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Deep Sea

Faunal Diversity in India

KAILASH CHANDRA
C. RAGHUNATHAN
HONEY U.K. PILLAI
JASMINE P.
TAMAL MONDAL

ZOOLOGICAL SURVEY OF INDIA

Chapter 31

MOLLUSCA: CEPHALOPODA

Basudev Tripathy*, Amit Kumar Mukhopadhyay and S.K. Sajan

The current chapter deals with the updated list of the deep sea cephalopods of India. A total of 54 species belonging to 27 genera, 16 families and six orders of the class Cephalopoda have been documented by various research team from Indian Ocean, Bay of Bengal and Arabian Sea and much of the collections are reported through deep sea faunal exploration. An overview of the marine molluscs research and distributional pattern of the cephalopods from the east coast and west coast of India is briefly discussed.

Keywords: Cephalopoda, distribution, east coast, Indian sea, marine molluscs, west coast

INTRODUCTION

Mollusca constitute an important component of marine biodiversity of mainland and island coasts of India. Marine molluscs occurs in diverse habitats viz. rocky coasts, sandy beaches, sea grass beds, coral reef ecosystems, mangroves and also at abyssal depths in the sea. Of the 586 global families, 279 represented from Indian region, which included ~3600 species and of which ~2300 (65%) are marine. As there are no proper estimations of the number of molluscan species occurring in the marine ecosystems of India, especially in the deep sea, this is an attempt towards assessment of cephalopod diversity in India of deep sea records, as cephalopods by virtue of their biological characters are deepsea mollusc. This work is primarily based on the earlier literature records on Indian cephalopod molluscs, materials present in the National Collection of Zoological Survey of India (ZSI) and the materials received by the Mollusca Section of Zoological Survey of India from different part of the country for identification and other publications on cephalopods of India other than those of ZSI. This paper attempted at presenting an overview of diversity of deep sea marine molluscs India, and special emphasis on the cephalopod recorded from Indian seas.

Zoological Survey of India, M-Block, New Alipore, Kolkata – 700 053, West Bengal, India. *Corresponding author's Email: tripathyb@gmail.com

Deep sea Fauna: Marine Mollusca of India (Cephalopoda)

Basudev Tripathy, Amit Kumar Mukhopadhyay and Sheikh Sajan

Malacology Division, Zoological Survey of India, M Block, New Alipore, Kolkata – 700 053, West Bengal, India

Corresponding author: Basudev Tripathy, e-mail: tripathyb@gmail.com

Abstract

The current chapter deals with the updated list of the deep sea cephalopods of India. A total of 54 species belonging to 27 genera, 16 families and six orders of the class Cephalopoda have been documented by various research team from Indian Ocean, Bay of Bengal and Arabian Sea and much of the collections are reported through deep sea faunal exploration. An overview of the marine molluscs' research and distributional pattern of the cephalopods from the east coast and west coast of India is briefly discussed.

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Introduction

Mollusca constitute an important component of marine biodiversity of mainland and island coasts of India. Marine molluscs occur in diverse habitats viz. rocky coasts, sandy beaches, seagrass beds, coral reef ecosystems, mangroves and also at abyssal depths in the sea. Ouf of the 586 reported families of Mollusca, India harbours 279, that include ~3600 species of which ~2300 (65%) reported from marine and coastal habitats. As there are no proper estimations of the number of molluscan species occurring in the marine ecosystems of India, especially in the deep sea, this is an attempt towards the assessment of cephalopod diversity in India of deep-sea records, as cephalopods by virtue of their biological characters are deepsea mollusc. This work is primarily based on the earlier literature records on Indian cephalopod molluscs, materials present in the National Collection of Zoological Survey of India (ZSI) and the materials received by the Mollusca Section of Zoological Survey of India from different part of the country for identification and other publications on cephalopods of India other than those of ZSI. This paper attempted at presenting an overview of the diversity of deep-sea marine molluscs in India, and special emphasis on the cephalopod recorded from Indian seas.

Historical Review

The important contributions to marine molluscan taxonomical research in India are those of Goodrich (1896), (Massy, 1916), Adam (1939), Ray (1948; 1952; 1954), Hornell and Tomlin (1951), Subramanyam et al. (1951a, 1951b), Patil (1954), Satyamurti (1956), Patil and Gopalkrishnan (1960), Gideon et al. (1961), Tikader (1964), Cheriyan (1968), Narayanan (1968; 1969; 1972), Prabhakar Rao (1968), Subba Rao (1968; 1970; 1980; 2003), Joshi (1969), Radhakrishna and Ganapati (1969), Nagabhusanam and Rao (1972), Satyanarayana Rao and Sundaram (1972), Virbhadra Rao and Krishna Kumary (1973; 1974), Rajagopal and Subba Rao (1974), Starmuehlner (1974), Subba Rao and Dey (1975; 1984; 1986; 2000), Subba Rao and Mookherjee (1975), Das et al. (1981), Kohn (1978), Rajagopal and Mookherjee (1978; 1982), Namboodiri and Sivadas (1979), Gopinadha Pillai and Appukuttan (1980), Subba Rao and Surya Rao (1980; 1991), Subba Rao et al. (1983; 1987; 1991; 1992; 1993), Kashinathan and Shamugan (1985), Mookherjee (1985), Tikader and Das (1985), Tikader et al. (1986), , Jhothinayagam (1987), Mookherjee and Barua (1989), Apte (1992; 1993; 1997; 1998; 2009), Babu Philip and Appukutan (1995), Mahapatra (2001; 2008), Surya Rao et al. (2004), Venkataraman et al. (2004), Subba Rao and Sastry (2005), Dey et al. (2005), Dey (2008), Arularasan and Kashinathan (2007), Ramakrishna et al. (2007; 2010),

Rao and Sastry (2007), Venkitesan (2007), Roy et al. (2008), Apte et al. (2010), Raghunathan et al. (2010), Rao (2010), Venkitesan and Mukherjee (2011). Apart, there are several anocdatal accounts of marine mollusca of India on various aspects of their ecology, taxonomy, diversity and distribution studies done by universities, academic and research institutions.

Marine Mollusca along East Coast of India

Species Diversity: As per available literature 2199 species of molluscs under 588 genera and 185 families has been recorded from East Coast of India. Out of these 2199 species; 17 species of Polyplacophora under 12 genera and 6 families, 1487 species of Gastropoda under 344 genera and 104 families, 54 species of Cephalopoda under 23 genera and 11 families, 632 species of Bivalvia under 207 genera and 63 families and 9 species of Scaphopoda under 2 genera and one familiy (Venkataraman et al., 2012). Out of these 1487 listed species of gastropods, 222 species are repeated and 7 species under 3 genera and 3 families are freshwater molluscs listed along with the marine fauna. However, the autheticity of the data is debatable since there are several typographic errors including distribution records from both the coasts of India and islands.

Marine Mollusca along the west coast of India

Species Diversity: Inspite of diversified ecosystem *viz.* Coral reef, mangrove, estuaries and rockey potches, molluscan diversity along the west coast of India is less compare to east coast of India. Available literature reveal 707 species of gastropods, 248 species of bivalves, two species of scaphopoda, 80 species of cephalopods and 9 species of polyplacophora occur along the west coast of India (Tripathy and Mukhopadhyay, 2013, 2015). The reason for such poor diversity of marine mollusc along west coast could be due meagre inventorization by faunal survey organisations.

Molluscan hotspot along the west coast: West coast of India having a good coral reef ecosystem *viz*. Gulf of kutchch and Malvan, estuarine ecosystems *viz*. Mandvi, Juari, Narmada, Tapi and several backwaters in Kerala, sandy coastal stretches of Karnataka (Gangoli, Kundapur), Kerala (Alapuzha, Kovalam) which are rich in molluscan faunal assemblages. There are new records of bivalves and gastropods from these areas (Tripathy and Mukhopadhyay, 2013, 2015).

Endemism along the west coast of India: Among the gastropoda, out of the 707 species, 35 species are endemic to the west coast of India. Similarly, 8 species of marine bivalves are endemic west cost of India. However, there is no endemic species of scaphopoda, cephalopoda and Opithobranchia known adequately from the west coast of India.

Marine Molluscs along Island Coast of India

Andaman and Nicobar group of Islands

Species Diversity: A total of 1147 species belonging to 384 genera and 143 families representing five classes of molluscs are reported from the Andaman and Nicobar Islands. Out of these 1057 species are present in the NZC of ZSI and rest are reported by authors outside ZSI. These species belong to 372 genera and 141 families. The class Polyplacophora is represented by only 12 species belonging to 7 genera and four families. The class Cephalopoda includes 33 species belonging to 18 genera and 11 families and these islands are type locality for atleast seven species of cephalopods. Near about 350 species of bivalves have been recorded from the islands under 150 genera and 54 families. The class Scaphopoda is represented by 7 species belonging to a single family and genus.All the species are restricted distribution to Andaman and Nicobar Islands.

Lakshadweep

Species Diversity: Nagabhushanam and Rao (1972) made an ecological survey of marine fauna of Minicoy atoll (Lakshadweep Archipelago) and reported 191 marine mollusca belonging to 94 genera. Of these, 3 species are belonging to 3 genera of Polyplacophora; 130 species belonging 67 genera of Gastropoda; 7 species belonging 5 genera of Cephalopoda; 51 species belonging 19 genera of Bivalvia. Subsequently, Surya Rao and Subba Rao (1991) provided a consolidated list of molluscs from Lakshadweep islands in which 424 species under 201 genera and 105 families reported. Among these, 4 species of polyplacophora under 3 genera and one family, 303 species of gastropods under 138 genera and 70 families, 11 species of cephalopods under 7 genera and 5 families and 107 species of bivalves under 53 genera and 29 families have been reported from Lakshadweep islands (Surya Rao and Subba Rao, 1991).

Deep sea Molluca:

In terms of deep sea Mollusca, in this paper, we have only mention about the cephalopod diversity and distribution in the Indian sea.

Cephalopods of India

Cephalopods are the most highly organized molluscs and are the most accomplished swimmers other than fish. The size veries from minute to 25 m long and 2.5 m diameter. The class represented by 650 species belonging to Nautilus, Cuttlefish, Squids and Octopuses. There are 65 species under the class Cephalopoda reported so far from the Indian Ocean region (Roper et al., 1984) of which 66 species are reported by ZSI (Tripathy and Mukhopadhyay, 2015). However, the current updated list, we have documented 54 species belonging to 27 genera, 16 families and six orders inhebit to the east and west coastal region of the Indian Sea. The collections present at the Zoological Survey of India is based on two primary sources *viz*. inherited from the Indian Museum and obtained from its own surveys conducted by the scientists and naturalists of the department. Much of the collections were tht of from the holdings of the Asiatic Society of Bengal especially from the collections made through RIMS Investigator during 1884–1926 in the Indian seas. The first ever report on Cephalopoda from India was published by Goodrich (1896) along with 18 species of Decapods and 10 species of Octopods. Further, Massy (1916) described based on the collections available in the Indian Museum deposited by Goodrich. Adam (1939) attempted describing 43 species which were identified by Goodrich (1896) and Massy (1916). The Cephalopods in the present list have been taken in most instances by the 'Investigator' off the Indian and Burmese coasts at depths varying from 5 to 2000 fathoms. Apart from that, reporting of Cephalopods through deep sea cruise by other organisations and individuals are also mentioned. The Table 1 given the details of deep sea cephalopods reported from Indian coastal waters and Indian sea.

Table 1. Cephalopods diversity and distribution in the Indian Seas.

Class	Subclass	Order	Family	Scientific Name	East Coast	West Coast
Cephalopoda Cuvier, 1795	Nautiloidea Agassiz, 1847	Nautilida Agassiz, 1847	Nautilidae Blainville, 1825	*Nautilus pompilius* Linnaeus, 1758	+	–
Cephalopoda Cuvier, 1795	Coleoidea Bather, 1888	Sepiida Zittel, 1895	Sepiidae Leach, 1817	*Sepia aculeata* Van Hasselt [in Férussac & d'Orbigny], 1835	+	+

Cephalopoda Cuvier, 1795	Coleoidea Bather, 1888	Sepiida Zittel, 1895	Sepiidae Leach, 1817	*Sepia arabica* Massy, 1916	_	+
Cephalopoda Cuvier, 1795	Coleoidea Bather, 1888	Sepiida Zittel, 1895	Sepiidae Leach, 1817	*Sepia brevimana* Steenstrup, 1875	+	+
Cephalopoda Cuvier, 1795	Coleoidea Bather, 1888	Sepiida Zittel, 1895	Sepiidae Leach, 1817	*Sepia dollfusi* Adam, 1941		
Cephalopoda Cuvier, 1795	Coleoidea Bather, 1888	Sepiida Zittel, 1895	Sepiidae Leach, 1817	*Sepia elliptica* Hoyle, 1885	+	+
Cephalopoda Cuvier, 1795	Coleoidea Bather, 1888	Sepiida Zittel, 1895	Sepiidae Leach, 1817	*Sepia kobiensis* Hoyle, 1885	+	+
Cephalopoda Cuvier, 1795	Coleoidea Bather, 1888	Sepiida Zittel, 1895	Sepiidae Leach, 1817	*Sepia pharaonis* Ehrenberg, 1831	+	+
Cephalopoda Cuvier, 1795	Coleoidea Bather, 1888	Sepiida Zittel, 1895	Sepiidae Leach, 1817	*Sepia prashadi* Winckworth, 1936	+	+
Cephalopoda Cuvier, 1795	Coleoidea Bather, 1888	Sepiida Zittel, 1895	Sepiidae Leach, 1817	*Sepia thurstoni* Adam & Rees, 1966	+	_
Cephalopoda Cuvier, 1795	Coleoidea Bather, 1888	Sepiida Zittel, 1895	Sepiidae Leach, 1817	*Sepia trygonina* (Rochebrune, 1884)	+	+
Cephalopoda Cuvier, 1795	Coleoidea Bather, 1888	Sepiida Zittel, 1895	Sepiidae Leach, 1817	*Sepiella cyanea* Robson, 1924	_	+
Cephalopoda Cuvier, 1795	Coleoidea Bather, 1888	Sepiida Zittel, 1895	Sepiidae Leach, 1817	*Sepiella inermis* (Van Hasselt [in Férussac & d'Orbigny], 1835)	+	+
Cephalopoda Cuvier, 1795	Coleoidea Bather, 1888	Sepiida Zittel, 1895	Sepiidae Leach, 1817	*Sepiella weberi* Adam, 1939	_	+
Cephalopoda Cuvier, 1795	Coleoidea Bather, 1888	Sepiida Zittel, 1895	Sepiadariidae Fischer, 1882	*Sepiadarium kochii* Steenstrup, 1881	+	_
Cephalopoda Cuvier, 1795	Coleoidea Bather, 1888	Sepiida Zittel, 1895	Sepiolidae Leach, 1817	*Euprymna berryi* Sasaki, 1929	+	_
Cephalopoda Cuvier, 1795	Coleoidea Bather, 1888	Sepiida Zittel, 1895	Sepiolidae Leach, 1817	*Inioteuthis maculosa*	+	_

				Goodrich, 1896		
Cephalopoda Cuvier, 1795	Coleoidea Bather, 1888	Myopsida	Loliginidae Lesueur, 1821	*Loliolus* (*Loliolus*) *hardwickei* (Gray, 1849)	+	_
Cephalopoda Cuvier, 1795	Coleoidea Bather, 1888	Myopsida	Loliginidae Lesueur, 1821	*Uroteuthis* (*Photololigo*) *duvaucelii* (d'Orbigny [in Férussac & d'Orbigny], 1835)	+	+
Cephalopoda Cuvier, 1795	Coleoidea Bather, 1888	Myopsida	Loliginidae Lesueur, 1821	Sepioteuthis lessoniana d'Orbigny, 1826	+	+
Cephalopoda Cuvier, 1795	Coleoidea Bather, 1888	Myopsida	Loliginidae Lesueur, 1821	*Uroteuthis* (*Photololigo*) *singhalensis* (Ortmann, 1891)	+	_
Cephalopoda Cuvier, 1795	Coleoidea Bather, 1888	Oegopsida d'Orbigny, 1845	Enoploteuthidae Pfeffer, 1900	*Abralia* (*Heterabralia*) *andamanica* Goodrich, 1896	+	_
Cephalopoda Cuvier, 1795	Coleoidea Bather, 1888	Oegopsida d'Orbigny, 1845	Enoploteuthidae Pfeffer, 1900	*Abraliopsis gilchristi* (Robson, 1924)	_	+
Cephalopoda Cuvier, 1795	Coleoidea Bather, 1888	Oegopsida d'Orbigny, 1845	Enoploteuthidae Pfeffer, 1900	*Abraliopsis* (*Abraliopsis*) hoylei (Pfeffer, 1884)	+	+
Cephalopoda Cuvier, 1795	Coleoidea Bather, 1888	Oegopsida d'Orbigny, 1845	Enoploteuthidae Pfeffer, 1900	*Abraliopsis* (*Micrabralia*) *lineata* Goodrich, 1896	+	_
Cephalopoda Cuvier, 1795	Coleoidea Bather, 1888	Oegopsida d'Orbigny, 1845	Histioteuthidae Verrill, 1881	*Stigmatoteuthis hoylei* (Goodrich, 1896)	+	_

Cephalopoda Cuvier, 1795	Coleoidea Bather, 1888	Bathyteuthida	Bathyteuthidae Pfeffer, 1900	*Bathyteuthis abyssicola* Hoyle, 1885	+	+
Cephalopoda Cuvier, 1795	Coleoidea Bather, 1888	Oegopsida d'Orbigny, 1845	Ommastrephidae Steenstrup, 1857	*Sthenoteuthis oualaniensis* (Lesson, 1830)	+	+
Cephalopoda Cuvier, 1795	Coleoidea Bather, 1888	Oegopsida d'Orbigny, 1845	Chiroteuthidae Gray, 1849	*Chiroteuthis imperator* Chun, 1908	+	+
Cephalopoda Cuvier, 1795	Coleoidea Bather, 1888	Oegopsida d'Orbigny, 1845	Chiroteuthidae Gray, 1849	*Chiroteuthis picteti* Joubin, 1894	+	–
Cephalopoda Cuvier, 1795	Coleoidea Bather, 1888	Oegopsida d'Orbigny, 1845	Cranchiidae Prosch, 1847	*Megalocranchia abyssicola* (Goodrich, 1896)	–	+
Cephalopoda Cuvier, 1795	Coleoidea Bather, 1888	Octopoda Leach, 1818	Opisthoteuthidae Verrill, 1896	*Opisthoteuthis grimaldii* (Joubin, 1903)	+	+
Cephalopoda Cuvier, 1795	Coleoidea Bather, 1888	Octopoda Leach, 1818	Amphitretidae Hoyle, 1886	*Bolitaena pygmaea* (A. E. Verrill, 1884)	+	+
Cephalopoda Cuvier, 1795	Coleoidea Bather, 1888	Octopoda Leach, 1818	Octopodidae d'Orbigny, 1840	*Amphioctopus aegina* (Gray, 1849)	+	+
Cephalopoda Cuvier, 1795	Coleoidea Bather, 1888	Octopoda Leach, 1818	Octopodidae d'Orbigny, 1840	*Octopus arborescens* (Hoyle, 1904)	+	+
Cephalopoda Cuvier, 1795	Coleoidea Bather, 1888	Octopoda Leach, 1818	Octopodidae d'Orbigny, 1840	*Octopus cyanea* Gray, 1849	+	+
Cephalopoda Cuvier, 1795	Coleoidea Bather, 1888	Octopoda Leach, 1818	Octopodidae d'Orbigny, 1840	*Octopus fusiformis* Brock, 1887	+	+
Cephalopoda Cuvier, 1795	Coleoidea Bather, 1888	Octopoda Leach, 1818	Octopodidae d'Orbigny, 1840	*Octopus gardineri* (Hoyle, 1905)	+	+
Cephalopoda Cuvier, 1795	Coleoidea Bather, 1888	Octopoda Leach, 1818	Octopodidae d'Orbigny, 1840	*Octopus globosus* Appellöf, 1886	+	+

Cephalopoda Cuvier, 1795	Coleoidea Bather, 1888	Octopoda Leach, 1818	Octopodidae d'Orbigny, 1840	*Callistoctopus macropus* (Risso, 1826)	+	+
Cephalopoda Cuvier, 1795	Coleoidea Bather, 1888	Octopoda Leach, 1818	Octopodidae d'Orbigny, 1840	*Octopus microphthalmus* Goodrich, 1896	+	_
Cephalopoda Cuvier, 1795	Coleoidea Bather, 1888	Octopoda Leach, 1818	Octopodidae d'Orbigny, 1840	*Octopus prashadi* Adam, 1939	+	_
Cephalopoda Cuvier, 1795	Coleoidea Bather, 1888	Octopoda Leach, 1818	Octopodidae d'Orbigny, 1840	*Callistoctopus taprobanensis* (Robson, 1926)	+	_
Cephalopoda Cuvier, 1795	Coleoidea Bather, 1888	Octopoda Leach, 1818	Octopodidae d'Orbigny, 1840	*Abdopus tonganus* (Hoyle, 1885)	+	_
Cephalopoda Cuvier, 1795	Coleoidea Bather, 1888	Octopoda Leach, 1818	Octopodidae d'Orbigny, 1840	*Octopus vulgaris* Cuvier, 1797	+	+
Cephalopoda Cuvier, 1795	Coleoidea Bather, 1888	Octopoda Leach, 1818	Octopodidae d'Orbigny, 1840	*Octopus bandensis* Hoyle, 1885	+	_
Cephalopoda Cuvier, 1795	Coleoidea Bather, 1888	Octopoda Leach, 1818	Octopodidae d'Orbigny, 1840	*Octopus elegans* Brock, 1887	+	_
Cephalopoda Cuvier, 1795	Coleoidea Bather, 1888	Octopoda Leach, 1818	Octopodidae d'Orbigny, 1840	*Cistopus indicus* (Rapp [in Férussac & d'Orbigny], 1835)	+	+
Cephalopoda Cuvier, 1795	Coleoidea Bather, 1888	Octopoda Leach, 1818	Octopodidae d'Orbigny, 1840	*Octopus hongkongensis* (Hoyle, 1885)	+	+
Cephalopoda Cuvier, 1795	Coleoidea Bather, 1888	Octopoda Leach, 1818	Octopodidae d'Orbigny, 1840	*Pteroctopus hoylei* (Berry, 1909)	+	+
Cephalopoda Cuvier, 1795	Coleoidea Bather, 1888	Octopoda Leach, 1818	Octopodidae d'Orbigny, 1840	*Pteroctopus keralensis* (Oommen, 1966)	_	+
Cephalopoda Cuvier, 1795	Coleoidea Bather, 1888	Octopoda Leach, 1818	Enteroctopodidae Strugnell,	*Muusoctopus profundorum*	+	_

			Norman, Vecchione, Guzik & Allcock, 2014	(Robson, 1932)		
Cephalopoda Cuvier, 1795	Coleoidea Bather, 1888	Octopoda Leach, 1818	Octopodidae d'Orbigny, 1840	*Teretoctopus alcocki* Robson, 1932	+	+
Cephalopoda Cuvier, 1795	Coleoidea Bather, 1888	Octopoda Leach, 1818	Argonautidae Cantraine, 1841	*Argonauta hians* Lightfoot, 1786	+	+

Conclusion

A total of 54 species belonging to 27 genera and 16 families representing the class-Cephalopoda are reported by various research team from Indian Ocean, Bay of Bengal and Arabian Sea and much of the collections are reported through deep sea faunal exploration. Nevertheless, there are confusion on the documentation of actual number of Cephalopod species occurring in India. The documentation of Cephalopods of West Coast of India by R.V. Varuna (Silas, 1968) with catalogue of species known from the Indian Ocean is one of most comprehensive study on Cephalopod resources of India with highlights on the taxonomic confusion on many species recorded from India in the past and there are still taxonomic confusions on many other species *viz Abralia lineata, Stigmatoteuthis japonica, Sepia (Doratosepion) andreanoides, Sepia esculenta* and *Aurosepina arabica.* So far, little attention has been paid to the study of the biology of Indian Cephalopods. Other sources of information are also limited to stray records or accounts in expedition reports. This is mostly due to scanty surveys on Cephalopods of Indian coastline in the past as most of the specimens present in the NZC are collected during the period 1896 to 1916 and very few surveys conducted thereafter. Several Cephalopods, especially the neritic squids and cuttlefishes are economically important as they form seasonal subsistence fishery in some places bordering the Indian Ocean. The same is true of several species of octopuses which are also consumed. Many of the Cephalopods are important links in the trophic chain and pelagic Cephalopods, especially some of the oceanic squids, are important as forage for pelagic fishes such as tunas, billfishes, lancet fishes and for the toothed whales. Some of the epipelagic and bathypelagic species are useful indicators of water masses. In spite of their usefulness, the Cephalopoda of the Indian Ocean has not received its due share of recognition. There are vast

areas which have not been explored for their Cephalopod fauna. In the light of these it is evident that there is need for more information on the Cephalopoda of the Indian Seas.

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Plate 1. Cephalopods of Indian Ocean, **1.** *Nautilus pompilius* Linnaeus, 1758 **2.** *Octopus vulgaris* Cuvier, 1797 **3.** *Cistopus indicus* (Rapp [in Férussac & d'Orbigny], 1835) **4.** *Sepia pharaonis* Ehrenberg, 1831 **5.** *Uroteuthis* (*Photololigo*) *duvaucelii* (d'Orbigny [in Férussac & d'Orbigny], 1835)