

General morphological characteristics of the *Sepia Pharaonis* (cephalopoda) from Persian gulf, Bushehr region

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Abstract. The common cuttlefish (*Sepia pharaonis* Ehenberg, 1831) is known as one of the economically important species in the classes Cephalopoda. Due to the high commercial values in this study, from October 2009 to July 2010, 50 cuttlefish were collected monthly from the Persian gulf, Bushehr region, (52°56' E, 27°16' N). Discrimination between species based on morphological characters. These characters are useful for species differentiation. In the present study, 22 morphometric characters were measured carefully. Length – weight regression were derived for male and females. The results obtained show that sexual dimorphism is not distinct. *Sepia pharaonis* have distinct tiger-stripe pattern on the dorsal side of the mantle. The tentacular club has big suckers, of which about 6 suckers in medial rows are much enlarged. The left ventral arm of male has 10-12 basal transverse series of normal suckers followed by 7 series of modified suckers. The cuttlebone is plate like callosity. A discriminant function that allows an easy separation of two species. The function, composed of these indices: head length/mantle length (HL/ML) and mantle width /mantle length (Mw/ML) and arms I length/ mantle length (A I L/ML), arms II length/ mantle length (A II L/ML), arms III length/ mantle length (A III L/ML) arms IV length/ mantle length (A IV L/ML).

Key words: Cephalopods, *Sepia Pharaonis*, cuttlefish, Morphometric

1. Introduction

Cuttlefish are sea animals of the order Sepiida belonging to the Cephalopoda class, phylum: Mollusca. *Sepia pharaonis* Ehenberg, 1831, is known as one of the economically important species (Boltezky, 1997). The *Sepia pharaonis* is a broadly distributed neretic demersal cephalopod species. *Sepia pharaonis* is the most common species of cuttlefish caught in the Persian Gulf, the Oman sea. Morphometric characters have greatly increased our knowledge. The field of morphometrics is concerned with methods for the description and statistical analysis of shape variation within and among samples of organisms (Boltezky, 1997). Morphometric methods and to compare shapes of organisms or of particular structures (Thompson, 1992). The knowledge of length-weight relationship plays a vital role in the fisheries biology and population dynamics. It helps in estimating the standing stock or biomass and thereby establishing the yield by converting one variable into the other as is often done during field studies (Petakis and Stergiou, 1995). In general they are caught incidentally along with other food fishes in trawl nets, boat seines and cast nets. During the peak season with light attracters were used to catch larger species of cuttlefish at night. These species are available throughout the year, the major fishing season is from December to March are caught in large numbers during full moon days and fog season. No studies have been performed on mantle length- weight relationship of *Sepia Pharaonis* from the Bushehr region, so far. Therefore, the present study is an attempt to understand information on size, mantle length – weight relationship parameters.

2. Material and Methods

The species of *Sepia Pharaonis*, were collected from Bushehr regions which is part of Persian Gulf and is located in 52°56' E; 27°16' N (Fig. 2-1). In this area fishermen hunt aquatic animals with trawl and gargoor. The collected specimens were identified accordingly Silas, 1985; Aoyama and Nguyen, 1989 and Graham,

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1994. A total of 50 specimens were analyzed (Fig. 2-2). The specimens were cleaned with tap water. Then it was mopped with blotting sheet to remove the external moisture and weighed to the nearest 0/01 g and recorded. Measured mantle length data for all male and female *Sepia Pharaonis*.



Fig. 2-1 Geographical situation of the sampling ports (A) Persian Gulf (B) Bushehr



Fig. 2-2 samples of cuttlefish (A) live *Sepia Pharaonis* (B)

The morphometric features recorded, according with Roper and Voss (1983) were: the dorsal mantle length (DML), Total length (TL) (Fig. 2-3A), wet weight (W), mantle width (MW), head length (HL), eye diameter, left first arm length, left second arm length, left third arm length, left fourth arm length, length of funnel, cuttlebone length, cuttlebone width in males and females (Fig. 2-3B), tentacular club (Fig. 2-3C) and weight of internal organs such as gut tract, male gonad, female gonad, ink sac, nidamental gland, systemic and brachial heart was measured carefully (Fig. 2-5, 2-6).

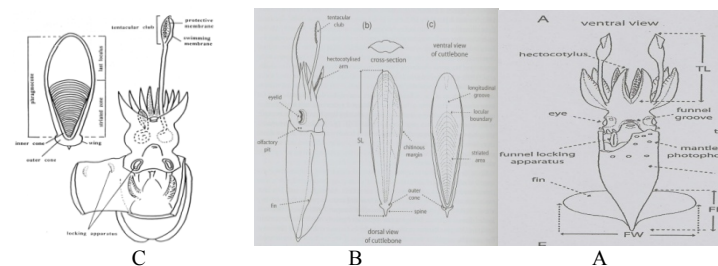


Fig. 2-3 Measue Tentacular club (C), cuttle bone (B), Total length (A)

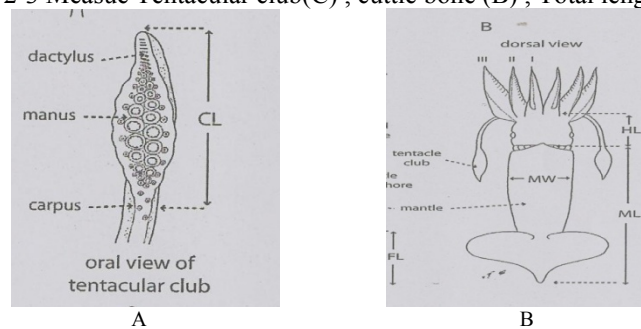


Fig. 2-4 Measue Tentacular Club (A), Mantel Length & Head Length (B)

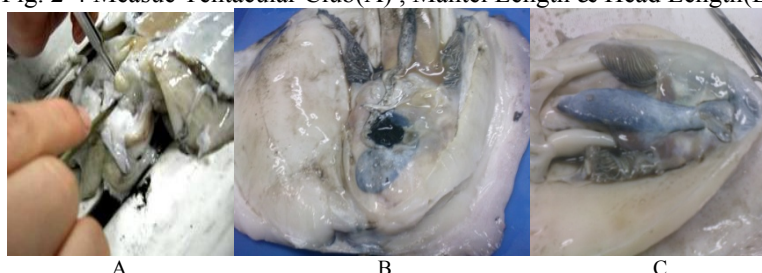


Fig. 2-5 Dissection of *Sepia pharaonis* (A), Internal organs (B), ink sac, gills and branchial hearts (B)



Fig. 2-6 Dissection of *Sepia pharaonis* Female gonad (D), Male gonad (E)

3. Results

In the present study, 22 morphometric characters were measured carefully (table 3-1). Length – weight regression was derived for male and females. The results obtained show that sexual dimorphism is not distinct.

Table 3-1- Morphometric measurements of *Sepia pharaonis* (measurements in mm)

Parameters	Mean	Range
Dorsal Mantle length	198.5	189-208
Eye diameter	23.96	11-35
Arm Characteristics(male)		
Left first arm length	165.16	
Left second arm length	150.96	65-223
Left third arm length	157.24	62-202
Left fourth arm length	178.96	63-220
Arm Characteristics(Female)		
Left first arm length	106.12	
Left second arm length	112.12	68-135
Left third arm length	116.60	79-150
Left fourth arm length	130.48	70-150
Cuttlebone Characteristics(male)		
Cuttlebone length	217.8	
Cuttlebone width	73.24	140-300
Cuttlebone Characteristics(Female)		
Cuttlebone length	206.53	
Cuttlebone width	72.36	160-240
Tentacular club	59.58	27-85

S. Pharaonis has a transverse tiger stripe pattern, which is more prominent in males and less distinct in females. The tentacle is long, almost equal in size to the length of the body, sometimes just exceeding the body length. The tentacular club is long and broad, 1/4 of DML. Suckers on the tentacular club are unequal in size, with about 6 median suckers, of which 3-4 are greatly enlarged. The average length of the tentacular club is 59.58 mm, with a range of 27-85 mm. The inner cone of the cuttlebone is a relatively long, plate-like structure without any cavity, white in color and plate-like in callosity. The average cuttlebone length in males is 217.8 mm (range 140-300 mm). The average cuttlebone length in females is 206.53 mm (range 160-240 mm). The average cuttlebone width in males is 73.24 mm (range 50-88 mm). The average cuttlebone width in females is 72.36 mm (range 54-86 mm). The hectocotylization pattern consists of 10-12 basal transverse series of suckers, normal followed by 7 series of modified suckers in the hectocotylized portion.

The average dorsal mantle length is 198.5 mm (range 189-208 mm). The average eye diameter is 23.96 mm (range 11-35 mm). The left first arm length in males is 165.16 mm and the range is 65-223 mm. The left second arm length in males is 150.96 mm and the range is 62-202 mm. The left third arm length in males is 157.24 mm and the range is 63-220 mm. The left fourth arm length in males is 178.96 mm and the range is 80-265 mm. The left first arm length in females is 106.12 mm and the range is 68-135 mm. The left second arm length in females is 112.12 mm and the range is 79-150 mm. The left third arm length in females is 116.60 mm and the range is 70-150 mm. The left fourth arm length in females is 130.48 mm and the range is 87-160 mm.

The average total weight (TW) in males is $706.08 \pm \text{SD}$ (range 310-2540 g) and the average total weight (TW) in females is $1160.78 \pm \text{SD}$ (range 220-1800 g).

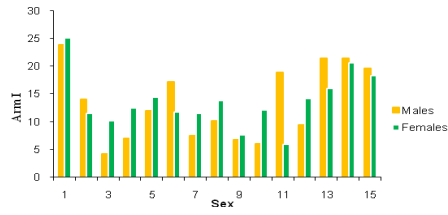


Fig. 3- 1 Relationships between Arm I length and sex

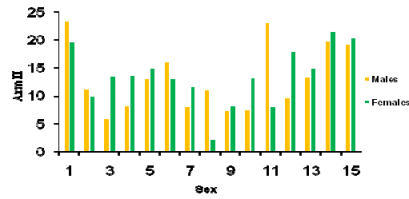


Fig. 3- 2 Relationships between Arm II length and sex

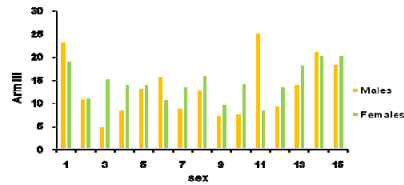


Fig. 3- 2 Relationships between Arm III length and sex

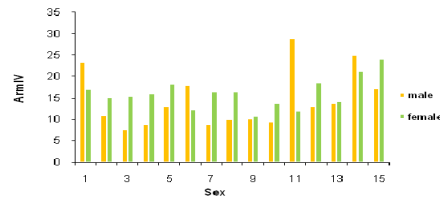


Fig. 3- 3 Relationships between Arm IV length and sex

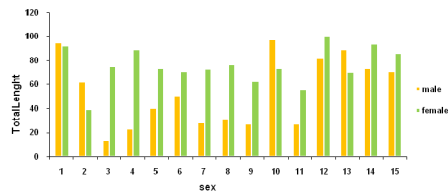


Fig. 3- 4 Relationships between total length and sex

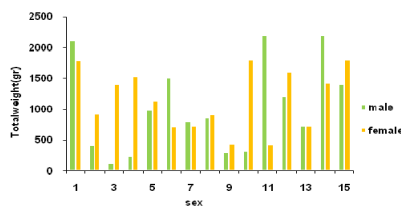


Fig. 3- 5 Relationships between total weight and sex

4. Discussion

Sepia Pharaonis is a targeted fishing species throughout its range (Nabhitabhata 1995).

FAO Names: En – *Pharaoh cuttlefish*; Fr – *Seiche pharaon*; Sp – *Sepia faraón*.

Diagnostic Features: Mantle oval. Male and female arm lengths subequal. Arm suckers tetraserial. Hectocotylus present on left ventral arm: **10 to 12 rows of normal size suckers proximally, 6 rows of reduced suckers medially**, then normal size suckers distally to arm tip. Suckers of hectocotylus in **2 dorsal series are much smaller than those in 2 ventral series**; oral surface of modified region wide, swollen, fleshy, with transversely grooved ridges; with shallow median furrow; suckers in 2 dorsal and 2 ventral series displaced laterally, with gap between them. Club sucker-bearing surface flattened, with **8 suckers in transverse rows**; suckers differ markedly in size: 5 or 6 median suckers enlarged (3 or 4 of these are greatly enlarged). Swimming keel of club terminates at proximal end of carpus. Dorsal and ventral protective membranes **not joined at base of club**; dorsal and ventral membranes same length; extend proximal to carpus along stalk. Dorsal membrane forms shallow cleft at junction with stalk. Buccal membrane with **a few, minute suckers** (each lappet bearing 1 or 2 small suckers). Cuttlebone outline oblong; bone bluntly rounded anteriorly; acuminate, acute, posteriorly; dorsal surface creamy white; dorsal surface evenly convex; texture smooth; dorsal median rib distinct, rib broadens anteriorly; lateral ribs indistinct. Chitin borders lateral and anteriormargins of cuttlebone. Spine short, pointed, curves dorsally, keel(s) absent. Striated zone concave; last locus flat; sulcus **deep, wide, extends** entire length of cuttlebone; sulcus **flanked by rounded ribs**. Anterior striae are **inverted U-shape**; limbs of inner cone extend anteriorly to end of striated zone. Inner cone limbs are narrow anteriorly, broaden posteriorly with **distinctive thick bulbous swelling**; outer cone calcified; narrow anteriorly, broadens posteriorly. Dorsal mantle with series of elongate papillae along each side, adjacent to base of each fin, or covered with numerous small papillae. **Colour:** Pale brownish or reddish purple. Head and arms with transverse zebra-stripe pattern. Dorsal mantle has white blotches or spots, transverse saddle mark, and has a transverse zebra-stripe pattern (saddle mark in females; stripes especially in males; small specimens may show stripe markings or few markings). Fins with longitudinal white band at base, bordered by narrow band of ground-coloured pigment along each side; white stripe solid on anterior 3/4 of body, interrupted by blocks of ground-coloured pigment on posterior 1/4 of mantle (FAO cephalopoda, 2005). **Geographical Distribution:** Indian Ocean and western Pacific: including the Red Sea and Persian Gulf, Oman sea, Arabian Sea south to Zanzibar and Madagascar, Andaman Sea to South China Sea, East China Sea, Taiwan Province of China, Japan (Kyushu and possibly southern Honshu), eastern Indonesia and northern Australia (from Monte Bello Island, Western Australia, 20°26'S 115°37'E, to at least Townsville, Queensland, 19°16'S 146°41'E, including Gulf of Carpentaria). Wadge Bank.

Habitat and Biology: *Sepia pharaonis* is a neritic demersal species which occurs down to 130 m. In the Gulf of Thailand and the Andaman Seas, animals are found from the coastal shallows to 100 m depth, with most caught between 10 and 40 m. Around Hong Kong, animals migrate to shallower waters during the mating season, where large numbers of adults congregate in 40 to 80 m on the continental shelf from November to February. During February and March, they move to the coast where spawning takes place from April to May in water temperatures between 18 and 24°C. Eggs are laid in clusters and attached to plants, shells and other hard substrates in approximately 5 to 20 m depth.

Sepia Pharaonis is a targeted fishing species throughout its range (Nabhitabhata 1995). Adult *S. pharaonis* have been reported at different sizes in the natural environment. (Dunning et al 1994) reported males up to 192 mm ML and females up to 173 mm ML on the north coast of Australia. *Sepia pharaonis* have been reported up to 420 mm ML off the coast of Yemen (Aoyama and Nguyen 1989); up to 370 mm ML off the southwestern coast of Taiwan (Lin and Su 1994); up to 262 mm ML in the Philippines (Watanuki et al. 1993); and in excess 240 mm ML in the Suez Canal in Egypt (Gabr et al. 1998). Chotiyaputta (1993) reports a maximum size of 350 mm for *S. pharaonis* in Thailand; this includes both the Gulf of Thailand and the Andaman Sea. Nabhitabhata and Nilaphat (1999) reported the maximum size for *S. pharaonis* in the Gulf of Thailand as 260 mm and 1,400 g, however a maximum size of only 162 mm ML and 368 g for males and 155 mm ML and 350 g for females was obtained in laboratory culture. The current study reports a maximum male size of 300 mm and 3,045 grams and maximum female size of 223 mm and 1,215 g.

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During maturation, there is a shift of emphasis from somatic growth to gonadal development and vitellogenesis. Research observations suggest that energy and nutrients for maturation are supplied mainly by diet rather than stored resources: the species does not use protein from muscle tissue for developing and growing its reproductive tissues. *Sepia pharaonis* appears to be an intermittent multiple spawner. In captive animals, the life cycle is less than 10 months. Estimated growth rates for wild animals show higher values for females than for males.

Interest to Fisheries: This species supports industrial or artisanal fisheries throughout its range. With *S. esculenta* Hoyle, 1885, it is the most abundant cuttlefish species caught in the Philippines and the Samar and Visayan Seas, with the highest catches reported in the Lingayen Gulf and Carigara Bay. In Iran, the fishing activity occurs during the spawning season, when adults migrate from deeper waters to shallower waters in the littoral zone. *Sepia pharaonis* is caught by bottom trawlers in the Oman Sea, and by traps in the Persian Gulf and is one of the most important cuttlefish species fished in both areas. The species is important to the commercial cephalopod fishery of Thailand, being highly abundant in the Gulf and the Andaman Sea, where it is the most common species of cuttlefish caught. The species contributes about 90% of the cuttlefishes caught off Australia by Chinese pair trawlers. Off the North West Shelf and Timor Seas, sepiids (mainly *S. pharaonis*) tend to replace squids as the dominant cephalopods caught. Domestic fisheries in these waters take this species as bycatch of prawn and mixed species trawl fisheries. In the Hong Kong area, it is the most abundant cuttlefish species and it is of greatest commercial importance in this area and along the whole coast of Kwangtung and Fukien, with about 400 tonnes landed annually in Hong Kong. Animals in this region are caught by spearing, lure-hooking and trawling. In southern Thailand, in addition to otter and pair trawls, the trammel net and hook-and-line are commonly used for catching *S. pharaonis*, with bottom otter and pair trawls used offshore, and push nets and lift nets used in inshore and coastal waters. Squid traps, in which egg clusters are placed to entice squids to enter, are also widely used and cuttlefishes, all mature animals ready to spawn, are a major bycatch. These traps accounted for 5% of total Thai cephalopod catch in 1994 (i.e. over 7 000 tonnes). Off the southwest coast of India, a modified type of hook, a baited hand-jig, is used to catch this species. *Sepia pharaonis* has been grown successfully in culture, and techniques are currently being improved in Thailand to culture these animals commercially. The flesh is thick, tender and excellent for human consumption.

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