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Natural diet of the common cuttlefish, *Sepia officinalis* (Linnaeus, 1758) off Lagos Coast, Nigeria

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Abstract. *The common cuttlefish, Sepia officinalis is one of the economically important species in the Class Cephalopoda. The study aimed to determine the natural diet of S. officinalis collected off Lagos coast, Nigeria. A total of 1082 samples were caught with the use of bottom trawl nets between 1000 and 1200 hrs over a period of eighteen months (August 2018 to January 2020) from eight stations off Lagos coast. Although the proportion of empty stomach was higher in wet season, the difference was not significant (P>0.05). Frequency of occurrence, numerical and fullness methods were used for analysing the food items. Of the 1,082 specimens examined, 90 (8.32%) were empty stomachs and 992 (91.68%) were found with food. Diet items sighted were grouped into eight major categories; these were fish parts (bones, eyes and scales), crustaceans (amphipods, shrimps and portunid crabs), annelids, filamentous algae, diatoms, sand grains, plant materials and unidentified masses. Crustaceans were the most abundant in large and medium size cuttlefish, while in the small size; fishes were dominant in their stomach contents. Cuttlefish can be regarded as euryphagous; feeding on wide range of organisms. Thus, there is dynamism in the feeding habit from carnivores to omnivorous.*

Keywords: *Sepia officinalis,* stomach content, Lagos coast, diets, opportunistic feeders

Introduction

Cephalopods are relevant in the marine ecosystem because of their predatory and prey roles in many aquatic food chains (Philippe and Shin, 2003). Cuttlefish are marine molluscs, belonging to the family Sepiidae, class *Cephalopoda*, which includes squid, octopuses and nautiluses. Cuttlefish undergo seasonal migrations between shallow and coastal waters in summer for spawning and deeper waters in winter (Bloor et al., 2013), resulting in a wide range of diets. Hence, their diets undergo changes during growth, as they get older the importance of fish in their diets increases and that of crustaceans decreases (Castro and Guerra, 1990). There are over 120 species of cuttlefish currently recognised (Reid et al., 2005) and these are primarily bottom - dwellers over a range of habitats, including rocky, sandy, and muddy substrates, sea grass, seaweed, coral reefs. Cuttlefish are of significant commercial value to artisanal and industrial fisheries (Reid et al., 2005).

The species of cuttlefish, *Sepia officinalis* is one of the most important demersal marine invertebrates inhabiting the continental shelf (Lawal-Are et al., 2018). Domingues et al. (2004) reported some vital features of cephalopod, such as short life cycles, fast growth rates and high food conversion, having high energy requirements.

However, investigations regarding the natural diet of *Sepia officinalis* in this part of the world remain scarce. It is on this account that this study was carried out aiming at providing useful information on the food and feeding habits of *S. officinalis* off Lagos coast, Nigeria.

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Material and methods

Study site

The study area was off Lagos coast (Figure 1), extending from Badagry to Ibeju-Lekki Local Government Areas of Lagos State, Nigeria. The study areas were located between Longitudes 2° 50' and 4° 50' and Latitude 6° 18' and 6° 21'. Eight sampling stations (1, 2, 3, 4, 5, 6, 7 and 8) were selected based on ecological and anthropogenic factors at approximately 10 nautical miles away from the shore. The stations were chosen because of sample availability all year round and distance between one station and the next is about 5 nautical miles to cover the entire Lagos coastline.

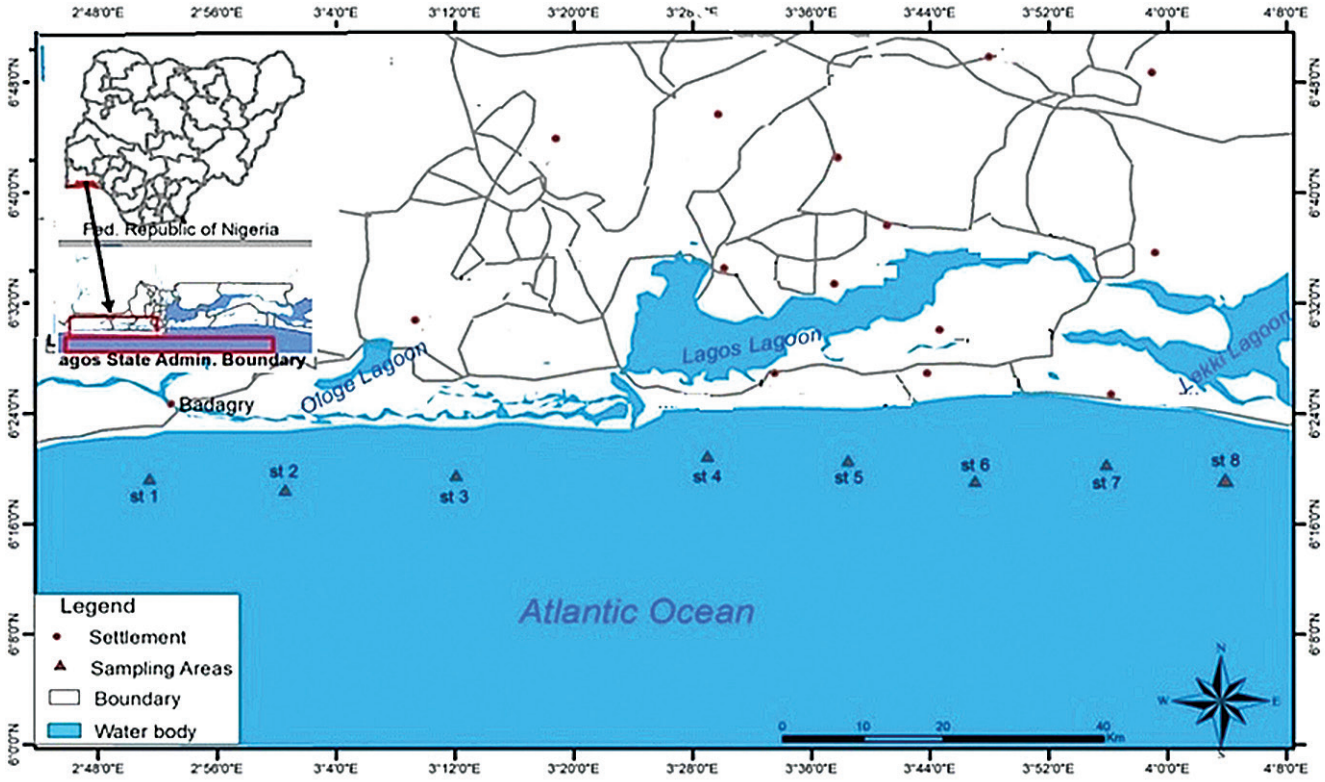

Figure 1. The study area, off the coast of Lagos, Nigeria showing the eight sampling stations

Sample collection

The specimens of *Sepia officinalis* (Figure 2) for this study were collected on board off Lagos coast. A total of 1,082 specimens of the cuttlefishes were collected from the months of August, 2018 to January, 2020 between 6:30 am and 8:30 am from eight locations using a 4-m industrial trawl nets equipped with a 44-mm mesh size cod-end. Each trawl lasted 15 min and was carried out in daylight during the low water tides. Once captured, the specimens were preserved in ice on chest at the point of collection and immediately transferred to the deep freezer at -20°C in the Department of Marine Science laboratory, Nigerian Institute for Oceanography and Marine Research where they were kept prior to laboratory work.

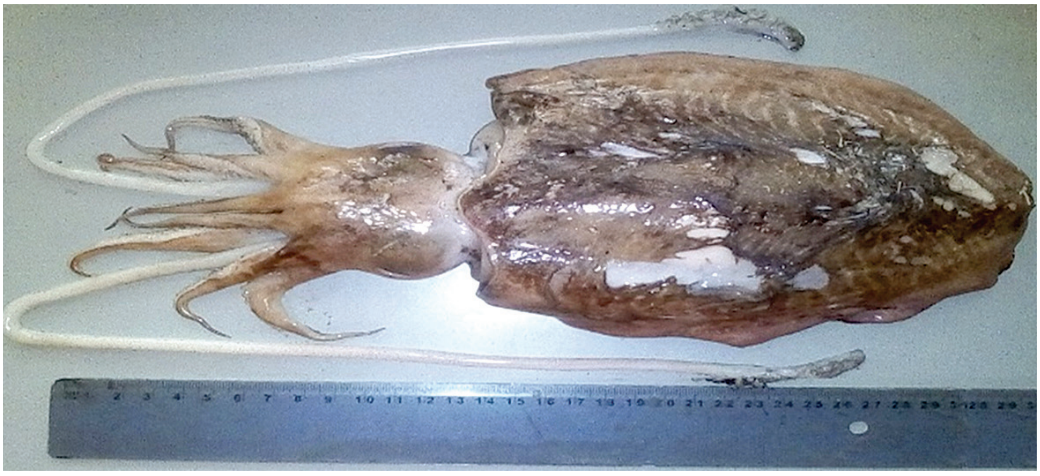

Figure 2. Dorsal view of Cuttlefish (Sepia officinalis) off Lagos coast, Nigeria

Stomach analysis

Cuttlefish samples were removed from the freezer and allowed to thaw and thereafter, sexed according to absence or presence of the hectotylized arm. Standard cuttlefish measurements recommended by Jereb et al. (2005) were used for morphometric characters and cuttlebone was removed and a pair of forceps was used to carefully remove the stomach below the cuttlebone region of each sample and placed in a petri dish. The state of fullness of each cuttlefish's stomach was recorded in the proforma as 0\4 1\4, 2\4, 3\4 and 4\4 representing empty stomachs, quarter-filled, half-filled, three-quarter filled and filled stomach, respectively. The method used for the analysis of these stomach contents were numerical and frequency of occurrence methods (Cortés, 1998). The frequency of occurrence method was determined as the number of stomachs in which each food item occurred and the result was expressed as percentages of the total number of specimens with food. In the Numerical method, estimate food items in each stomach were identified and counted, thus, the total of each kind of food item was recorded and expressed as a percentage of the total number of all food items.

Statistical analysis

Data on gut contents were tested for normality and homogeneity of variance using chi-square. The differences in the contribution of each food item were tested using Quadratic fit. Descriptive and inferential data analysis was conducted using MS Excel 2010

Results and discussion

Empty stomachs

A total of 1082 specimens of *S. officinalis* were examined for food and feeding habits, 90 (8.32%) had empty stomachs. Figure 3 showed that although the proportion of empty stomach was higher in wet season, the difference was not significant (P = 1.5, P >0.05). The Monthly empty stomach index (Table 1) showed the least occurrence in January 2019 with 7.7%, the highest occurrence in March 2019 with 17.1% while there were no empty stomachs in November 2018, July 2019 and October 2019. The results of empty stomach in relation to size (three groups) (small size group, 4.45 – 11.11cm; medium size group, 11.12 – 19.69 cm and large size group, 19.70- 27.60 cm) of *S. officinalis* obtained off Lagos coast are shown in Table 2; the highest percentage of empty stomach with 9.33% was in the small size group (4.45 – 11.11 cm), while the lowest with 5.55% was recorded in the large size group (19.70 – 27.60 cm). The diet of most aquatic organisms would change based on some factors, either intrinsic (size, behaviour and taxonomy) or extrinsic (biotope, region) (Pauly, 1998) while food preference would be determined by the age of fish, prey accessibility and mobility, prey abundance, prey energy content, prey size selection and seasonal changes (Stergiou and Fourtouni, 1991). The proportion of these empty stomachs might be because of their frequent feeding coupled with high rate of digestion. It could also be that the period of feeding before been caught was a short or a larger part of the food items that had been rapidly digested during the catch and subsequent transportation. A similar result was reported by Castro and Guerra (1990) who noticed a larger number of empty stomachs found within smaller animals (ML\65 mm) and a higher feeding intensity in mature females. Furthermore, cuttlefish collected during the rainy season (June to November), were observed to have fuller stomach contents than those collected during the dry season (December to May). This report is similar to what was recorded by Moruf (2020) on diet composition of *Goniopsis pelii* from South West Nigeria. The incidence of some empty stomachs in cuttlefish observed during the period of sampling may vary according to maturity and reproductive activity and this could be that the cuttlefish have digested some of the food taken before they were captured (Vinson and Angradi, 2011).

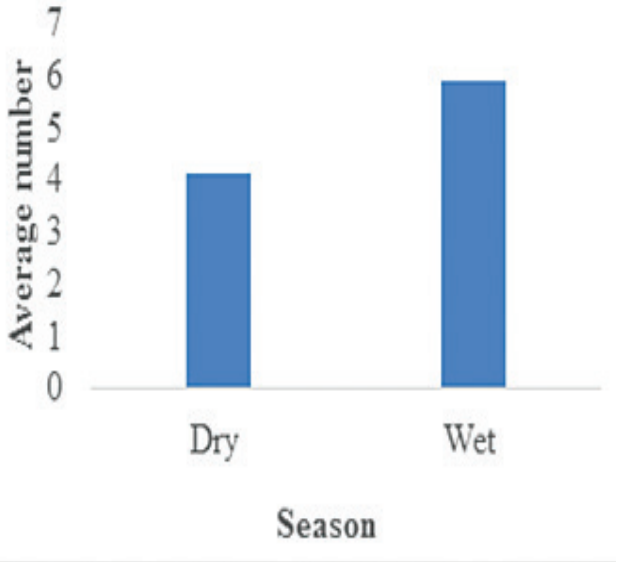

Figure 3. Seasonality in number of empty stomachs of *Sepia officinalis* off Lagos Coast (Aug 2018 – Jan 2020)

Table 1. Monthly Empty stomachs of *Sepia officinalis* Off Lagos coast, Nigeria (Aug 2018 – Jan 2020)

Year	Month	Number examined	Number with empty stomach	% Empty stomach
2018	Aug	79	8	11.4
	Sept	70	8	10
	Oct	68	9	13.2
	Nov	68	0	0
	Dec	46	6	10.9
2019	Jan	39	2	7.7
	Feb	33	4	12.1
	Mar	35	6	17.1
	Apr	32	5	15.6
	May	67	8	11.9
	June	70	6	8.6
	July	79	0	0
	Aug	86	6	6.9
	Sept	84	8	9.5
	Oct	68	0	0
	Nov	67	6	8.9
	Dec	56	5	8.9
2020	Jan	35	3	8.6
	Total	1.082	90	8.32

Table 2. Empty stomachs of *Sepia officinalis* in relation to size off Lagos coast, Nigeria (Aug 2018 – Jan 2020)

Size (Dorsal width)	Range (cm)	Number Examined	Number with Empty Stomach	% Empty Stomach
Small	4.45 – 11.11	600	56	9.33
Medium	11.12 – 19.69	429	31	7.23
Large	19.70 – 27.60	53	3	5.66

Food Items

Eight major food items were observed in the stomach of the 1,082 examined specimens of *S. officinalis*. These include fish parts (bone, eye, scale and eye), crustaceans (shrimp, broken appendages and crab), Annelids, filamentous algae, diatoms, sand grains, plant materials and unidentified food masses (Figure 4). Thus, Crustaceans (amphipods, shrimps and portunid crabs) were the most abundant and important food item sighted by numerical method (55.17%) and occurrence method (29.38%). Fish fragments (Ammodytidae, Gobiidae and Soleidae) were next of importance with 39.39% and 15.57% by numerical method and occurrence method, respectively. Plant materials contributed 2.66% by numerical method but occurred in 4.79% of the stomachs. Diatoms occurred as 1.9% (numerical) and 2.69% (occurrence). Filamentous algae also accounted for 1.77% by numerical methods and 6.59% by occurrence methods. Also, sand grains and unidentified mass occurred as 5.39% and 7.49%, respectively.

The dietary analysis though crude has revealed that the feeding habit of the species. *S. officinalis* is a carnivore with a preference for animal food. It could also be considered as an opportunistic feeder because it will scavenge, predate and in addition deposit feeding, which is indicated by the presence of sand in the stomachs. This result is similar with the reports of some researchers such as Pinczon du Sel and Daguzan (1997), Blanc et al. (1998), Alves et al. (2006), Neves et al. (2009), Pinczon du Sel et al. (2000), Evans (2012) and Akesse et al. (2016) on *S. officinalis* diet from Atlantic waters and other locations. Furthermore, preference for animal matter was also in agreement with other authors, for example Lawal-Are (2009) and Moruf and Ojetayo (2017).

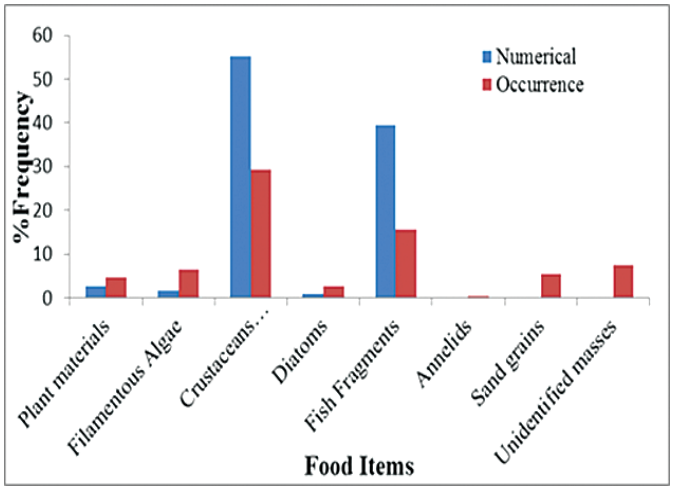

Figure 4. Stomach Content of *S. officinalis* off Lagos coast (August 2018 - January 2020)

The Fullness Index (FI) in *S. officinalis* collected off Lagos coast between Aug 2018 and Jan 2020 is shown in Table 3. Of the 1,082 specimens examined, 992 (91.68 %) were found with food. Out of the 600 small size *S. officinalis* stomachs with food, 200 (33.33%) stomachs were full ($^4/_4$) fed; 257 (42.82%) stomachs were ¾ fed; 114 (19%) stomachs were $^2/_4$ fed; 29 (4.83%) stomachs were ¼. Out of 429 medium size with food, 143 (33.33%) stomachs were full ($^4/_4$) fed; 184 (42.89%) stomachs were ¾ fed; 82 (19.11%) stomachs were $^2/_4$ fed; 20 (4.66%) stomachs were ¼ fed. In the large size group of 53 stomachs with food, 18 (33.96%) stomachs were full ($^4/_4$) fed; 22 (41.51%) stomachs were ¾ fed; 10 (18.87%) stomachs were $^2/_4$ fed; 3 (5.66%) stomachs were ¼ fed.

The highest FI value of 257 (42.83) for three quarter-fed (¾) was recorded in the small size group while the lowest FI value of 3 (5.66) for one quarter-fed (¼) was recorded in the large size group illustrated in Table 3. A similar observation was made by Neves et al. (2009) on feeding habits of the cuttlefish *S. officinalis* during its life cycle in the Sado estuary Portugal. Differences in terms of the importance of the different types of prey in the diet of *S. officinalis*, as well as occurrence of more species, are probably consequences of habitat differences, predator size and the number of analyzed stomachs (Pinczon du Sel et al., 2000). The present study showed a significant change with the size of the cuttlefish.

Table 3. Fullness Index by size of *S. officinalis* stomach off Lagos coast, Nigeria (Aug 2018 – Jan 2020)

Size (Dorsal width)	Range (cm)	Number Examined	¼ Full Stomach No (%)	$^2/_4$ Full Stomach No (%)	¾ Full Stomach No (%)	$^4/_4$ Full Stomach No (%)
Small	4.45 – 11.11	600	29 (4.83)	114 (19)	257 (42.83)	200 (33.33)
Medium	11.12 – 19.69	429	20 (4.66)	82 (19.11)	184 (42.89)	143 (33.33)
Large	19.70 – 27.60	53	3 (5.66)	10 (18.87)	22 (41.51)	18 (33.96)

Conclusion

The fullness index (FI) of the stomach contents of *S. officinalis* examined could be attributed to richness of sampling stations, favourable habitat condition as well as season at which the study was carried. Although the proportion of empty stomach was higher in wet season, the difference was not significant (P>0.05). Crustaceans (amphipods, shrimps and portunid crabs) were the most abundant food item sighted by numerical method and occurrence method. Fish fragments (ammodytidae, gobiidae and soleidae) were next of importance, followed by plant materials. Many remains could not be determined to species because they were too small or too broken up. Identified species reflect the benthic way of life of this cuttlefish as they are all bottom-living species. Cuttlefish are known for their opportunistic feeding behaviour, a preference for some prey according to length and behaviour could be perceived during this study. Thus, there is dynamism in the feeding habit from carnivores to omnivores.

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