



Feeding Ecology of the Common Cuttlefish *Sepia officinalis* in the Ivorian Exclusive Economic Zone, Gulf of Guinea: Seasonal and Ontogenetic Variations in Diet Composition

Ekumou Valeri Akesse^{1*}, N'zebo Moise Kouamenan¹, Fulgence Kouato², Beda Nestor Kimou¹ and Abdoulaye Koné¹

¹Formation Unit and Research of Marine Sciences, Department of Oceanography and Marine Resources, San Pedro University, BP 1800 San Pedro, Côte d'Ivoire

²Laboratory for Environment, Climate, Health, Engineering and Sustainable Development, Department of Animal Biology, Peleforo GON COULIBALY University, BP 1328 Korhogo, Côte d'Ivoire

*Corresponding Author: valeriekumou@gmail.com

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ABSTRACT

Understanding the feeding ecology of *Sepia officinalis* is essential for assessing its ecological role and improving the management of cephalopod resources in the Gulf of Guinea. This study investigated the diet of the common cuttlefish *S. officinalis* in the Ivorian Exclusive Economic Zone, with particular emphasis on seasonal and ontogenetic variations in prey composition. A total of 528 stomachs were examined, of which 407 contained food. Prey composition was assessed using the numerical percentage (Cn%), gravimetric percentage (W%), frequency of occurrence (F%), and Index of Relative Importance (%IRI). Seasonal and ontogenetic dietary similarities were evaluated using the Schoener overlap index and Spearman rank correlation. Fish and crustaceans were the principal prey groups, but their relative importance varied substantially among seasons. Fish accounted for 50.96%, 21.11%, 59.70% and 77.66% IRI during the great cold, small hot, small cold and great hot seasons, respectively, whereas crustaceans accounted for 47.95%, 77.92%, 37.08% and 20.34% IRI, respectively. *Penaeus notialis* was particularly important during the great cold and small hot seasons, while fish prey contributed substantially during the other seasons. Seasonal dietary overlap varied substantially among season pairs (Schoener $\alpha = 0.42-0.89$), and Spearman correlations ranged from 0.59 to 0.95, with significant correlations observed for three of the six seasonal comparisons. Ontogenetic analysis showed a marked difference in diet between juveniles and adults, with juveniles relying predominantly on crustaceans, particularly *Penaeus notialis*, whereas adults consumed mainly fish. The results demonstrate that *S. officinalis* has a broad and flexible feeding strategy, with prey composition and relative prey importance changing according to season and body size. These findings highlight the importance of considering both seasonal and ontogenetic variation when assessing the trophic ecology and resource use of *S. officinalis* in Ivorian waters.

INTRODUCTION

Cephalopods constitute an ecologically and economically important group of marine invertebrates that play a key role in marine food webs as both predators and prey. Their rapid growth, short life cycles and high ecological plasticity allow them to respond quickly to environmental changes and fishing pressure, making them increasingly important components of global fisheries resources. In many regions of the world, cephalopods have gained growing attention as alternative fishery resources capable of partially compensating for the decline of several overexploited fish stocks (**Boyle and Rodhouse, 2005; Doubleday *et al.*, 2016**). In the Exclusive Economic Zone of Côte d'Ivoire, cephalopods are exploited by both industrial trawlers operating from the fishing port of Abidjan and by artisanal fisheries. Among the species landed, the common cuttlefish *Sepia officinalis* (Linnaeus, 1758) is the most abundant and regularly recorded species in landings, followed by the common Octopus *Octopus vulgaris* (Cuvier, 1797) and the European squid *Loligo vulgaris* (Lamarck, 1798). According to official statistics from the Ivorian Directorate of Aquaculture and Fisheries (**DAP**), approximately 331.969 tons of cuttlefish were recorded in landings at the Abidjan fishing port in 2015. These observations highlight the growing importance of cephalopods in local fisheries and their potential contribution to the diversification of marine resources exploited in the region. The common cuttlefish *Sepia officinalis* is a neritic benthic species typically inhabiting sandy and muddy substrates in coastal waters. It is an active predator that feeds mainly on fish, crustaceans and other molluscs, which it captures using its rapidly extensible tentacles and powerful beak (**Boyle and Rodhouse, 2005; Jereb and Roper, 2010**). Through its predatory activity, this species plays an important role in structuring coastal trophic webs and contributes to energy transfer within marine ecosystems. Despite the economic importance of cephalopods in West African fisheries, scientific information on their biology, ecology and stock structure remains relatively scarce in the Ivorian marine ecosystem. Available studies mainly provide general information on cephalopod occurrence and fisheries exploitation, while detailed ecological studies remain limited. In particular, knowledge of the feeding ecology of *Sepia officinalis* in Ivorian waters is still lacking. Understanding the diet composition of this species is essential for assessing its trophic role, evaluating its interactions with other species and improving ecosystem-based fisheries management. Previous studies on the feeding ecology of cuttlefish in West Africa have mainly focused on populations from the Senegalese coast (**Bakhayokho, 1980**). However, environmental conditions, prey availability and fishing pressure may vary considerably along the Gulf of Guinea, potentially influencing feeding strategies and trophic behavior of cephalopod populations. The present study therefore aims to investigate the feeding ecology of *Sepia officinalis* in the Ivorian Exclusive Economic Zone. Specifically, this work seeks to (i) describe the diet composition of the species, (ii) identify the main prey groups contributing to its trophic spectrum, and (iii) examine potential variations in feeding habits according to marine seasons and size classes of

individuals. Recent evidence from aquatic ectotherms likewise indicates that temperature and production conditions can modify feed intake, feed conversion, and growth responses, supporting cautious interpretation of seasonal feeding patterns (**Khallaf et al., 2021; Hudi et al., 2025**). By providing new data on the trophic ecology of this species, this study contributes to improving the ecological knowledge of cephalopods in the Gulf of Guinea and supports the sustainable management of marine living resources in the region.

MATERIALS AND METHODS

Study Area

The study was conducted in the Exclusive Economic Zone (EEZ) of Côte d'Ivoire, which extends along approximately 550 km of coastline bordering the Gulf of Guinea in the eastern tropical Atlantic Ocean. This maritime area represents an important zone for the development of marine fisheries and constitutes a significant source of animal protein for the Ivorian population. Both industrial trawlers operating from the fishing port of Abidjan and numerous artisanal fishing units exploit marine resources within this coastal ecosystem. The study area is located in the Gulf of Guinea, a major component of the West African marine ecosystem. Geographically, this region is bounded to the north by the West African coastline, to the west by Cape Palmas (approximately 8° W), and to the east by about 2°30' E longitude (**Pezenne and Bard, 1992**). The Ivorian coastline is characterized by a succession of sandy beaches forming a broad arc open to the Atlantic Ocean. The regional climate is typically Guinean and is strongly influenced by seasonal oceanographic processes. One of the main characteristics of this marine environment is the presence of four distinct marine seasons determined by annual variations in sea surface temperature and coastal upwelling dynamics (**Pezenne and Bard, 1992**). Two cold seasons occur during the year and are associated with coastal upwelling events. The major cold season extends from July to October, while the minor cold season occurs from January to February. During these periods, colder and more saline oceanic waters rise to the surface, with salinity values generally exceeding 35‰ and sea surface temperatures ranging between 23 and 25 °C. In contrast, two warm seasons are also observed: a major warm season from March to June and a minor warm season from November to December. These periods are characterized by warmer surface waters with temperatures ranging from 28 to 30 °C and slightly lower salinity levels, generally below 35‰ (**Golé Bi et al., 2005**). These seasonal oceanographic fluctuations strongly influence marine productivity, prey availability and the distribution of many marine organisms in the Gulf of Guinea.

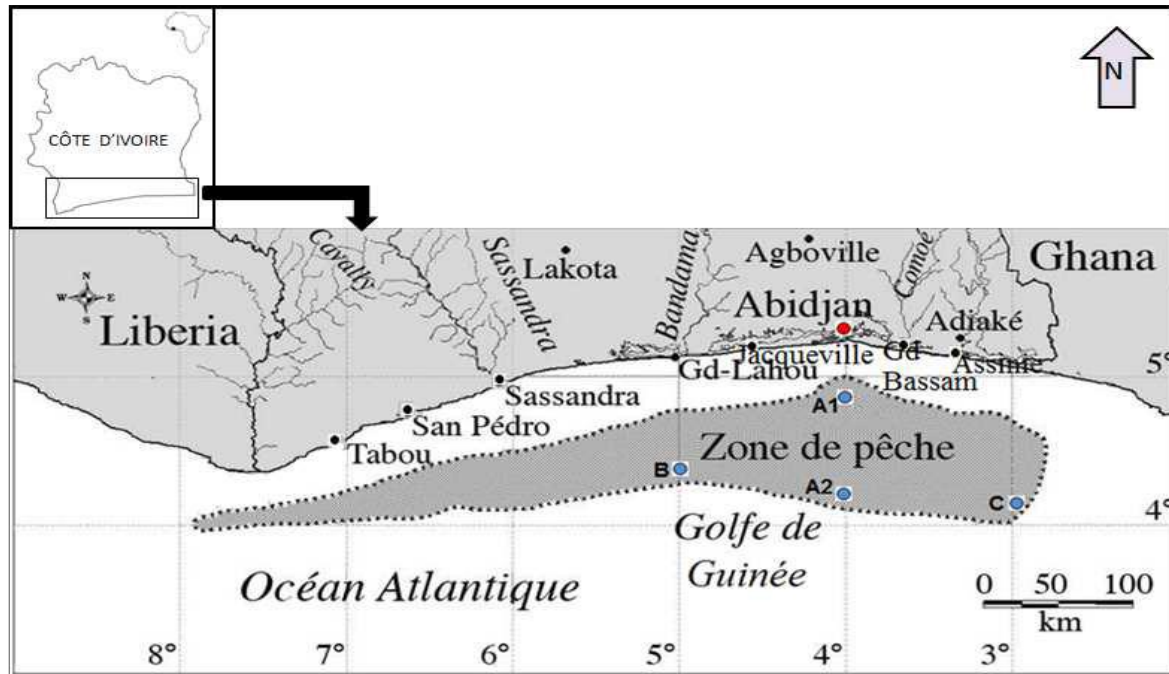


Fig. 1. Fishing zone of Côte d'Ivoire.

Sampling Strategy and Stomach Content Analysis

Specimens of the common cuttlefish *S. officinalis* were collected monthly from July 2014 to June 2015 at the fishing port of Abidjan and at the artisanal landing site of Vridi Canal, both located along the coast of Côte d'Ivoire. Sampling was conducted during the unloading of industrial trawlers and artisanal fishing units. Individuals landed at the fishing port of Abidjan were captured by industrial trawlers using demersal trawl nets, whereas specimens obtained at the Vridi Canal landing site were caught by artisanal fishermen using local jigging techniques. Fishing trips conducted by industrial trawlers generally lasted approximately eight days, while artisanal fishing trips typically lasted only a few hours. Each month, one crate containing approximately 30 cuttlefish specimens from the industrial fishery and one container containing approximately 15 cuttlefish specimens from the artisanal fishery were randomly selected for sampling at the Abidjan fishing port and the Vridi Canal landing site, respectively. For each specimen, biometric measurements were recorded to characterize the individuals, including dorsal mantle length (DML, cm) and total body weight (W, g). Specimens were classified according to the size at first sexual maturity (L50) reported by **Akesse (2016)** for *S. officinalis* in the Ivorian Exclusive Economic Zone: juveniles (DML < 18 cm) and adults (DML $\geq$ 18 cm). Some stomachs from artisanal fishery landings were dissected and analyzed immediately while fresh, whereas in other cases, the portion of the digestive tract extending from the oesophagus to the stomach was removed and preserved in 5% formalin for subsequent laboratory analysis. In the laboratory, stomachs were carefully dissected and their contents were rinsed with water through a series of sieves with mesh

sizes of 1000 µm, 500 µm and 250 µm. Prey remains were then examined either with the naked eye or under a stereoscopic binocular microscope depending on their size. All prey items were sorted, counted and weighed before identification. Whenever possible, prey were identified to the lowest possible taxonomic level using the identification guides of **Fischer *et al.* (1987a, 1987b)**. However, because many prey items were highly digested, identification was often limited to higher taxonomic categories based on resistant structures such as fish otoliths, crustacean exoskeleton fragments or cephalopod beaks. To quantify diet composition, several commonly used trophic indices were calculated following the methods described by **Hyslop (1980)**, **Castro and Guerra (1990)**, **Collins *et al.* (1994)** and **Coelho *et al.* (1997)**. These included the vacuity coefficient (Cv), frequency of occurrence (F), numerical percentage (Cn), and gravimetric percentage (W), which together provide both qualitative and quantitative information on prey importance in the diet.

▪ Diet Composition Indices

Several quantitative indices commonly used in trophic ecology were calculated in order to describe the feeding habits of the common cuttlefish *S. officinalis*. These indices provide complementary information on the relative importance of different prey categories in the diet.

▪ Vacuity Coefficient (VC)

The vacuity coefficient represents the proportion of empty stomachs among all examined stomachs and provides an estimate of feeding intensity.

$$VC\% = \frac{\text{number of empty stomachs}}{\text{number of examined stomachs}} \times 100$$

▪ Frequency of Occurrence (F)

The frequency of occurrence indicates how often a particular prey type appears in the stomach contents.

$$F\% = \frac{\text{number of stomach containing item } i}{\text{number of examined full stomachs}} \times 100$$

▪ Numerical Percentage (Cn)

The numerical percentage represents the proportion of each prey type relative to the total number of prey items identified.

$$Cn\% = \frac{\text{Total number of the item } i}{\text{Total number of all items}} \times 100$$

▪ **Gravimetric Percentage (W)**

The gravimetric percentage corresponds to the contribution of each prey category to the total prey biomass found in stomach contents.

$$W\% = \frac{\text{Weight of the item } i}{\text{Total weight of the preys}} \times 100$$

▪ **Index of Relative Importance (IRI)**

To obtain a more integrated evaluation of the importance of each prey category, the Index of Relative Importance (IRI) proposed by **Pinkas *et al.* (1971)** was calculated as follows:

$$IRI = F\%(Cn\% + W\%)$$

To facilitate comparisons among prey categories, the standardized percentage form of the index was also calculated:

$$IRI\% = \frac{IRI}{\sum IRI} \times 100$$

This index combines numerical abundance, biomass contribution and occurrence frequency, thereby providing a comprehensive measure of prey importance in the diet.

▪ **Food Coefficient (Q)**

The food coefficient proposed by **Hureau (1970)** was also used to classify prey according to their importance in the diet.

$$Q = W\% \times Cn\%$$

Based on the value of Q, prey categories were classified into three trophic groups:

- **Q > 200** : preferential prey
- **20 < Q < 200** : secondary prey
- **Q < 20** : occasional or accessory prey

This classification takes into account both the abundance and biomass contribution of prey items.

▪ Diet Overlap: Schoener Index

Dietary overlap between biological stages (juveniles and adults) and between marine seasons was assessed using the Schoener index (**Schoener, 1970**), which measures the similarity between two diets.

$$\alpha = 1 - 0,5 \left(\sum_{k=0}^n |p_{xi} - p_{yi}| \right)$$

where:

P_{xi} = proportion of prey type i in the diet of group x

P_{yi} = proportion of prey type i in the diet of group y

Dietary overlap is considered biologically significant when $\alpha > 0.6$ indicating a high similarity between the compared diets.

Statistical Analysis

Statistical analyses were performed using Statistica version 7.1. The Spearman rank correlation coefficient was used to examine potential relationships between dietary compositions among size classes and between marine seasons. Calculations were based on the percentage values of the Index of Relative Importance (IRI%). Statistical significance was evaluated at a probability level of $p < 0.05$.

RESULTS

1- Variation of the Vacuity Coefficient

1-1- Monthly Variation of the Vacuity Coefficient

A total of 528 stomachs of the common cuttlefish *S. officinalis* were examined during the study period (**July 2014–June 2015**). Among them, 121 stomachs were empty, resulting in an overall vacuity coefficient of 22.91%. The monthly variation of the vacuity coefficient is presented in **Fig. 2**. The highest values were recorded in September (28.60%) and February (26.02%), whereas the lowest values occurred in April (18.06%) and May (18.10%).

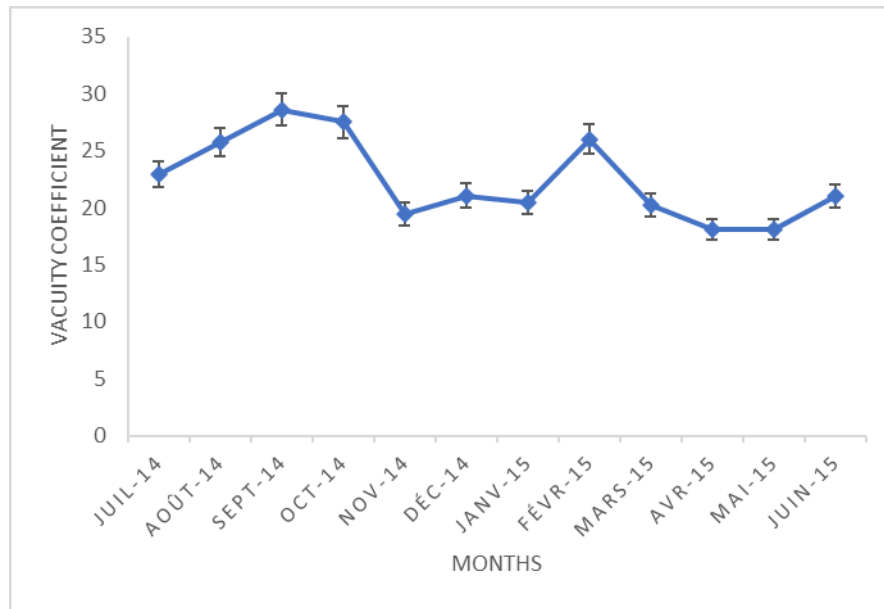


Fig. 2. Monthly variation of the vacuity coefficient in *Sepia officinalis*.

1-2- Seasonal Variation of the Vacuity Coefficient

The seasonal variation of the vacuity coefficient is illustrated in **Fig. 3**. The highest percentages were recorded during the major cold season (26.19%) and the minor cold season (23.26%). In contrast, the lowest vacuity coefficient was observed during the major warm season (19.59%).

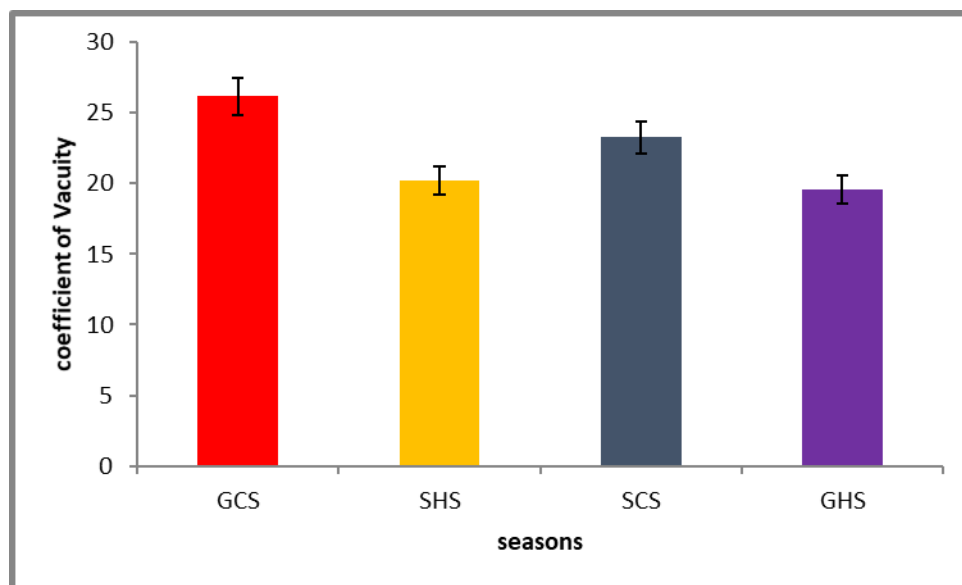


Fig. 3. Seasonal variation of the vacuity coefficient in *Sepia officinalis*. GCS (great cold season); SHS (small hot season); SCS (small cold season); GHS (great hot season).

1-3- Size-related variation in the vacuity coefficient

The variation in the vacuity coefficient among size classes is illustrated in **Fig. 4**. Adult individuals showed a higher vacuity coefficient (24.21%) than juveniles (16.03%), consistent with lower feeding activity in adults during the sampling period.

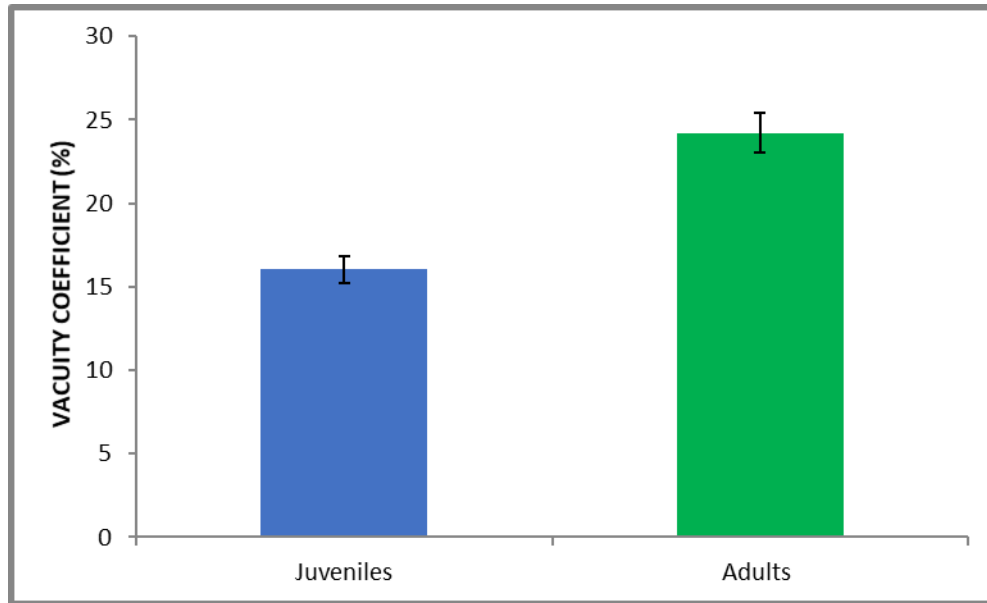


Fig. 4. Size-related variation of the vacuity coefficient in *S. officinalis*.

2- Diet composition

2-1- General diet composition

Of the 528 stomachs examined, **407 contained food items**. Eight prey categories belonging to five major taxonomic groups were identified (**Table 1**).

Fish and crustaceans represented the dominant prey groups. The fish group consisted mainly of unidentified teleost remains and two identifiable taxa:

- *Sardinella* sp. (family Clupeidae)
- *Galoides decadactylus* (family Polynemidae)

The crustacean group included the shrimp *Penaeus notialis* and brachyuran crabs. One cephalopod species was identified in the stomach contents: *S. officinalis* itself, indicating cannibalistic behavior. According to the food coefficient (Q), **fish (Q = 3133.5)** and **crustaceans (Q = 1303.9)** were classified as preferential prey ($Q > 200$). Cephalopods ($Q = 8.24$), plant debris ($Q = 5.08$), and polychaetes ($Q = 1.65$) were considered accessory prey.

Table 1. Dietary composition of *Sepia officinalis* from the Exclusive Economic Zone (EEZ) of Côte d'Ivoire and percentage values of the corresponding feeding indices.

Category	Cn(%)	W(%)	F(%)	%IRI	Q
Fish					
Unspecified fish	19.03	28.94	21.62	24.55	550.73
<i>Sardinella sp.</i>	15.49	14.7	23.59	16.85	227.7
<i>Galoides decadactylus</i>	17.35	16.77	17.70	14.29	290.96
Crustaceans					
Macroures					
<i>Penaeus notialis.</i>	22.39	21.36	28.01	29.00	478.25
Brachyours					
Crabs	13.8	14.67	19.90	13.41	202.45
Cephalopod					
<i>Sepia officinalis</i>	4.29	1.92	6.14	0.90	8.24
Polychaetes	2.99	0.55	4.67	0.39	1.64
Plant debris	4.66	1.09	4.42	0.60	5.07
TOTAL					
FISH	51.87	60.41	62.91	55.69	3133.5
CRUSTACEANS	36.19	36.03	47.90	42.41	1303.9
CEPHALOPODS	4.29	1.92	6.14	0.9	8.24
POLYCHAETES	2.99	0.55	4.67	0.39	1.65
PLANT DEBRIS	4.66	1.09	4.42	0.60	5.08

Note: Cn% = percentage by number; W% = percentage by weight; %F = frequency of occurrence; IRI = index of relative importance (%); Q = feeding coefficient

2-2- Seasonal variation of diet composition

Diet composition varied markedly among the four marine seasons. During the great cold season (GCS), fish constituted the main prey group, with a total %IRI of 50.96%, followed by crustaceans (47.95%). At the prey-item level, *Penaeus notialis* was the most important prey (29.62% IRI), followed by unidentified fish (21.50%), crabs (18.33%), *Sardinella sp.* (17.54%) and *Galoides decadactylus* (11.92%). During the small hot season (SHS), crustaceans clearly dominated the diet (%IRI = 77.92%), mainly

due to the high contribution of *P. notialis* (%IRI = 59.89%), whereas fish accounted for 21.11% IRI. During the small cold season (SCS), fish and crustaceans contributed relatively similarly to the diet, accounting for 59.70% and 37.08% IRI, respectively. During the great hot season (GHS), fish were the dominant prey group (%IRI = 77.66%), whereas crustaceans contributed 20.34% IRI. Cephalopods, polychaetes and plant debris remained minor dietary components throughout the seasons. The Schoener index showed variable dietary overlap among seasons. The highest overlap was observed between the GCS and SCS ($\alpha = 0.89$), followed by the SCS and GHS ($\alpha = 0.78$), GCS and GHS ($\alpha = 0.72$), and GCS and SHS ($\alpha = 0.69$). In contrast, dietary overlap was lower between SHS and SCS ($\alpha = 0.59$) and particularly between SHS and GHS ($\alpha = 0.42$), indicating greater differences in diet composition between these seasonal pairs. Spearman rank correlation analysis also revealed differences in the similarity of prey rankings among seasons. Significant positive correlations were observed between GCS and SHS ($R_s = 0.95$), GCS and SCS ($R_s = 0.82$), and SCS and GHS ($R_s = 0.74$). In contrast, the correlations between GCS and GHS ($R_s = 0.67$), SHS and SCS ($R_s = 0.68$), and SHS and GHS ($R_s = 0.59$) were not statistically significant. The particularly low Schoener overlap between SHS and GHS ($\alpha = 0.42$), together with their non-significant Spearman correlation ($R_s = 0.59$), reflects a substantial seasonal change in the relative importance of prey.

2-3- Ontogenetic Changes in Diet

Diet composition differed markedly between juveniles and adults (**Table 3**).

Juveniles fed predominantly on crustaceans (%IRI = 96.77), particularly the shrimp *Penaeus notialis* (%IRI = 92.81). Fish (%IRI = 3.05), plant debris (0.11%) and polychaetes (0.06%) were consumed occasionally, while cephalopods were absent from juvenile stomach contents. In contrast, adults fed mainly on fish (%IRI = 75.67%), while crustaceans represented secondary prey (%IRI = 22.43%). Cephalopods (1.52%), plant debris (0.25%) and polychaetes (0.12%) were considered occasional prey. The Schoener index indicated a low dietary overlap between juveniles and adults ($\alpha = 0.20$), suggesting a marked ontogenetic shift in diet. The Spearman rank correlation was positive but not statistically significant ($R_s = 0.57$, $p = 0.139$), further indicating differences in prey ranking between the two size classes (**Table 4**).

Table 2. Dietary composition of *Sepia officinalis* according to marine seasons and percentage values of the corresponding feeding indices.

Preys	Cn%	W%	F%	IRI%
Great cold season (GCS)				
Fish				50.96
Unspecified fish	19.75	2.29	23.13	21.50
<i>Sardinella sp.</i>	17.83	2.07	20.9	17.54
<i>G. decadactylus</i>	14.65	1.82	17.16	11.92
Crustacean				47.95
<i>P. notialis</i>	23.57	1.86	27.61	29.62
Crabs	18.47	1.61	21.64	18.33
Cephalopod	4.46	0.33	5.22	1.05
Polychaetes	0.64	0.005	0.75	0.02
Plant debris	0.64	0.01	0.75	0.02
Small hot season (SHS)				
Fish				21.11
Unspecified fish	14.15	17.36	23.08	9.95
<i>Sardinella sp.</i>	9.44	13.23	15.38	4.77
<i>G. decadactylus</i>	11.32	13.96	18.46	6.39
Crustacean				77.92
<i>P. notialis</i>	37.74	33.40	61.54	59.89
Crabs	20.75	18.19	33.85	18.03
Cephalopod	4.72	4.13	7.69	0.93
Polychaetes	0.94	0.06	1.54	0.02
Plant debris	0.95	0.1	1.54	0.02
Small cold season (SCS)				
Fish				59.7
Unspecified fish	17.42	24.36	19.49	22.80
<i>Sardinella sp.</i>	18.18	22.49	20.34	23.16
<i>G. decadactylus</i>	14.39	17.8	15.25	13.74
Crustacean				37.08
<i>P. notialis</i>	18.94	13.38	21.18	19.18
Crabs	17.42	15.39	19.49	17.90
Cephalopod	6.06	5.35	6.77	2.16
Polychaetes	4.55	0.16	5.08	0.67
Plant debris	3.03	1.07	3.39	0.39
Great hot Season (GHS)				
Fish				77.66
Unspecified fish	26.27	15.7	14.44	32.07
<i>Sardinella sp.</i>	16.95	22.9	22.22	19.65
<i>G. decadactylus</i>	20.34	23.5	20.00	25.94
Crustacean				20.34
<i>P. notialis</i>	13.56	16.27	30.00	11.76
Crabs	10.17	18.83	27.77	8.58
Cephalopod	4.24	0.75	5.55	0.62
Polychaetes	3.39	0.24	4.44	0.36
Plant debris	5.08	1.8	6.67	1.02

Note: GCS (great cold season); SHS (small hot season); SCS (small cold season); GHS (great hot season).

Table 3. Composition of the diet of *Sepia officinalis* according to the size.

Juveniles				Adults				
Preys	Cn%	W%	F%	IRI %	Cn%	W%	F%	IRI %
Fish				3.05				75.67
Unspecified fish	10.00	13.87	12.28	2.60	23.06	26.70	29.35	32.42
<i>Sardinella sp</i>	3.57	4.95	4.39	0.33	19.84	22.97	25.25	24.00
<i>G. decadactylus</i>	2.14	2.97	2.63	0.12	17.70	20.80	22.53	19.25
Crustacean				96.77				22.43
<i>P. notialis</i>	65.71	63.8	80.70	92.81	16.09	13.04	20.48	13.24
Crabs	13.57	13.17	16.66	3.96	13.40	10.86	17.06	9.19
Cephalopod	0.00	0.00	0.00	0.00	5.36	4.66	6.83	1.52
Polychaetes	2.14	0.45	2.63	0.06	1.88	0.33	2.39	0.12
Plant debris	2.86	0.79	3.51	0.11	2.68	0.65	3.41	0.25

Note: Cn% = percentage by number; W% = percentage by weight; %F = frequency of occurrence;

IRI = index of relative importance (%);

Table 4. Correlation between diet composition, size classes, and marine seasons using Schoener's index and Spearman's rank correlation coefficient

	Schoener's index (α)	Spearman's rank (Rs)	p-value
GCS/SHS	0.69	0.95	<0.001
GHS/GCS	0.7	0.67	0.069
GCS/SCS	0.89	0.82	0.011
SHS/SCS	0.59	0.68	0.062
SCS/GHS	0.78	0.74	0.037
SHS/GHS	0.42	0.59	0.117
Juveniles/Adults	0.20	0.57	0.139

Note: GCS = great cold season; SHS = small hot season; SCS = small cold season; GHS = great hot season. Dietary overlap was considered high when Schoener's index $\alpha > 0.60$. Spearman rank correlations were considered statistically significant at $p < 0.05$.

DISCUSSION

The vacuity coefficient observed in *Sepia officinalis* was higher during the cold seasons than during the hot seasons, suggesting seasonal variability in feeding activity. Periods of increased trophic activity appear to occur during certain months of the warm seasons, particularly prior to the reproductive period, when energetic demands increase. Reproductive processes are known to influence feeding behaviour in cephalopods, as the development of gonads may reduce the space available for the digestive tract and consequently limit food intake. During the breeding period, mature individuals often exhibit reduced feeding activity or temporary fasting. Similar patterns have been reported for *Sepia officinalis* in several regions, where feeding intensity tends to decrease during reproductive periods (**Castro and Guerra, 1992; Guerra, 2006**). Studies on cephalopod trophic ecology have also highlighted strong seasonal variability in feeding activity linked to environmental conditions and reproductive cycles (**Boyle and Rodhouse, 2005; Pierce et al., 2010**). Comparable observations have been reported for the common octopus *Octopus vulgaris*, another cephalopod species with similar ecological and reproductive strategies, which tends to feed more actively during warmer periods than during colder seasons (**Hatanaka, 1979**). **Mangold (1982)** observed in the Gulf of Morbihan vacuity coefficient was also higher in mature individuals than in juveniles, indicating that feeding activity is more intense in younger specimens. According to **Henri James E., (2012)** younger individuals generally increase their feeding rates to support accelerated somatic growth. Many cephalopods exhibit an early phase of rapid exponential growth, which allows them to reduce the period during which they are highly vulnerable to predation. This growth strategy has been described by **Semmens et al. (2004)** who demonstrated that early life stages of cephalopods require high energetic intake to sustain rapid development. Our findings are consistent with those reported by recent studies indicating that the vacuity coefficient tends to increase with the age or size of the cuttlefish. Higher feeding activity in juveniles promotes rapid post-hatching growth and contributes to increased survival rates (**Vasconcelos et al., 2014; Guerra-Marrero et al., 2024**). The classification of prey items using both the Index of Relative Importance (IRI) and the food coefficient (Q) clearly shows that *Sepia officinalis* feeds mainly on fish and crustaceans. Similar trophic patterns have been documented in several regions within the distribution range of this species (**Vasconcelos et al., 2014; Guerra-Marrero et al., 2024**). A large proportion of fish prey could not be identified because of their advanced state of digestion. However, the presence of fish bones, scales, and other resistant structures suggests that these prey mainly consist of small teleost fishes. Observations from the present study indicate that *S. officinalis* generally captures prey smaller than its own body size, a pattern commonly reported in cephalopods where prey size tends to increase with predator size (**Boyle and Rodhouse, 2005**). The advanced state of digestion observed in many stomach contents may be explained by the rapid digestive processes

characteristic of cephalopods. Cephalopods possess highly efficient digestive systems that allow them to process prey rapidly, often leaving only resistant structures such as bones, otoliths, or exoskeleton fragments (Boyle and Rodhouse, 2005; Guerra-Marrero *et al.*, 2024). Cannibalistic behavior in cuttlefish has been previously documented by Richard (1971), who suggested that this behavior may occur when food resources become limited and weaker individuals become more vulnerable. Although some similarities in diet composition were observed among the marine seasons, the results clearly indicate that the diet of *Sepia officinalis* was not constant throughout the year. The relative contribution of the main prey groups varied considerably among seasons. Fish were the dominant prey group during the great cold season (50.96% IRI), the small cold season (59.70% IRI), and particularly the great hot season (77.66% IRI), whereas crustaceans predominated strongly during the small hot season, accounting for 77.92% IRI. At the prey-item level, *Penaeus notialis* was the main prey during the great cold and small hot seasons, whereas fish prey, particularly unidentified fish, *Sardinella sp.* and *Galoides decadactylus*, contributed substantially during the other seasons. These variations indicate that the cuttlefish adjusted the relative importance of its prey according to seasonal conditions. A similar seasonal variability in the diet of *S. officinalis* was reported by Mzaki *et al.* (2017) in Moroccan waters, where seasonal changes were described as an important source of variation in diet composition. Their results showed pronounced shifts in diet among seasons, which the authors related to changes in the availability of preferred prey. In their study, fishes dominated the diet throughout the year, with a particularly high contribution during winter, whereas increased consumption of crustaceans during autumn coincided with the recruitment period of several decapod species. The present results from the Ivorian Exclusive Economic Zone are consistent with the general pattern reported by Mzaki *et al.* (2017), in that seasonal changes in prey importance suggest that the diet of *S. officinalis* responds to seasonal fluctuations in the prey community. However, the pattern observed in Côte d'Ivoire differs from that reported in Morocco because crustaceans, rather than fish, became the dominant prey group during the small hot season. This difference may reflect regional and seasonal differences in prey availability and abundance. An ontogenetic shift in diet was clearly observed in this study. Juveniles fed predominantly on crustaceans, whereas adults consumed mainly fish. This pattern likely reflects differences in hunting ability and prey capture efficiency between size classes. Juvenile cuttlefish may target crustaceans because these organisms are easier to capture than fast-swimming fish. Similar patterns have been reported in previous studies. Alves *et al.* (2006) suggested that juvenile cuttlefish preferentially consume crustaceans due to their limited predatory capabilities. Likewise, Castro and Guerra (1990) reported that the importance of crustaceans in the diet of cuttlefish decreases progressively with growth, while the consumption of fish increases. Other studies have also confirmed that larger cuttlefish tend to consume higher proportions of fish relative to crustaceans. Similar ontogenetic dietary shifts have been

reported by **Alves *et al.* (2006)**. Overall, these results demonstrate that *Sepia officinalis* exhibits a flexible and opportunistic feeding strategy, with diet composition influenced by ontogenetic stage, physiological condition, and seasonal environmental factors.

CONCLUSION

The present study indicates that *Sepia officinalis* in the Ivorian Exclusive Economic Zone has a broad and flexible diet composed mainly of fish and crustaceans. Although the same major prey groups occurred throughout the year, their relative importance varied among marine seasons. Fish predominated during the great cold, small cold and great hot seasons, whereas crustaceans were strongly dominant during the small hot season. The seasonal Schoener and Spearman analyses further confirmed that dietary similarity was variable among seasons, with particularly low overlap between the small hot and great hot seasons. Therefore, the diet of *S. officinalis* cannot be considered constant throughout the annual cycle. Ontogenetic differences were also pronounced. Juveniles relied predominantly on crustaceans, especially *Penaeus notialis*, whereas adults consumed mainly fish. The low Schoener overlap between juveniles and adults further indicates a substantial dietary shift with body size. These differences may reflect changes in prey availability, habitat use and feeding requirements during growth, although these mechanisms require further investigation through simultaneous studies of prey availability in the environment. Overall, the results indicate that seasonal and ontogenetic variability are important components of the feeding ecology of *S. officinalis* in Ivorian waters. Incorporating these variations into future ecological assessments will contribute to a better understanding of trophic interactions and to the sustainable management of this commercially exploited cephalopod resource.

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