

## A checklist of the barnacles (Crustacea: Cirripedia: Thoracica) of the Persian Gulf and Gulf of Oman with nine new records

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### Abstract

The present annotated checklist contains 43 species of thoracican barnacles known to date from the area, 33 and 26 from the Persian Gulf and the Gulf of Oman, respectively. Nine species are new records for the area including *Amphibalanus subalbidus* (Henry, 1973), *Armatobalanus allium* (Darwin, 1854), *Chelonibia patula* (Ranzani, 1818), *Conchoderma hunteri* (Owen, 1830), *Lepas anserifera* Linnaeus, 1767, *Lithotrya valentiana* Reinhardt, 1850, *Megabalanus coccopoma* (Darwin, 1854), *Megabalanus occator* (Darwin, 1854) and *Platylepas hexastylos* (Fabricius, 1798), of which *A. subalbidus* and *M. coccopoma* are reported as alien species from the region.

**Key words:** Barnacle, Cirripedia, Persian Gulf, Gulf of Oman, Checklist, New records

### Introduction

The classification of the subphylum Crustacea has recently been revised by Ahyong *et al.* (2011). They included three superorders for the infraclass Cirripedia Burmeister, 1834, namely Acrothoracica Gruvel, 1905 (burrowing barnacles), Rhizocephala Müller, 1862 (parasitic barnacles) and Thoracica Darwin, 1854 (true barnacles). The superorder Thoracica is well represented and well documented compared to the other two groups. However, the cirripede fauna of the Persian Gulf and the Gulf of Oman has not received much taxonomic attention compared to other crustacean groups. The majority of studies on the barnacle fauna of the region are pre-1970, although barnacles are some of the most potent marine organisms passively distributed to new areas via human activity (Tottrup *et al.* 2010; Farrapeira *et al.* 2007). *Acasta spongites* (Poli, 1795) was the first recorded species from the region (Gruvel, 1902), Nilsson-Cantell (1938) reported 13 species from the Persian Gulf and four from the Gulf of Oman and Stubbings (1961) reported five species from the Kuwait coast in the Persian Gulf. Utinomi (1969) examined material collected by the Danish Expedition 1937/1938 and recorded 16 species, of which 13 are from the Persian Gulf and nine from the Gulf of Oman. He also recorded two species of parasitic barnacles, *Sacculina leptodiae*, Guerin-Ganivet, 1911 and *S. angulata* Van Kampen & Boschma, 1925, from the crabs *Leptodius* spp and *Thalamita iranica* Stephensen, 1946, respectively. Basson *et al.* (1977) and Jones (1986) recorded two and five species from Saudi Arabia and Kuwait, respectively. Since 2005, a biodiversity project along the Iranian coast of the Persian Gulf and the Gulf of Oman is focusing mainly on intertidal Crustacea. Barnacles collected by the project are deposited in the Zoological Museum, University of Tehran (ZUTC) (detailed in Shahdadi, 2007). From this collection, two chthamalid species were recorded (Shahdadi & Sari, 2011), a new species, *Tetraclita ehsani* Shahdadi *et al.* 2011, was described, and the remainder are presented herein. The current work adds nine new records to the barnacle list of the Persian Gulf and the Gulf of Oman. Some are likely newly introduced to the area, raising the recorded number of thoracican barnacles to 43 species, of which 33 occur in the Persian Gulf and 26 in the Gulf of Oman. An annotated checklist of the barnacles is provided and their geographical distribution, habitat

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## References

- Achituv, Y. & Safriel, U.N. (1980) A new *Chthamalus* (Crustacea, Cirripedia) from intertidal rocks of the Red Sea. *Israel Journal of Zoology*, 29, 99–109.
- Achituv, Y. (2004) Coral-inhabiting barnacles (Cirripedia, Balanomorpha, Pyrgomatidae) from the Kermadec Island and Niue Island, New Zealand. *New Zealand Journal of Marine and Freshwater Research*, 38, 43–49.  
<http://dx.doi.org/10.1080/00288330.2004.9517216>
- Achituv, Y. & Langsam, Y. (2004) Coral-inhabiting barnacles (Cirripedia. Thoracica. Balanomorpha. Pyrgomatinae) from east of 150° West. *Journal of Natural History*, 39, 1705–1717.  
<http://dx.doi.org/10.1080/00222930400021523>
- Ahyong, S.T., Lowry, J.K., Alonso, M., Bamber, R.N., Boxshall, G.A., Castro, P., Gerken, S., Karaman, G.S., Goy, J.W., Jones, D.S., Meland, K., Rogers, D.C. & Svavarsson, J. (2011) Subphylum Crustacea Brünnich, 1772. In: Zhang, Z.-Q. (Ed.), Animal Biodiversity. An Outline of Higher-level Classification and Survey of Taxonomic Richness. *Zootaxa*, 3148, 165–191.
- Al-Jahani, A.M.M. (2008) Oil pollution preparedness in the ROPME Sea Area. In: Abuzinada, A.H., Barth, H.-J., Krupp, F., Böer, B. & Abdessalam, T.Z. (Eds.), *Protecting the Gulf's Ecosystem from Pollution*. Birkhäuser Verlag, Switzerland, 107–120.
- Annandale, N. (1906) Report on the Cirripedia collected by Professor Herdman, at Ceylon, in 1902. *Ceylon Pearl Oyster Fisheries Supplementary Report*, 31, 137–150.
- Annandale, N. (1909) An account of the Indian Cirripedia Pedunculata Part 1. Family Lepadidae (sensu stricto). *Records of the Indian Museum*, 2 (2), 61–137.
- Aurivillius, C.W.C. (1894) Studien über Cirripeden. Kongl. Svenska Vetenskaps-Akademiens Handlingen, 26 (7), 7–89.
- Basson, P.W., Burchard, J.E., Hardy, J.H. & Price, A.R.G. (1977) *Biotopes of the Western Arabian Gulf*. ARAMCO, Dhahran, 284 pp.
- Buckeridge, J.S. & Newman, W.A. (2006) A revision of the Iblidae and the pedunculate barnacles (Crustacea: Cirripedia: Thoracica), including new ordinal, familial and generic taxa, and two new species from New Zealand and Tasmanian waters. *Zootaxa*, 1136, 1–38.
- Burmeister, H. (1834) *Beiträge zur Naturgeschichte der Rankenfusser (Cirripedia)*. G. Reimer, Berlin, 60 pp.
- Chan, B.K.K., Prabowo, R.E. & Lee, K-S. (2009) *Crustacean fauna of Taiwan. Barnacles, volume I - Cirripedia. Thoracica excluding the Pyrgomatidae and Acastinae*. National Taiwan Ocean University, Keelung, Taiwan, i–xx, 1–297.
- Darwin, C. (1852) *A monograph of the sub-class Cirripedia, with figures of all the species. The Lepadidae: Or, Pedunculated Cirripedes*. Ray Society, London, 400 pp.
- Darwin, C. (1854) *A monograph on the Subclass Cirripedia, with figures of all the species. The Balanidae, the Verrucidae, etc.* Ray Society, London, 684 pp.
- Dineen, J.F. & Hines, A.H. (1994) Effects of salinity and adult extract on settlement of the oligohaline barnacle *Balanus subalbidus*. *Marine Biology*, 119, 423–430.  
<http://dx.doi.org/10.1007/bf00347539>
- Ellis, J. (1759) An account of several rare species of barnacles. *Philosophical Transactions*, 1758, 50, 845–55. [read December 21, 1758; published 1759]
- Fabricius, O. (1798) Tillæg til Conchyliæ-Slaegterne *Lepas*, *Pholas*, *Mya* og *Solen*. *Skrivter af Naturhistorie-Selskabet* 4, 34–51.
- Farrapeira, C.M.R., Melo, A.V.O.M., Barbosa, D.F. & Silvas, K.M.E. (2007) Ship hull fouling in the Port of Recife, Pernambuco. *Brazilian Journal of Oceanography*, 55, 207–221.  
<http://dx.doi.org/10.1590/s1679-87592007000300005>
- Forskål, P. (1775) *Descriptiones Animalium Avium, Amphibiorum, Piscium, Insectorum, Vermium; quae in Itinere orientali observavit. Petrus Forskal. Post Mortem Auctoris editit Carsten Niebuhr. Adjuncta est materia Medica Kahirin*, 9, i–xxxiv, 1–164, 1 map.
- Goh, N.K.C., Ng, P.K.L. & Chou, L.M. (1999) Notes on the shallow water gorgonian associated fauna on coral-reefs in Singapore. *Bulletin of Marine Science*, 65, 259–282.
- Gray, J.E. (1825) A synopsis of the genera of Cirripedes arranged in natural families, with a description of some new species. *Annals of Philosophy*, new series, 10, 97–107.
- Gruvel, J.A. (1902) Cirripèdes. *Expédition scientifique du "Travailleur" et du "Talisman" pendant les années 1880–1883*, 7, 1–178, 7 pls.

- Gruvel, J.A. (1903) Revision des Cirripèdes appartenant à la collection du Muséum d'Histoire Naturelle (Opercules). II. Partie systématique. *Muséum National d'Histoire Naturelle*. Paris, Nouvelles Archives, Série 4, 5, 95–170.
- Gruvel, J.A. (1905) *Monographie des Cirripèdes au Thencostrace*. Masson et Cie, Paris, 472 pp.
- Guerin-Ganivet, J. (1911) Contribution à l'étude systématique et biologique des Rhizocéphales. *Travaux Scientifiques de Laboratoire de Zoologie et de Physiologie Maritimes de Concarneau*, 3, 1–97.
- Haapkylai, J., Ramade, F. & Salvat, B. (2007) Oil pollution on coral reefs: a review of the state of knowledge and management needs. *Vie et Milieu*, 57, 95–1.
- Henry, D.P. (1973) Descriptions of four new species of the *Balanus amphitrite* complex (Cirripedia: Thoracica). *Bulletin of Marine Science*, 23 (4), 964–1001.
- Henry, D.P. & McLaughlin, P.A. (1975) The barnacles of the *Balanus amphitrite* complex (Cirripedia, Thoracica). *Zoologisch Verhandelingen*, 141, 1–254.
- Henry, D.P. & McLaughlin, P.A. (1986) The recent species of *Megabalanus* (Cirripedia, Balanomorpha) with special emphasis on *Balanus tintinnabulum* (Linnaeus) *sensu lato*. *Zoologische Verhandelingen*, 235, 1–69.
- Hinds, R.B. (1844) Voyage of *Sulphur*, 1836–1842. Vol. 1. Mollusca, London, 24 pp.
- Hoek, P.P.C. (1883) Report on the Cirripedia collected by H.M.S. Challenger during the years 1873–1876. *Report of the Scientific Results from the Exploratory Voyages of H.M.S. Challenger*, Zoology, 8, 1–169.
- Hoek, P.P.C. (1907) The Cirripedia of the Siboga Expedition, Pedunculata. *Siboga-Expedition*, Monograph, 31a, 1–127, pls. 1–10.
- Hoek, P.P.C. (1913) The Cirripedia of the Siboga Expedition, B. Cirripedia sessilia. *Siboga-Expedition*, Monograph, 31b, i–xxv, 129–275, pls. 11–27, text figs. 1–2.
- Jones, D.A. (1986) *A field guide to the sea shore of Kuwait and the Arabian Gulf*. University of Kuwait, 192 pp.
- Jones, D.S., Hewitt, M.A. & Sampey, A. (2000) A checklist of the Cirripedia of the South China Sea. *The Raffles Bulletin of Zoology, Supplement* 8, 233–307.
- Kampen, P.N. Van & Boschman, H. (1925) Die Rhizocephalen der Siboga-Expedition. *Siboga-Expedition*, Monograph, 31 bis.
- Kolbasov, G.A. (1993) Revision of the genus *Acasta* Leach (Cirripedia: Balanoidea). *Zoological Journal of the Linnean Society*, 109, 395–427.  
<http://dx.doi.org/10.1111/j.1096-3642.1993.tb00307.x>
- Lamarck, J.B.P.A. de M. ch. De. (1818) *Histoire naturelle des animaux sans vertèbres*. Vol. 5. Deterville, Paris, 612 pp.
- Leach, W.E. (1817) Distribution systématique de la classification des Cirripèdes. *Journal de Physique de Chimie et d'Histoire naturelle*, 85, 67–69.
- Leach, W.E. (1825) A tabular view of the genera composing the class Cirripedes, with descriptions of the species of *Otion*, *Cineras* and *Clyptera*. *The Zoological Journal*, 2, 208–215.
- Linnaeus, C. (1758) *Systema Naturae Sive Regna Tria Naturae, Secundum Classes, Ordines, Genera, Species, cum Characteribus, Differentiis, Synonymis, Locis*. Tomus I. Editio decima, reformata, Holmiae, ii + 824 pp.
- Linnaeus, C. (1767) *Systema Naturae per regna tria naturae – editio duodecima, reformata*. Holmiae, 1 (2), 533–1327.
- Müller, F. (1862) Die Rhizocephalen, eine neue Gruppe Schmarotzender Kruster. *Archiv für Naturgeschichte*, 28, 1–9.
- Naser, M.D., Timothy, J.P., Ng, N.K., Apel, M., Yasser, A.G., Bishop, J.M., Ng, P.K.L. & Clark, P.F. (2012) Invasive records of *Eriocheir hepuensis* Dai, 1991 (Crustacea: Brachyura: Grapsoidea: Varunidae): Implications and taxonomic considerations. *BioInvasions Records*, 1 (1), 71–86.  
<http://dx.doi.org/10.3391/bir.2012.1.1.15>
- Newman, W.A. & Ross, A. (1976) Revision of the Balanomorph barnacles, including a catalogue of the species. *Memoirs of the San Diego Society of Natural History*, 9, 1–108.
- Newman, W.A. (1987) Evolution of cirripedes and their major groups. In: Southward, A.J. (Ed.), *Barnacle Biology. Crustacean Issues*, 5, pp. 3–42.
- Newman, W.A. (1979) On the biogeography of balanomorph barnacles of the southern ocean including two new balanid taxa: a subfamily, two genera and three spp. *Proceedings of the International Symposium on Marine Biogeography and Evolution in the Southern Hemisphere, University of Auckland, July 14–29, 1978, New Zealand*. Department of Scientific Industrial Research Information, Series 137, 1, 279–306.
- Nilsson-Cantell, C.A. (1938) Cirripedes from the Indian Ocean in the collections of the Indian Museum, Calcutta. *Memoirs of the Indian Museum*, 13, 1–81.
- Owen, R. (1830) *Catalogue of the contents of the Museum of the Royal College of Surgeons of London*, Invertebrate Part I, 1–44.
- Pilsbry, H.A. (1907) The barnacles (Cirripedia) contained in the collections of the U.S. National Museum. *Bulletin of the United States National Museum*, 60, 1–122.  
<http://dx.doi.org/10.5479/si.03629236.60.1>
- Pilsbry, H.A. (1916) The sessile barnacles (Cirripedia) contained in the collection of the U.S. National Museum; including a monograph of the American species. *Bulletin of United State National Museum*, 93, 1–366.  
<http://dx.doi.org/10.5479/si.03629236.93.1>
- Pitombo, F.B. (2004) Phylogenetic analysis of the Balanidae (Cirripedia, Balanomorpha). *Zoologica Scripta*, 33, 261–276.  
<http://dx.doi.org/10.1111/j.0300-3256.2004.00145.x>
- Poli, G.S. (1795) *Testacea utriusque Sicilae eorumque historia et anatomie* Tom 2. *Testacea Utriusque Siciliae*, 2, 75–264.

- Ranzani, C. (1818) Osservazioni su i Balanidi. *Opuscoli Scientifici*, 2, 63–93.
- Reinhardt, J.T. (1850) Om Slaegten *Lithotryas* Evne til at bore sig ind Steenblokke. *Videnskabelige Meddelelser Naturhistorisk Forening i Kjøbenhavn*, 1, 1–18.
- Rezai-Atagholipour, M., Naderloo, R., Kamrani, E. & Savari, R. (2013) Preliminary biological information of *Scylla serrata* (Forskål, 1775) (Brachyura, Portunidae) in the Persian Gulf and Gulf of Oman: a conservation priority. *Crustaceana*, 86 (3), 322–335.  
<http://dx.doi.org/10.1163/15685403-00003174>
- Ross, A. & Newman, W.A. (1973) Revision of the coral-inhabiting barnacles (Cirripedia. Balanidae). *Transactions of the San Diego Society of Natural History*, 17, 137–174.
- Shahdadi, A. (2007) *Taxonomy and Biogeography of Intertidal Barnacles (Crustacea, Cirripedia) of the Persian Gulf and the Gulf of Oman*. Unpublished M. Sc. thesis, University of Tehran, 131 pp.
- Shahdadi, A. & Sari, A. (2011) Chthamalid barnacles (Cirripedia. Thoracica) of the Persian Gulf and Gulf of Oman, Iran. *Journal of the Marine Biological Association of the United Kingdom*, 91 (3), 745–753.  
<http://dx.doi.org/10.1017/s0025315410001803>
- Shahdadi, A., Chan, B.K.K. & Sari, A. (2011) *Tetraclita ehsani* sp. n. (Cirripedia, Tetraclitidae), a common intertidal barnacle from the Gulf of Oman, Iran. *Zookeys*, 136, 1–12.  
<http://dx.doi.org/10.3897/zookeys.136.1772>
- Sowerby, G.B. (1822–1834) *The genera of recent and fossil shells, for the use of students in Cochology and Geology, with original Plates by James Sowerby (Nos. i–xvii), continued by J.de C. Sowerby, Nos. xviii–xlvi*. G.B. Sowerby, London, no pagination, 270 plates.
- Spengler, L. (1790) Beskrivelse og Oplysing over den hidindtil lidet udarbeide Slaegt af mangeskallede Konchylier, som Linnaeus har daldet *Lepas*, med tilfoede nye og ubeskrevne Aeter. (Om. Conchylie-Slaegten *Lepas*). *Skrifter af Naturhistorie Selskabet*, 1 (1), 158–212.
- Stephensen, K. (1946) The Brachyura of the Iranian Gulf. *Danish Scientific Investigations in Iran*, Part IV, 57–237.
- Stubnings, H.G. (1961) Some Cirripedia from the Persian Gulf. *Annals and Magazine of Natural History*, Series 13, 4 (39), 171–176.  
<http://dx.doi.org/10.1080/00222936108655798>
- Tøttrup, A.P., Chan, B.K.K., Koskinen, H. & Høeg, J.T. (2010) ‘Flying barnacles’: implications for the spread of non-indigenous species. *Biofouling, The Journal of Bioadhesion and Biofilm Research*, 26 (5), 577–582.  
<http://dx.doi.org/10.1080/08927014.2010.489203>
- Tsang, L.M., Achituv, Y., Chu, K.H. & Chan, B.K.K. (2012) Zoogeography of intertidal communities in the West Indian Ocean as determined by ocean circulation systems: patterns from the *Tetraclita* barnacles. *PLoS One*, 7 (9), e45120.  
<http://dx.doi.org/10.1371/journal.pone.0045120>
- Utinomi, H. (1969) Cirripedia of the Iranian Gulf. *Videnskabelige Meddelelser fra Dansk Naturhistorisk Forening*, 132, 79–94.
- Williams, R. (1986) The occurrence of *Trilasmis kaempferi* (Cirripedia, Lepadomorpha) in the Rockall Trough on a previously unrecorded host, *Neolithodes grimaldi* (Decapoda, Anomura). The Oceanography of the Rockall Channel. *Proceedings of the Royal Society of Edinburgh*, 88B, 309–311.
- Yamaguchi, T., Prabowo, R.W., Ohshiro, Y., Shimono, T., Jones, D., Kawai, H., Otano, M., Inagawa, S., Akaya, T. & Tamura, I. (2009) The introduction to Japan of the Titan barnacle, *Megabalanus coccopoma* (Darwin, 1854) (Cirripedia. Balanomorpha) and the role of shipping in its translocation. *Biofouling*, 25, 325–333.  
<http://dx.doi.org/10.1080/08927010902738048>
- Yan, Y., Chen, H., Huang, L. & Sun, L. (2005) Larval development of the barnacle, *Ibla cumingi* (Cirripedia. Pedunculata. Iblidae) reared in the laboratory. *Journal of the Marine Biological Association of the United Kingdom*, 85 (4), 903–908.  
<http://dx.doi.org/10.1017/s0025315405011872>
- Zevina, G.B. & Litvinova, N.M. (1970) Supplement to the fauna of the barnacles (Cirripedia. Thoracica) of the Red Sea. In: Kovalevsky, A.O. (Ed.), *Biology of the Sea*, 18, pp. 172–181. [in Russian]
- Zevina, G.B. (1978) A new system of the family Scalpellidae Pilsbry (Cirripedia, Thoracica). 1. Sub-families Lithotryinae, Calanticinae, Pollicipinae, Scalpellinae, Brochiinae and Scalpellipsinae. *Zoologicheskiy Zhurnal*, 57 (7), 998–1007. [in Russian]