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Species diversity and basic biology of Octopus from Maharashtra waters, northwest coast of India

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ABSTRACT

Octopus diversity was studied from Maharashtra waters during the period January 2000 - December 2017. Eight species were identified and they are *Cistopus chinensis* Zheng, Lin, Lu and Ma, 2012, *'Octopus' tehuelchus* d'Orbigny, 1834 [*In* 1834-1847], *Amphioctopus neglectus* (Nateewathana and Norman, 1999), *Amphioctopus marginatus* (Taki, 1964), *Macrotritopus defilippi* (Verany, 1851), *Octopus "vulgaris"* type IV Cuvier, 1797, *Amphioctopus kagoshimensis* (Ortmann, 1888) and *Argonauta hians* [Lightfoot], 1786. The estimated annual catch in trawl and the catch rate of Octopus (all species combined) for the period 2000-2017 from NFW showed an increasing trend from 2.3 t (2002) to a peak of 501.7 t (2016) and and the corresponding catch rate ranged from 0.001 kg/hr (2002) to 0.155 kg/hr (2016).

Key words: Octopus, Biodiversity, Biology, Fishery, Maharashtra.

INTRODUCTION

Octopods popularly called as 'Devilfish' and locally known as '*Jeevre makul*' are caught mainly as by-catch in the bottom trawl. Octopuses are marine benthic animals found to live from the seacoast down to 1000 m depth and they have been exploited for more than 2000 years (Roper *et al*., 1984). As many as 200 species of Octopodidae are known to occur in the world oceans (Worms, 1983), of which about 60 are reported from the Indian Ocean (Roper *et al*., 1984). The major species of octopods that contribute to the world fishery come under the genera *Octopus, Cistopus* and *Eledone*. There are about 80 species of cephalopods of commercial and scientific interest distributed in the Indian Seas (Silas, 1968). Among the cephalopods, the octopods are the least studied in the Indian waters. Oommen (1966, 1967, 1971, 1975, 1976, 1977), Roper *et al*. (1984), Silas *et*

al. (1985b) and Sivasubramanium (1991) described the species of octopods from Indian waters. Victor and Jayabalan (1998) reported landing of a giant octopus from Gulf of Mannar. Sarvesan (1969), Paul (1997) and Chandage *et al.* (2006) described the brooding behavior while Ignatius and Srinivasan (2006) described embryonic development of octopus. Hornell (1917), Sarvesan (1974) mentioned about the traditional methods of octopus fishery. Sundaram (2009) also gave an account on the uses of cephalopods. Jereb *et al.* (2014) gave the latest nomenclature for octopods.

Octopuses are considered a delicacy in many countries. The most important octopus fisheries and markets are located in Asia (particularly Japan) and in the Mediterranean countries (Roper *et al*., 1984). Among cephalopod resources, octopods are the least exploited in India. Earlier octopus was considered as a non-conventional resource and fishermen discarded it because of poor demand, but due to increasing export market, even low value octopods are now exploited.

The traditional practice employed for fishing octopuses in different parts of the world involves simple methods like trap setting, harpooning or poisoning the coral rock pools which they inhabit, during low tide. In shallow areas they are caught by setting traps and also by using longline, handlines and spears (Sundaram and Dias, 2008). Varghese (1981) gave the status of small-scale octopus fisheries from Lakshadweep. Silas *et al*. (1985a) gave an account on octopus resources from Indian waters. Kripa and Joseph (1994) and Kripa *et al.* (2000) described landings of octopus from Kochi waters while Sundaram and Sarang (2004), Sundaram (2010, 2011b) and Ramkumar (2013) gave an account on the octopus fishery from Maharashtra waters. Mohamed *et al*. (2009) and Sugumar (2015) gave an account on the exploitation of juvenile cephalopods from the Arabian Sea and Bay of Bengal including octopus. Sundaram (2011a) gave an account on the fishery of cephalopods including octopods from Maharashtra.

From the above literature it seems there is no study on the diversity of octopus from Maharashtra waters and therefore an attempt has been made to present the same. The major landing centres of Maharashtra such as New Ferry Wharf, Sasoon Docks and Versova are situated in Mumbai and they account for nearly 60% of Maharashtra landings (Annam and Sindhu, 2005) hence the species from these centres can be considered as representative of Maharashtra state.

MATERIALS AND METHODS

During the period January 2000 - December 2017, weekly visits were carried out to New Ferry Wharf and monthly visits were made to Sasson Docks and Versova landing centre. Samples were collected from the trawlers operated at New Ferry Wharf. The specimens were brought to the laboratory for species identification based on the identification characters as described in Roper e*t al*. (1984) and Silas *et al*. (1985b). The latest nomenclature by Jereb *et al.* (2014) was also later referred. Further biological analysis were also carried out and dorsal mantle length (DML) was measured using digital calipers and total body weight (TBW) by an electronic balance (± 0.01 g) after the specimens were dried on blotting paper. The measurements were taken as described in CMFRI manual (1995). As mechanised trawling was suspended from 10th June to 15th August, due to southwest monsoon and restrictions imposed by the government of Maharashtra, observations could not be collected for the month of July.

Octopus are observed in trawl and *dol* catches in Maharashtra The trawlers of New Ferry Wharf operate 70-80 km off northwest coast of Mumbai at a depth of 30-60 m. At Sasoon Docks the fishing area extends up to Ratnagiri and the depth of operation extends from 20-90 m, but generally they carry out trawling in waters beyond 40 m. At Versova the trawlers operate in 20-40 m depth, parallel to coastline from Vasai in the north and Murud–Janjeera in the south. The *dol* nets are operated along Mumbai harbor at the depths of 5-10 m (Mane and Sundaram, 2011). Catch and effort data for octopus from trawlers were obtained from the data files maintained by the Fishery Resources Assessment Division of Mumbai Research Centre of Central Marine Fisheries Research Institute.

Three hundred specimens of *C. chinensis*, 100 specimens of *O. tehuelchus* and *M. defilippi*, 50 specimens of *A. neglectus* and *A. marginatus,* and 25 specimens of *O. "vulgaris"* type IV and *A. kagoshimensis* and a single specimen of *A. hians* were analysed. The length-weight relationship was obtained by the method of 'least squares' based on individual measurements. The relationship of DML and TBW was

expressed as parabolic equation of the form, $W = a * L^b$. The stomach condition was analysed following Kore and Joshi (1975). The food items were in well-crushed and macerated condition, therefore it was possible to categorise up to the level of groups only (such as fish). The Index of Preponderance was estimated as suggested by Natarajan and Jhingran (1961). The maturity studies and the relative length of arms i.e. the arm formula was estimated following Silas *et al.* (1985). The size at first maturity was estimated by King's (1995) method. To estimate the fecundity, ovaries were removed from the fresh specimens and a few drops of formalin (4%) were added and teased to facilitate easy separation. Ova diameter measurements were made according to Prabhu (1956).

RESULTS AND DISCUSSION

With the increased exploitation and expansion of fishing grounds, new records of cephalopods are reported from various places all along the Indian coast. Due to the growing demand for octopus in the International market, octopus fishery is catching up in Maharashtra. The estimated annual catch in trawl and the catch rate of octopus for the period 2000-2017 from NFW showed an increasing trend from 47 t (2000) to a peak of 324.4 t (2006) and then a decline to 20.9 t (2011) which further increased to a peak of 501.7 t (2016) followed by a steep decline to 66.2 t (2017) and the corresponding catch rate ranged from 0.029 kg/hr (2000) to 0.181 kg/hr (2006) to 0.009 kg/hr (2011) to 0.155 kg/hr (2016) to 0.03 kg/hr (2017) (Fig 1). There seems to cyclic fluctuations as far as landings are concerned. The minimum catch was 2.3 t (2002) and the maximum catch was 501.7 kg (2017). The minimum catch rate was 0.001 kg/hr (2002) and the maximum catch rate was 0.181 kg/hr (2006). According to Nair *et al.* (1992), the seasons recognized for the cephalopod fishery are the premonsoon (February-May), the monsoon (June-August) and the post monsoon (September-January). The monthly abundance suggests that octopus fishery is very high during premonsoon seasons in Maharashtra i.e. during February-April (Sundaram, 2010). Octopods contribute 2% towards the total cephalopod catch (CMFRI, 2011) and the species *C. chinensis* contributing about 90% dominates the octopus fishery in Mumbai waters (Sundaram and Sarang, 2004). The octopus species available in Maharashtra waters are listed below according to their abundance. The species identification was carried out as per Norman and Hochberg (2005) and Jereb *et al.* (2014).

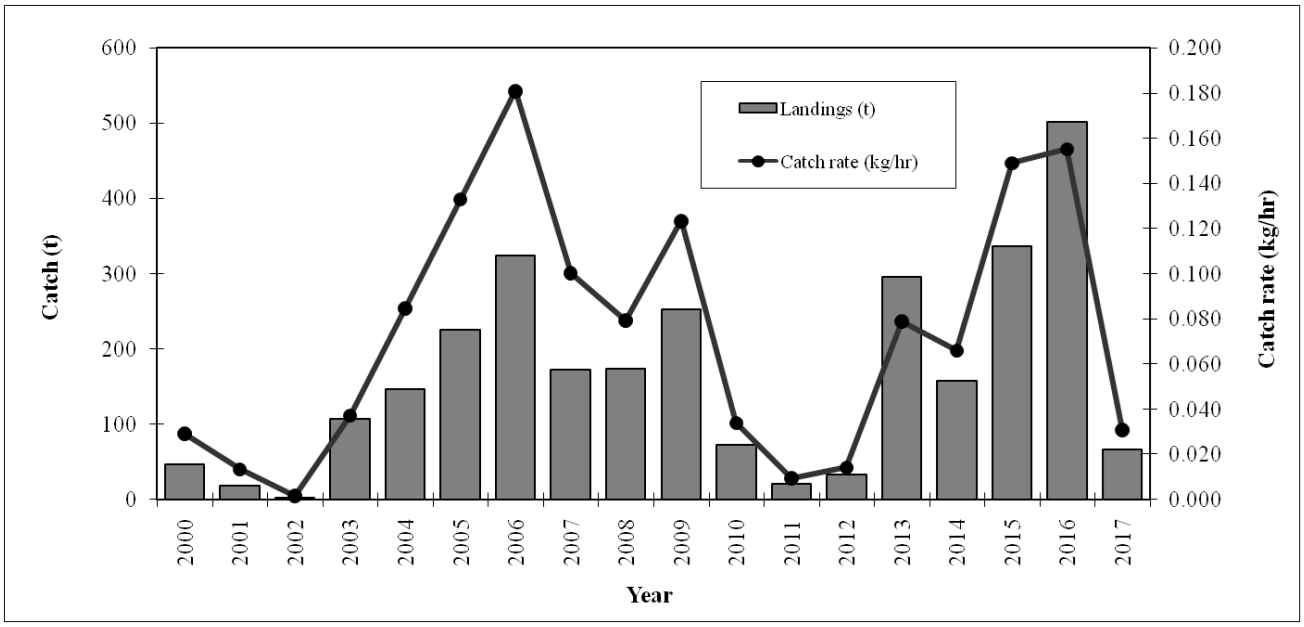

Fig 1. Catch and catch rate of Octopus by trawlers at New Ferry Wharf, Mumbai

***Cistopus chinensis* Zheng, Lin, Lu and Ma, 2012**

C. chinensis is commonly known as 'White spotted pouched octopus' and earlier they were known as *Cistopus indicus* (Orbigny, 1840). The new identification was made as per Jereb *et al*. (2014). Indo-Pacific species, mostly found in Indo-Malayan region, the Philippines, China, Bangladesh, India and Pakistan. It's a benthic species, occurring from 0 to 50 m depth on mud bottom. The mantle is elongate with constricted neck. Arms are long, slender with attenuate tips and dorsal arms always longest. Eight small water pouches with small pores are present on the base of the web between the arms (Roper *et al*., 1984).

In Maharashtra the species is observed in trawlers and *dol* netters at New Ferry Wharf, Sasoon Docks and Versova landing centre. The species is observed in the catch throughout the year. The peak period of abundance is April and August. Sundaram (2011b) gave an account on the rising trend of the landings of this species in Mumbai waters. Sundaram and Deshmukh (2011) estimated the length-weight relationship as TBW = 0.001053 * DML $^{2.69321}$ for males and for TBW = 0.009 * DML $^{2.19221}$ for females. The DML of *C. chinensis* in Mumbai waters during the period ranged between 20 and 229 mm. According to Roper *et al.* (1984) the maximum DML for the species is 180 mm. However specimens as large as 229 mm DML were recorded in Mumbai and these large sized specimens were observed in September. The Index of Preponderance revealed that in males, fish formed the major constituent of food (54.7%) followed by prawns (24.9%), cephalopods (14.6%), crabs (0.6%) and digested matter (5.1%) and in females, fish (66.2%) was followed by prawns (17.8%), cephalopods (13.3%), crabs (0.4%) and digested matter (2.2%). In males 54.7% of the guts analysed were empty, 25.9% were ¼ full, 9.4% were ½ full, 7.1% were ¾ full and 2.8% were gorged. In females 63.2% of the guts analysed were empty, 25% were ¼ full, 6.6% were ½ full, 3.9% were ¾ full and 1.3% were gorged. There seems to be no difference in the feeding habits between males and females. As in all species of octopods, males were dominant and the sex-ratio was 1:0.36. Of the total, 29.7% males were immature, 55.7% mature and 14.6% gravid. Among females, 5.3% were immature, 30.3% mature and 64.5% gravid. Hundred percent of females were mature above 130 mm. The size at 50% maturity for females was estimated at 82.7 mm DML. In the present study the maximum fecundity was 13,260 and the ova diameter ranged from 2-6 mm. The Gonado-Somatic index (GSI) of females increased from October onwards and reached a peak in March and thereafter there was decline till November. The observations indicate that the peak spawning season is from March to May.

'Octopus' tehuelchus d'Orbigny, 1834 [*In* 1834-1847]

O. tehuelchus is commonly known as 'Tehuelche octopus' and earlier it was known as *Octopus lobensis* Castellanos and Menni, (1969). The new identification was made as per Jereb *et al*. (2014). They are found in Southwest Atlantic region. *O. tehuelchus* is a benthic species occurring in shallow waters down to 60 to 80 m in depth. The body of *O. tehuelchus* is smooth and bulky and the male seems to be larger and heavier than females. Mantle is broad, short and globular with its width almost equal of its length. Arms are broad, moderately long and very robust at bases. According to Sundaram (2013), *O. tehuelchus* has an arm formula of 1 > 2 > 3 > 4. The 3rd left arm of males is shorter as compared to females of the corresponding size. The species have a striking similarity with *C. chinensis* but for its stout body and comparatively shorter arm lengths (Roper *et al*., 1984).

In Maharashtra the species is observed in trawlers at NFW from 2006 onwards and constitutes in the fishery almost throughout the year with peak period of abundance during January-April. Kripa *et al*. (2000) have recorded the occurrence of this species from Kerala waters. According to Roper *et al*. (1984) the maximum mantle length of the species is 100 mm. However, the mantle length of the species landed at Mumbai was from 65-190 mm with the corresponding weight ranging from 213 to 1120 g. The mantle length ranged from 35-136 mm and weighed 5-400 g in Kochi waters (Kripa *et al*., 2000). Gut analysis revealed that the majority of the stomachs were in 'trace' and 'empty' condition and the food was finely macerated. The species seems to mainly feed on 'fish' (66.7%) followed by 'prawn' (15.2%), squids (1.6%) and 16.5% was digested matter. Unlike other octopods where males are more in number, this species has a sex ratio of 1:1.5. About 50% of the specimens analysed for the maturity studies were in 'mature condition' followed by 'gravid' (37.5%) and very few 'immature' specimens (12.5%). The fecundity of the species ranged from 700 to 4,660 numbers and the ova diameter ranged from 1-3 mm. According to Roper *et al*. (1984) the eggs are about 9 mm long.

***Amphioctopus neglectus* (Nateewathana and Norman, 1999)**

A. neglectus is commonly known as 'Neglected ocellate octopus' and earlier they were known as *Octopus membranaceus* Quoy and Gaimard, 1832. The new identification was made as per Jereb *et al*. (2014). It's an Indo-Pacific species extending from the Indian Ocean to Japan, China, Philippines and southward to Australia. *A. neglectus* is a benthic shallow water species occurring down to about 60 m depth. It shows a strong cryptic behavior and usually hides in holes on flat bottoms. *A. neglectus* has a saccular to elongate mantle with small, close-set tubercles over head, mantle and arms. Two cirri like warts were observed over each eye. Arms moderately long, robust and the web is low. The right arm III is hectocotylised in males. The most important identification character is the presence of a conspicuous dark ringed ocellus on the web base of arm II, antero-ventral to the eyes (Roper *et al*., 1984).

In Maharashtra the species is observed in trawlers at New Ferry Wharf and Sasoon Docks. The species is observed in the fishery during December-February (Sundaram and Khan, 2009). Meiyappan and Mohamed (2003) have recorded the occurrence of this species from the northwest and southeast coasts. According to Kripa *et al*. (2000), the major octopus species landed in Kerala is *A. neglectus* contributing about 82% towards the octopus catch. The mantle length of the species landed at New Ferry Wharf ranged from 30-80 mm. The length range of the species landed at Cochin ranged between 20-90 mm Kripa *et al*. (2000). According to Roper *et al*. (1984) the maximum mantle length of the species is 80 mm and maximum total length is 300 mm. The majority of the gut was empty and food if present could not be identified, as they were in finely macerated condition. According to Roper *et al*. (1984), the spawning season extends from December-February.

***Amphioctopus marginatus* (Taki, 1964)**

A. marginatus is commonly known as 'Veined octopus' and earlier name was *Octopus dollfusi* Robson, 1928. The new identification was made as per Jereb *et al*. (2014). It is distributed in Indo-China and Hong Kong. This octopus is a benthic species living in holes in the bottom or inside empty mollusk shells in extremely shallow waters close to the coast to few meters depth. The important distinguishing characters of *A. marginatus* are elongated oval mantle and inconspicuous eyes. The arms are moderately long and stout and the dorsal arms are the shortest. The mantle, head and arms are covered dorsally with numerous large reticulate warts with each unit bordered by a darkly pigmented line. Some of the larger suckers at the base of the arms are bluish in colour (Roper *et al*., 1984).

In Maharashtra the species is observed in trawlers at NFW and Sasoon Docks. They were observed in trawl catches during December-May (Sundaram and Sawant, 2010). Sarvesan (1969) made some observations on the brooding behavior of this species. Meiyappan and Mohamed (2003) have recorded occurrence of this species along Chennai and Kochi coasts. According to Kripa *et al*. (2000), *A. marginatus* contributed about 3% towards octopus fishery in Kochi. At NFW the mantle length ranged from 50-90 mm during December - March while larger specimens up to 120 mm were observed during April-May. According to Roper *et al*. (1984) the maximum mantle length of this species is 90 mm. The gut analysis showed finely macerated food and the majority of the guts were observed with 'trace' and 'empty' condition. The species seems to mainly feed on 'prawns' followed by 'fish'. Males dominated in numbers among the specimens analysed.

Macrotritopus defilippi (Verany, 1851)

M. defilippi is commonly known as 'Lilliput longarm octopus' and earlier they were known as *Octopus defilippi* Verany, 1851. The new identification was made as per Jereb *et al*. (2014). *M. defilippi* are distributed along the Mediterranean Sea, eastern Atlantic from Morocco to Angola, Cape Verde Islands, western Atlantic, Bahamas, Gulf of Mexico, Caribbean Sea to Brazil, Indian Ocean, Arabian Peninsula to Burma. It is a little known benthic species occurring in sandy bottom from 6 to 60 m depth but occasionally reported up to 200 m depth. Its larvae and juveniles are pelagic (called 'Macrotritopus larva') and characterized by extremely long arms III. The mantle is relatively very small compared to the strikingly long arms. The skin is smooth with no pigmented ocellus or ring. All the arms are very long, slender, with tapering ends, fragile and highly asymmetrical with three primary suckers on each arm. According to Sundaram and Deshmukh (2010), usually in octopods the left side arms (LA) and the right side arms (RA) follow the same symmetry but in present observations the species showed difference in arm ratio. The left arm

ratio is 3 > 2 > 4 > 1 and the right arm ratio is 2 > 4 > 1 > 3. Overall the proportion of the arms is in the order of LA-3 > LA-2 > RA-2 > LA-4 > RA-4 > LA-1 > RA-1 > RA-3 (Roper *et al*., 1984).

In Maharashtra the species are landed by trawlers at NFW and they were observed in the fishery from the year 2007 onwards. They are extremely seasonal in Mumbai waters and are observed in the catch during March-June and contribute about 10-15% towards the octopus fishery. Kripa *et al*. (2000) has also mentioned about the stray landings of an octopus species with extremely long arms in Cochin waters. According to Roper *et al*. (1984), the maximum length of this species is 90 mm but from Mumbai waters, specimens up to 105 mm were also recorded. Sundaram and Deshmukh (2010) estimated the length-weight relationship as TBW = 0.01361 * DML $^{1.83443}$. Fish formed the major constituent food (93.3%) followed by 'digested matter' (6.7%). 41.2% of the guts analysed were in full condition followed by empty stomach (35.3%), ¼ full (17.6%) and ½ full (5.9%). Males dominated as in all species of octopods and the sex-ratio was 1:0.03. 29.4% were immature, 70.6% were mature and no specimen was in gravid or spent condition. According to Roper *et al*. (1984), females release more than 10,000 eggs which are 2.1 mm long.

***Octopus "vulgaris"* type IV Cuvier, 1797**

O. "vulgaris" type IV is commonly known as 'Common octopus' and earlier they were known as *Octopus vulgaris* Cuvier, 1797. The species has worldwide distribution in temperate and tropical waters. It is a benthic, neritic species occurring from the coastline to the outer edge of the continental shelf and is found in a variety of habitats, such as rocks, coral reefs and grass beds. Now they are classified as type I to IV as per their distribution range. The body of *O. "vulgaris"* type IV is bulky; arms are broad, moderately long and very robust at bases. Arms stout, of about equal length and thickness, dorsal pair of arms slightly shorter and the 3rd left arm of males is shorter as compared to females of the corresponding size. The species have a striking similarity with *O. tehuelchus* and *C. chinensis* but for its stout body and comparatively shorter arm lengths and the arrangement of suckers on the arms (Roper *et al*., 1984).

In Maharashtra the species is observed in rocky crevices all along the Mumbai coast especially in areas such as 'Madh', Arnala etc. The species is caught by *dol* netters operated at a depth of 14-16 m. The species is observed in the fishery almost throughout the year with peak period of abundance during January-April (Sundaram and Sarang, 2011). According to Roper *et al*. (1984) the maximum total length of the species is 1.3 m. However, the species occurring at Mumbai has the maximum total length of 40 cm only. The species mainly feeds on 'fish' (40%) followed by 'crustacean remains' (20%) and 40% digested matter (probably 'bivalve' and other 'gastropod remains') and all the specimens were in different stages of maturity.

Amphioctopus kagoshimensis (Ortmann, 1888)

A. kagoshimensis is commonly known as 'Stareye octopus' and earlier they were known as *Octopus aegina* Gray, 1849. The new identification was made as per Jereb *et al*. (2014). Distributed in Western Pacific, Indian Ocean, Red Sea, Japan to Mozambique. It's a benthic species and found commonly on the continental shelf from 30-120 m depth. It is trawled on the continental shelf or caught with traps and it also supports subsistence fisheries in East Africa. The mantle of *A. kagoshimensis* is rounded to oval and is covered with small tubercles or fine papillae arranged in a reticulate pattern. Eyes are prominent and single cirrus like extension is observed on the dorsal to each eye. The arms are moderately long with arm-I strikingly the shortest. The arm ratio is 4:2:3:1 (Roper *et al*., 1984).

In Maharashtra the species was observed in the *dol* catch at NFW, Sasoon Docks, Vasai, Arnala etc. This species is observed throughout the year in Mumbai waters with relatively better catch during premonsoon months (Sundaram and Jadhav, 2013). According to Roper *et al*. (1984) the maximum mantle length for the species is 100 mm with a total length of 300 mm and weighing 400 gms. The mantle length of *A. kagoshimensis* observed at Mumbai was however smaller ranging from 18-40 mm with a corresponding weight raging from 4.4-29.7 g. The species mainly feeds on 'fish' (60%) followed by 'crustacean remains' (40%). Silas *et al.* (1985a) had reported the occurrence of this species from Indian waters and Sivasubramaniam (1991) reported from the Bay of Bengal. In Maharashtra the species is more abundant in *dol* catches and very few specimens are caught by trawl nets.

***Argonauta hians* [Lightfoot], 1786**

A. hians is commonly known as the 'Lesser argonaut' and earlier they were known as *Argonauta hians* Lightfoot, 1786. The new identification was made as per Jereb *et al*. (2014). The species is an epipelagic octopod which has been reported from tropical and subtropical oceans (Beesley *et al.,* 1998). *A. hians* is widely distributed in the Indo-Pacific (Sukhsangchan *et al.,* 2009). It has a slender body, narrow head, and unequal arm length and has eight arms, each arm with two rows of sucker; the number of suckers on the arm is different among species. Dorsal arms in female are with laterally enlarged membrane. Shells vary from white with brownish black tint on the nodules and adjacent ribs to light brown with sooty brown pigmentation over most of the surface of the shell (Voss and Williamson, 1971). The keel is wide and bears the characteristic 15 to 23 prominent, large and blunt nodules placed in pairs over the keel. Great variations exist in size and form of the nodules.

The Argonauts are free-swimming octopuses of open ocean habitats. The unique characteristic of *Argonauta* is that the female produces a brittle white shell commonly known as a 'Paper nautilus', while dwarf males lack a shell. The shell has an enlarged web of dorsal arms, functioning as an elaborate egg case. The calcareous structured shell is thin and laterally compressed. The egg case is a single chamber with a flat keel fringed with two rows of tubercles. The lateral sides of the shell have radial ribs. The shell provides protection and is used as a flotation device and as a place to attach their eggs (Beesley *et al*., 1998).

In Maharashtra, a single female specimen of *A. hians* was collected on 08-12-14 from the trawl landings at Sasoon Dock, Mumbai (Sundaram and Mane, 2015). The length of the specimen was 61 mm and weighed 105 gm. Silas *et al.* (1985b) described this species from Indian waters. Vaitheeswaran *et al.* (2014) have recorded the occurrence of this species from the Gulf of Mannar, southeast coast of India. The occurrence of *A. hians* off Mumbai waters, northwest coast of India is reported for the first time.

Some octopods are known to make seasonal migrations, which are influenced by breeding activity. It seems that in all probability these species may have come to nearshore waters for breeding. Octopus catch was earlier discarded, as it did not fetch any price, but in recent years, octopuses are also being exploited in commercial quantities and are almost totally exported. As the catch of octopus is often badly affected on the deck, the fishermen preserve the catch in a tank containing chilled seawater. The octopuses are taken to the processing unit within 4-6 hours, where they are degutted and are mainly exported. The price ranged between Rs.70-80/kg at the landing centre. Due to the abundant availability of octopus and commercial importance, a detailed study on the distribution and population dynamics is essential from the Northwest coast of India in general and Maharashtra coast in particular. Fig. 1 clearly indicates that the catch rate declined over the years due to over exploitation. Further studies on the biology and other aspects would prove useful to evolve effective fishery management measures for judicious exploitation of the resource. The octopuses caught in *dol* nets are generally alive and can be used in the aquarium industry also. All the specimens are deposited in the reference collection of Mumbai Research Centre of Central Marine Fisheries Research Institute.

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