henderson, 1893 (9) *Parasesarma plicatum*, Latreille, 1803 (10) *Pseudosesarma glabrum*, Ng, 2017 (11) *Austruca annulipes*, Milne Edwards, 1837 (12) *Austruca perplexa*, Milne Edwards, 1852. Scale bar-1cm

The mangroves of the Puthuvype area are under severe degradation from the rapid urban development and industrialization (Sahadevan *et al*., 2017). Although previous reports on brachyuran crabs in and around the Puthuvype area are available (Apreshgi, 2014; Devi, 2015; Sahadevan, 2016; Ng *et al*., 2017; Apreshgi and Abraham, 2018), the present study will serve as a baseline data on these decapods for their conservation planning. Considering the faunal richness (including crabs) and ongoing industrial development near the isolated mangrove patch at Puthuvype in the Cochin backwaters, urgent conservation action should be taken to sustain the animal diversity by protection the existing mangroves through legislation and awareness programmes.

Table 1. Abundance of brachyuran crab in the mangroves at Puthuvype, Cochin backwaters

Family	**Species**	**Annual mean abundance** (individuals. 25 m^2)
Portunidae	*Scylla olivacea*	20
	Scylla serrata	11
	Scylla tranquebarica	29
	Thalamita crenata	30
Grapsidae	*Metopograpsus latifrons*	8
	Metopograpsus messor	16
	Metopograpsus thukuhar	23
Sesarmidae	*Neosarmatium malabaricum*	21
	Parasesarma plicatum	211
	Pseudosesarma glabrum	6
Ocypodidae	*Austruca annulipes*	201
	Austruca perplexa	111

Table 2. Diversity indices of brachyuran crabs in the mangroves at Puthuvype, Cochin backwaters

Diversity indices	**Pre-monsoon**	**Monsoon**	**Post-monsoon**	**Annual**
Shannon-Weiner's diversity index	1.71	1.89	1.88	2.11
Simpson's dominance index	0.24	0.21	0.2	0.25
Shannon's evenness index	0.69	0.75	0.71	0.89

ACKNOWLEDGEMENTS

This work was supported by the E grantz fellowship from the Government of Kerala. Laboratory and other facilities are provided by the Head of the Department of Aquatic Biology and Fisheries, University of Kerala, Thiruvananthapuram (DABFUK). The first author is thankful to Dr. A. Bijukumar (DABFUK), Dr. Peter K.L Ng (National University of Singapore), and Dr.Christoph D. Schubart (University of Regensburg, Germany) for confirming the species identity. Thanks are also due to Dr. Tresa Radhakrishnan (DABFUK) for the support extended.

REFERENCES

Apreshgi, K.P. 2014. *Diversity of brachyurans crabs of selected mangrove ecosystems of Kerala*. M.Phil. dissertation, University of Kerala, Thiruvananthapuram, 94 pp.

Apreshgi, K.P., Dhaneesh, K.V., Tresa, R. and Biju Kumar, A. 2016. DNA barcoding of fiddler crabs *Uca annulipes* and *U. perplexa* (Arthropoda, Ocypodidae) from the Southwest of India. *J. Mar. Biol. Ass. Ind*, 58 (1)

Apreshgi, K.P. and Abraham, K.M. 2018. Brachyuran mangrove crab diversity of Puthuvype mangrove belt, Cochin, Kerala, pp. 93–97. In: *Proceedings of the International Conference on Innovations and*

Sustainable Research in Environment and Life Sciences,7–9th August, 2018.P.G. and Research Department of Zoology, Fatima Mata National College, Kollam, Kerala.

Araty Sasikumar, 2009. Faunal diversity of mangrove ecosystems of Kadalundi and Nalallam, North Kerala, India. PhD Thesis, University of Calicut, Kerala.

Aspey, W. P. 1978. Fiddler crab behavioral ecology: burrow density in *Uca pugnax* (Smith) and *Uca pugilator* (Bosc) (Decapoda Brachyura). *Crustaceana*, 34: 235–244.

Bhat, S.G. and Sreekanth P.M., 2018. Riverine biodiversity monitoring with reference to true mangroves in comparison with preflood data. Final Report to Kerala State Biodiversity Board, 3371/A8/2018/KSBB. Dept. of Biotechnology, CUSAT, Kochi, Kerala, 66pp.

Caésar, I.I., Armendáriz, L.C. and Becerra, T.V. 2005. Bioecology of the fiddler crab *Uca uruguayensis* and the burrowing crab *Chasmagnathus granulates* (Decapoda, Brachyura) in the Refugio de Vida Silvestre Bahía Samborombón, Argentina. *Hydrobiologia*, 545: 237–248.

Davie, P.J.F. 1994. Revision of Neosarmatium Serine and Soh (Crustacea: Brachyura: Sesarminae) with descriptions of two new species. Memoirs of the Queensland Museum 35(1): 35-74.

Dev Roy, M.K. and Das, A.K. 2000. Taxonomy, ecobiology and distribution pattern of the brachyuran crabs of mangrove ecosystem in Andaman Islands. *Rec. Zool. Surv. India*, Occ. Paper No. 185: 1–211, pls. 1–21, text figs. 1–5.

Devi, P.L. 2015. Brachyuran crabs of Cochin backwaters-Diversity, habitat ecology and systematics, with special emphasis to genus *Scylla*. Ph.D. thesis, Faculty of science, Cochin University of Science and Technology, Kochi, India, 325pp.

Ewa-Oboho, I.O. 1993. Substratum preference of the tropical estuarine crabs, *Uca tangeri* Eydoux (Ocypodidae) and *Ocypode cursor* Linne (Ocypodidae). *Hydrobiologia*, 271: 119–127.

Fabricius, J.C. 1798. *Supplementum Entomologiae Systematicae*. Proftet Storch. *Hafniae* (= Copenhagen), pp. 1–572

Forsskal, P. 1775. Descriptiones Animalium Avium, Amphibiorum, Piscium, Insectorum, Vermium; quae in Itinere orientali observavit. Petrus Forskål. Post Mortem Auctoris editit Carsten Niebuhr. Adjuncta est materia Medica Kahirina. Hauniae, Heineck et Faber, http://dx.doi.org/10. 5962/bhl.title.2154

Henderson, J.R. 1893. A Contribution to Indian Carcinology. *Transaction of the Linnaean Society, London*, series 2 (Zoology) 5: 325-458

Herbst, J.F.W. 1796. Versuch einer Naturgeschichte der Krabben und Krebse nebst einer systematischen Beschreibung ihrer verschiedenen Arten. 2:1–226.

Humphries, C.J., Williams, P.H. and Van-Wright, R.I. 1995. Measuring biodiversity value for conservation. Annual. Rev. Ecol. Syst. 26:93-111.

Icely, J.D. and Jones, D. A. 1978. Factors affecting the distribution of the genus *Uca* (Crustacea: Ocypodidae) on an East African shore. *Estua. Coast. Mar. Sci.*, 6: 315–322.

Latreille, P. 1803. Histoire naturelle, generate et particuliere, des crustaces et des insectes: Vol. 3. F. Dufart. 468 p.

Macnae, W. 1968. A general accounts of the fauna and flora of mangrove swamps and forests in the Indo-west Pacific region. *Adv. Mar. Biol*., 6:73–270.

Milne Edwards, H. 1852. Observations sur les affinités zoologiques et la classification naturelle des Crustacés. *Annales des Sciences Naturelles, Zoologie*, 18: 109-166 (pls. 3-4)

Milne Edwards, H.1837. Histoire Naturelle des Crustacés, comprenant l'anatomie, la physiologie et la classification de ces animaux. Librairie de Roret, Paris, 2, 532 pp., Atlas, 32 pp., pl. 1–42.

Naskar, K. and Mandal, R. 1999. *Ecology and Biodiversity of Indian Mangroves. Part-I: Global Status*. Daya Publishing House, Delhi, 361 pp.

Ng, P.K.L., Guinot, D. and Davie, P.J.F. 2008. Systema Brachyurorum: Part I. An annotated checklist of extant brachyuran crabs of the world. *Raffles Bull .Zool.*, Supp. No.17:1–296.

Ng, P.K.L., Rani, V. and Nandan, S.B. 2017. A new species of *Pseudosesarma* Serène & Soh, 1970 (Crustacea: Brachyura: Sesarmidae) from Cochin in southwestern India. *Zootaxa*, 4311(2):263–270.

Owen, R. 1839. Crustacea In: The zoology of captain Beechey's voyage; complied from the collections and notes made by captain Beechey, the officers and naturalist of the expedition, during a voyage to the Pacific and Bering Straits performed in His Majesty's ship Blossom, under command of captain F. W. Beechey, R.N.F.R.S. in the years 1825, 26, 27, and 28: 77-92. (H. G. Bohn, London).

Pandya, P. J. and Vachharajani, K.D. 2010. Spatial distribution and substratum preference of the brachyuran crab, *Macrophthalmus depressus* (Decapoda: Ocypodidae) along the lower estuarine mudflat of Mahi River, Gujarat, India. *Crustaceana*, 83(9): 1056– 1067.

Pillai, N.K. 1951. Decapoda (Brachyura) from Travancore. *Bull. Cent. Res. Inst. Univ. Travancore*, Ser. C Nat. Sci., 2:1–46.

Rabalais, N.N. and Cameron, J.N. 1985. Physiological and morphological adaptations of adults *Uca subcylindrica* to semi-arid environments. *Biol. Bull*., 168: 135–146.

Radhakrishnan, C., Gopi, K.C. and Palot, M.J. 2006. Mangroves and their faunal associates in Kerala with special reference to Northern Kerala, India. Rec. Zool. Surv. India, *Occ. Paper* No.*246:1–81*.

Rajesh, L., Smrithy, R., Pati, S.K. and Biju Kumar, A. 2017. The freshwater crabs (Decapoda: Brachyura) of Kerala, India. *Journal of Aquatic Biology and Fisheries*, 5: 132-153.

Rüppell, W.P.E.S. 1830. Beschreibung und Abbildung von 24 Arten kurzschwänzigen Krabben, als Beitrag zur Naturgeschichte des rothen Meeres. Frankfurt a.m., H.L. Brönner, 1–28

Sahadevan, P. 2016. Diversity of fishes, crustaceans and molluscs of Puthuvypeen of Ernakulam District, Kerala, South India. *Int. J. Fish. Aquat. Stud*., 4(6):101–107.

Sahadevan, P., Dinesan, C. and Suma, C.C. 2017. On mangroves and mangrove associates of Puthuvypin of Ernakulam district of Kerala (South India). *Int. J. Multidiscip. Res. Dev.*, 4(3): 134–139.

Sakai, T. 1976. *Crabs of Japan and the Adjacent Seas. Volume 1*. Kodansha Ltd., Tokyo, 773 pp.

Sandilyan, S.K., Thiyagesan, R., Nagarajan and Jayshree, V. 2010. Salinity rise in Indian mangroves – a looming danger for coastal biodiversity. *Current Science*, 98(6).

Sethuramalingam and Ajmal Khan, S. 1991. *Brachyuran crabs of Parangipettai Coast*. Centre of Advanced study in Marine Biology, Annamalai University, 92pp.

Shanij, K., Praveen, V.P., Suresh, S., Oommen, M.M. and Nayar, T.S. 2016 a. Leaf litter translocation and consumption in mangrove ecosystems: the key role played by the sesarmid crab *Neosarmatium malabaricum*. *Current science*, VOL. 110, NO. 10

Shanij, K., Praveen, V.P., Suresh, S., Oommen, M.M. and Nayar, T.S. 2016 b. Tree climbing and temporal niche shifting: an anti-predatory strategy in the mangrove crab *Parasesarma plicatum* (Latreille, 1803). *Current Science*, 111(7).

Shannon, C.E. and Weaver, W. 1963. *The Mathematical theory of Communication*, University of Illinois Press, Urbana, 117pp.

Simpson, E.H. 1949. Measurement of diversity. *Nature*, 163: 688.

Soundarapandian, P., Samuel, N.J., Ravichandran, S. and Kannupandi, T. 2008. Biodiversity of Crabs in Pichavaram Mangrove Environment, South East Coast of India. International Journal of Zoological Research 4(2): 113-118

Sreelekshmi, S., Preethy, C.M., Rani, V., Philomina, J., Asha, C.V., Nandan, S.B. and Radhakrishnan, C. K. 2018. Diversity, stand structure, and zonation pattern of mangroves in southwest coast of India. *Journal of Asia Pacifica Biodiversity*. 11 (4): 573-582

Thurman, C.L. 1998. Osmoregulation by six species of fiddler crabs (*Uca*) from the Mississippi delta area in the northern Gulf of Mexico. *J. Exp. Mar. Biol. Ecol*., 291: 233–252.

Trivedi, J.N., Trivedi, D.J., Vacchirajani, K.D. and Peter, K.L.Ng. 2018. An annotated checklist of the marine brachyuran crabs (Crustacea: Decapoda: Brachyura) of India. Zootaxa, 4502 (1): 001-083.

Varadharajan, D., Soundarapandian, P. and Pushparajan, N. 2013. Effect of Physico-Chemical Parameters on Crabs Biodiversity. *J Marine Sci Res Dev* 3:1.

White, A. 1847. List of the specimens of Crustacea in the collection of the British Museum. British Museum, London, viii + 143 pp. Biodiversity of brachyuran crabs (Crustacea: Decapoda) from non-consolidated sublittoral bottom on the northern coast of Sa˜o Paulo State, Braz

WoRMS Editorial Board. 2018. World Register of Marine Species. Available from http://www.marinespecies.org at VLIZ .Accessed 2018-03-17