Egyptian Journal of Aquatic Biology & Fisheries
Zoology Department, Faculty of Science,
Ain Shams University, Cairo, Egypt.
ISSN 1110 – 6131
Vol. 28(4): 281 – 296 (2024)
www.ejabf.journals.ekb.eg


# Investigating the Dietary of *Saurida undosquamis*: A Comparative Study Across Two Key Marine Ecosystems in Egypt

**Alaa A. Roshdy[1*], Azza A. El-Ganainy[2], Amira A. Ali[1]**
[1]Department of Marine Science, Faculty of Science, Suez Canal University, Egypt
[2]National Institute of Oceanography and Fisheries, Suez, Egypt
*Corresponding author: alaaroshdy@science.suez.edu.eg

**ARTICLE INFO**
**Article History:**
Received: May 16, 2024
Accepted: June 28, 2024
Online: July 18, 2024

**Keywords**:
*Saurida undosquamis*
Feeding aspects,
Diet composition,
Feeding intensity,
Gastro-somatic index

**ABSTRACT**

The present study was conducted for the purpose of determining the main feeding aspects of the brushtooth lizardfish *Saurida undosquamis*. It was carried out from September 2018 till April 2019 in the Northern Gulf of Suez, and from March 2018 to March 2019 in the South-Eastern Mediterranean Sea at Port Said. A total of 1110 specimens were monthly collected from both sites. The analysis of stomachs content showed that *S. undosquamis* is a carnivorous species, feeding on some of both vertebrates and invertebrates preys. The seasonal variations in diet composition revealed that fish remains were the most dominant food item for both populations; however, not during all seasons. Regarding the intensity of feeding, individuals with stomachs containing food were observed mostly during winter with a percentage of 71.4%, while their maximum percentage was in spring with 80.3% for the Gulf of Suez and the Mediterranean Sea populations, respectively. On the other hand, the degree in fullness followed a different trend for individuals from both populations. The variations of diet composition in relation to size for both populations showed that fish remains were the most abundant food items for specimens of almost all size classes, and the monthly averages of gastro–somatic index indicated that both study sites had fluctuation in values.

## INTRODUCTION

Studies on the diet composition of any species are considered one of the essential factors in fisheries biology and community ecology, as the nature and content of food needs for fish growth provide insights on its habitats **(Mequilla & Campos, 2007; Laban, 2008)**.

Analysis of gut contents could provide a solid insight to assess the fish feeding habit both qualitatively and quantitatively. It provides helpful information on fish life, food resources, possible competitors, its position in the food web and estimation of trophic levels **(Post *et al.*, 2000; Cardone *et al.*, 2006)**. The quality and quantity of food are among the most important factors that affect growth directly and indirectly on maturation and mortality of fish, thus being ultimately related to fitness **(Wootton, 1990)**.

The study of food and feeding habits of different fish species needs continuous research since the accurate description of their diet composition constitutes the basis for the development of successful fisheries management for species conservation, breeding, capture, and culture **(Oronsaye & Nakpodia, 2005)**.

All previous studies have confirmed that the brushtooth lizardfish, *Saurida undosquamis* **(Richardson, 1848)** is a predatory carnivorous. **Jaiswer *et al.* (2002)** reported that it feeds chiefly on teleost fishes, cephalopods, and crustaceans. Several authors **(Ben-Yami & Glaser, 1974)** have stated that this species preys exclusively during the day. However, **Golani (1993)** couldn't rule out at least some nocturnal activity since many full stomachs were found in specimens captured at night during his study. According to the orientation of the prey in the stomach, **Golani (1993)** recorded two hunting strategies of this species, (i.e., prey organism found head facing posterior of predator were most likely ambushed while those found facing in the opposite direction were probably chased or caught from behind).

Earlier studies on the food and feeding habits of *S. undosquamis* were reported by numerous authors such as **El-Ganainy (1992, 2003)** in the Gulf of Suez, **Golani (1993)**, who recorded the diet and feeding composition in the Mediterranean Sea, **Kadharsha *et al.* (2013)** on Southeast Indian Coast who studied the feeding composition and intensity; and **Ozyurt *et al.* (2017)** in the İskenderun Bay, Turkey, who investigated the feeding diet and prey-predator length relationship.

This study focused on the feeding biology of *S. undosquamis* collected from the Gulf of Suez and the Egyptian Mediterranean waters, such as the size-related variations in the diet composition, feeding intensity, estimation of the prey percentages, and calculation of the filling index ($G_aSI$) in order to compare those parameters during different months/ seasons. This will help to explain the impact of the Mediterranean on the diet of this migrant species.

## MATERIALS AND METHODS

### 1. Biological measurements

Specimens were weighed to the nearest 0.01g using a digital balance, and their total length was determined in cm using a ruler. Each fish was dissected, and the alimentary tract was removed from the stomach and examined. For each fish, the degree of stomach fullness was estimated by an arbitrary 0- 4 point scale: 0 for empty stomachs, 1 for ¼ full, 2 for ½ full, 3 for ¾ full and 4 for full, according to **Pillay (1952)**.

### 2. Food content analysis

Each stomach was opened longitudinally, and the contents were scraped out. Contents were then transferred into a small divided petri dish and diluted by water. They were sorted into groups and examined. The occurrence method, which involves recording the occurrence of each food item irrespective of its quantity in each stomach, was adopted **(Hynes, 1950)**. On the other hand, the point method by **Kislaioglue and Gibson (1977)** was also applied.

The three methods of **Mohan and Sankaran (1988)** and **Godfriaux (1969)** were used to express the different food items statistically as follows:

#### *2.1. Percentage of occurrence*

The percentage of occurance was obtained by dividing the number of fish containing a given food item/category by the total number of fish examined in the sample, then multiplied by a 100. This value measures the selectivity and availability of food to the fish.

***2.2. Percentage of diet composition***

Food points for each food item/category were summed and divided by a total number of food points given to all fish examined, then multiplied by a 100. This value gives the relative volumes of food items that constitute the fish diet.

***2.3. Percentage of volume composition***

Food points for each food item/category were multiplied by the degree of fullness, then summed and divided by a total number of the potential stomach/volume then multiplied by a 100. This value gives the rate of stomach volume occupied by each food item/category and is considered the most accurate method.

**3. Calculation of gastro-somatic index ($G_aSI$)**

The filling index or $G_aSI$ is a valuable and efficient indicator used to compare the feeding intensity (food consumption) during the different months and determine the environmental and physiological effects on feeding habits. The $G_aSI$ was obtained through the following equation **(Desai, 1970)**:

$$G_aSI = \text{Gut weight} * 100 / \text{Body weight}$$

## RESULTS

**1. Diversity of food items**

The Gulf of Suez population exceeded the Mediterranean one in terms of the diversity of food items. Fish preys were represented from five teleost families in the stomachs of both populations. Fig. (1) represents the stomach of *S. undosquamis* containing fish prey. Three types of crustacean parts occurred in the stomachs of the Gulf of Suez population, while two were found in the stomachs of the Mediterranean one. On the other hand, molluscs occurred more often in the stomachs of the Gulf of Suez individuals than those of the Mediterranean Sea population.

Food diversity regarding monthly variations fluctuated with no particular trend (Fig. 2). However, individuals ranging between 20- 25cm (medium-sized fishes) had the highest diversity in both studied sites; yet again, specimens from the Gulf of Suez had the highest diversity at all size groups than the Mediterranean' individuals, except in the smallest size where both populations had equal values of food items (Fig. 3).

**2. Diet composition**

Analysis of stomachs content showed that *Saurida undosquamis* is a carnivorous species, feeding on fish, crustaceans (particularly shrimps), and molluscs (particularly cephalopods). Fig. (4) presents the percentage of the diet composition at both sites. The results showed the following:

**(I) Fish remains:** They formed the highest composition of the diet by 68 and 66% in the Gulf of Suez and the Mediterranean Sea populations, respectively, and was represented with the following categories:

- **Semi-digested fish:** Fish with almost all body organs (non-identifiable) were the primary food items, constituted 53 and 60% of all consumed food items in the stomachs of the Gulf of Suez population and the Egyptian Mediterranean one, respectively.

- **Whole fish:** Intact fish were represented mainly by specimens belonging to some commercial families like Carangidae, Clupeidae, Mullidae, Sparidae, Mugilidae and Synodontidae. They constituted 15% of the stomachs belonging to the Gulf of Suez population and 6% of stomachs of the Egyptian Mediterranean one.

**(II) Digested food (unidentified food parts):** They were found at 20 and 24% in the stomachs of the Gulf of Suez population and the Egyptian Mediterranean Sea population, respectively.

**(III) Crustacean parts:** They were found at 8% in the guts of specimens from the Gulf of Suez and 5% in their stomachs from the Egyptian Mediterranean Sea. They were represented mainly by the whole juvenile shrimps and parts of the crabs and mantis shrimps' exoskeleton.

**(IV) Molluscs:** This group constituted 4 and 5% of the food bulk of stomachs from the Gulf of Suez and the Egyptian Mediterranean Sea populations, respectively. It included the juvenile cuttlefish (cephalopods) and the shell remains of gastropods.

**Fig. 1.** The stomach of *S. undosquamis* containing fish prey

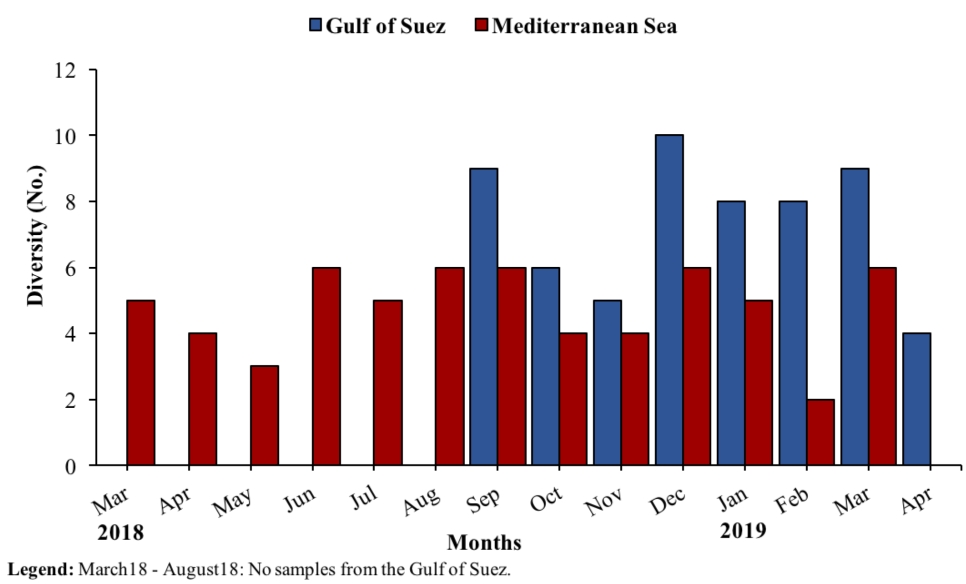


**Fig. 2.** Monthly variations of the diversity of food items of *Saurida undosquamis* from the study sites

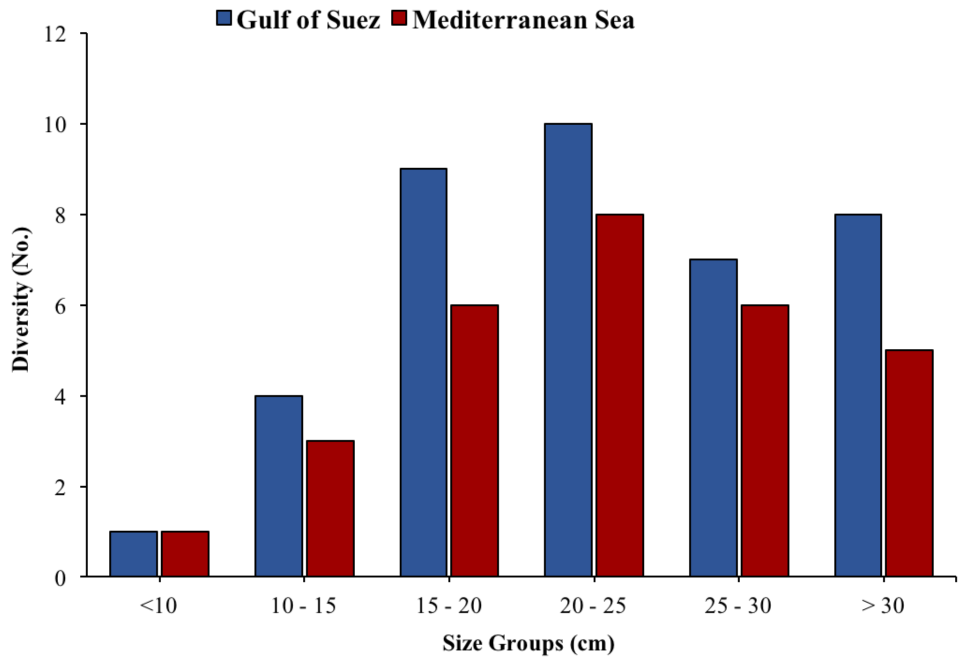


**Fig. 3.** Diversity of food items in stomachs of *Saurida undosquamis* in relation to size from both study sites

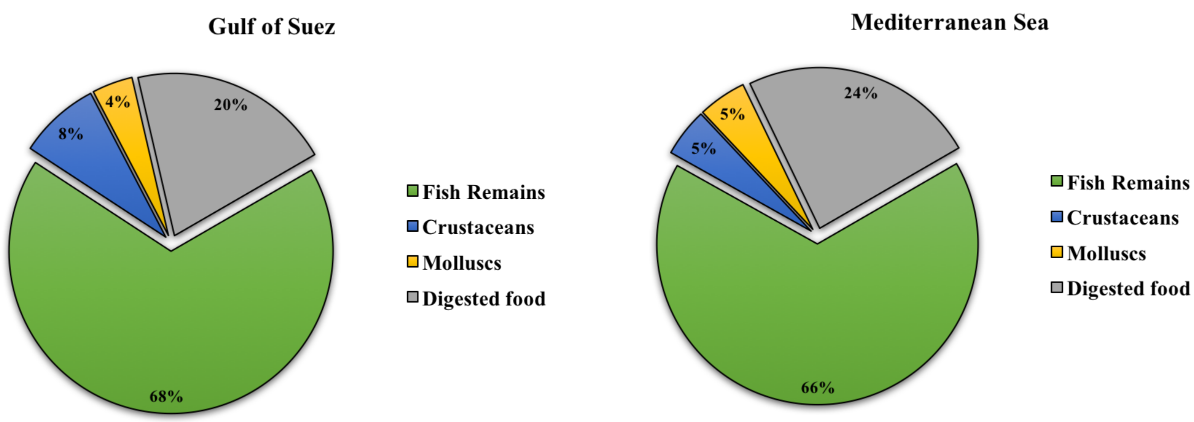


**Fig. 4.** Diet composition of *Saurida undosquamis* collected from both study sites

## 3. Seasonal variations in diet composition

For the Gulf of Suez population, all food items occurred in the fishes' stomachs with different percentages, however fish remains were the most dominant food item with the highest value in winter (63.2%) and the lowest (29.7%) in spring. Other food items occurred with different percentages through the different seasons (Table 1 & Fig. 5). For the Mediterranean Sea population, fish remains followed a similar trend with the highest percentage in autumn (72.2%) and the lowest in winter (32.2%). Other food items occurred with variations in percentages through the different seasons (Table 1 & Fig. 5).

**Table 1.** Seasonal variations in diet composition of *Saurida undosquamis* collected from both study sites

| Site | Season | Fish Remains (%) | Molluscs (%) | Crustaceans (%) | Digested food (%) |
|---|---|---|---|---|---|
| Gulf of Suez | Autumn 2018 | 46.1 | **19.2** | **17.3** | 17.4 |
| | Winter 2019 | **63.2** | 18.8 | 15.5 | 2.5 |
| | Spring 2019 | 29.7 | 9.2 | 14.3 | **46.8** |
| Mediterranean Sea | Spring 2018 | 54.8 | **12.6** | 16.6 | 16.1 |
| | Summer 2018 | 56.7 | 7.1 | **22.0** | 14.2 |
| | Autumn 2018 | **72.2** | 4.0 | 13.9 | 10.0 |
| | Winter 2019 | 32.2 | 10.8 | 6.5 | **50.5** |

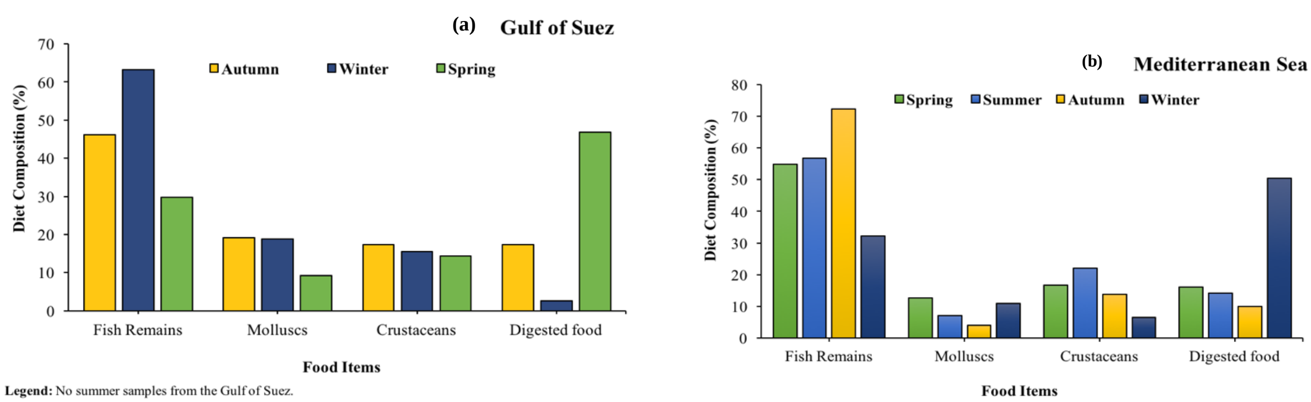


**Fig. 5.** Seasonal variations in diet composition of *Saurida undosquamis* collected from **(a)** Gulf of Suez and **(b)** Mediterranean Sea

## 4. Intensity of feeding

For the Gulf of Suez population, individuals with stomachs containing food were observed mostly during winter with a percentage of 71.4%, while their maximum percentage was in spring with 80.3% for the Mediterranean Sea population (Table 2 & Fig. 6). On the other hand, the percentage of individuals with > 25 degree in fullness (i.e. 50, 75, 100) was at its highest during winter 2019 for the Gulf of Suez population and during autumn 2018 for the Mediterranean Sea one (Table 3 & Fig. 7). The feeding intensity varied for different length groups. Individuals that ranged between 24- 32 and

18- 32cm had the highest percentages of empty stomachs, considering fishes caught from the Gulf of Suez and the Mediterranean Sea, respectively. On the other hand, small and semi medium-sized fishes were observed with the highest values of full stomachs (Table 4 & Fig. 8).

**Table 2.** Seasonal variations of the feeding intensity percentages of *Saurida undosquamis* collected from both study sites.

| Site | Season | NO. | Empty Stomach | | Stomach Containing Food | |
|---|---|---|---|---|---|---|
| | | | No. | (%) | No. | (%) |
| Gulf of Suez | Autumn 2018 | 261 | 86 | 33.0 | 175 | 67.0 |
| | Winter 2019 | 126 | 36 | 28.6 | 90 | **71.4** |
| | Spring 2019 | 106 | 69 | **65.1** | 37 | 34.9 |
| | **Total** | **493** | **191** | **39** | **302** | **61** |
| Mediterranean Sea | Spring 2018 | 208 | 41 | 19.7 | 167 | **80.3** |
| | Summer 2018 | 150 | 100 | 66.7 | 50 | 33.3 |
| | Autumn 2018 | 104 | 40 | 38.5 | 64 | 61.5 |
| | Winter 2019 | 155 | 122 | **78.7** | 33 | 21.3 |
| | **Total** | **617** | **303** | **49.1** | **314** | **51** |

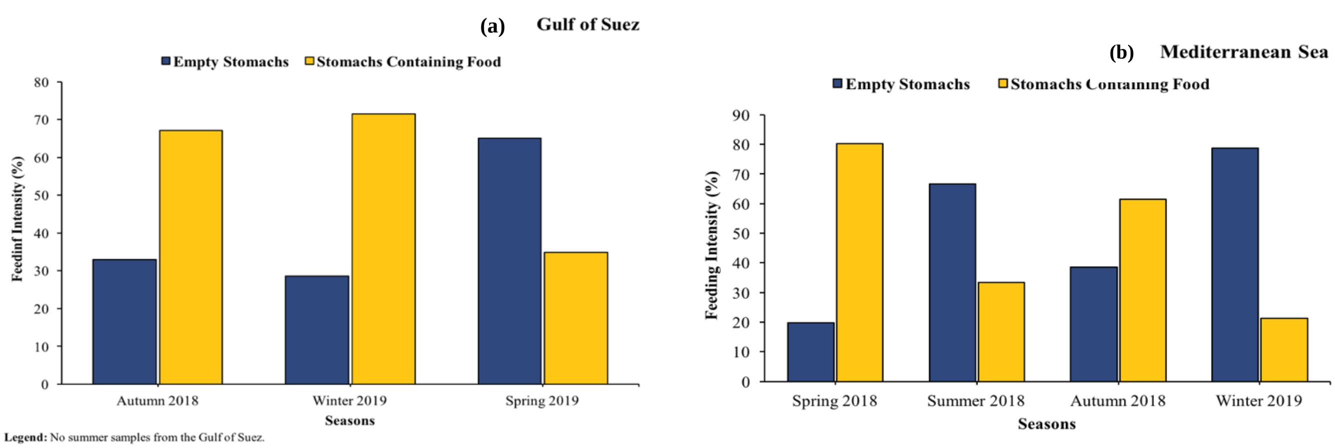


**Fig. 6.** Seasonal variations in the feeding intensity of *Saurida undosquamis* collected from **(a)** Gulf of Suez and **(b)** Mediterranean Sea

**Table 3.** Seasonal variations in the degree of fullness of *Saurida undosquamis* collected from both sites

| Site | Season | NO. | Empty | Trace (25%) | ½ full (50%) | ¾ full (75%) | Full (100%) |
|---|---|---|---|---|---|---|---|
| Gulf of Suez | Autumn 2018 | 126 | 5.6 | 23.0 | 4.8 | **57.1** | 9.5 |
| | Winter 2019 | 261 | 10.4 | 10.4 | 8.5 | 19.8 | **50.9** |
| | Spring 2019 | 106 | **15.1** | **26.8** | **36.8** | 14.2 | 7.1 |
| Mediterranean Sea | Spring 2018 | 208 | **15.3** | 19.2 | 15.9 | **13.0** | 36.6 |
| | Summer 2018 | 150 | 10.7 | 48.7 | **18.0** | 8.7 | 14.0 |
| | Autumn 2018 | 104 | 10.5 | 5.8 | 6.5 | 10.8 | **66.5** |
| | Winter 2019 | 155 | 3.8 | **57.7** | 13.5 | 3.8 | 21.2 |

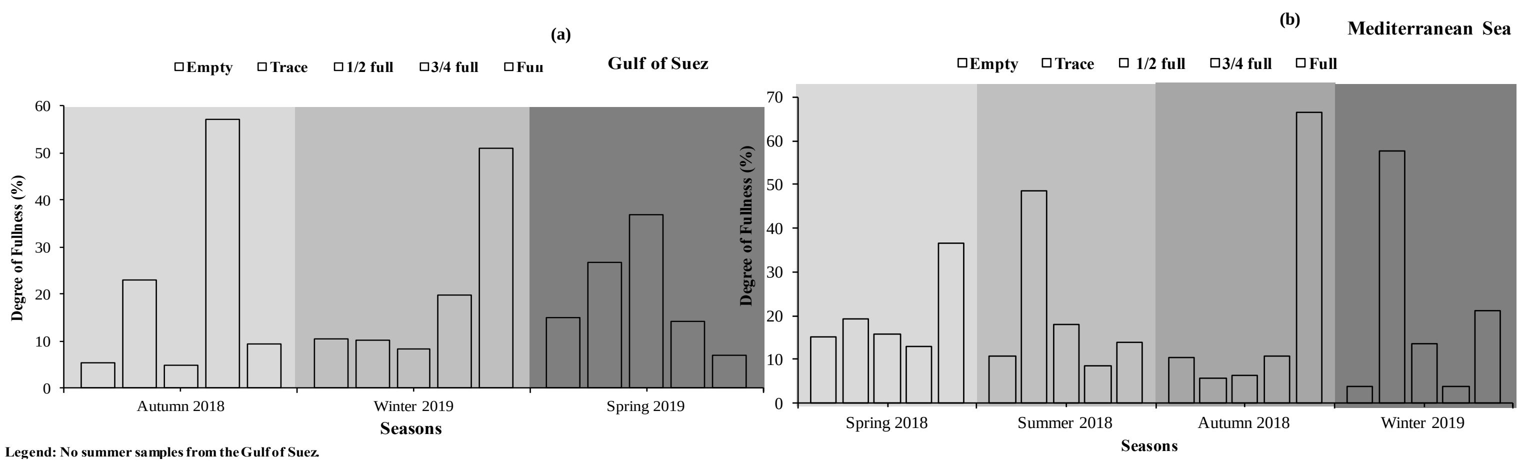


**Fig. 7.** Seasonal variations in the degree of fullness of *Saurida undosquamis* collected from **(a)** Gulf of Suez and **(b)** Mediterranean Sea

**Table 4.** Variations in the feeding intensity of *Saurida undosquamis* with the different size classes collected from both sites

| Site | Size Class (cm) | Mid-Length (cm) | Empty | Trace (25%) | ½ Full (50%) | ¾ Full (75%) | Full (100%) |
|---|---|---|---|---|---|---|---|
| Gulf of Suez | **8-10** | **9** | 11.3 | 0 | 33.9 | **42.7** | 12.1 |
| | **10-12** | **11** | 0 | 3.7 | 25.2 | 21.5 | 49.5 |
| | **12-14** | **13** | 0 | 0 | 3.3 | 53.3 | 43.3 |
| | **14-16** | **15** | 8.9 | 7.1 | 10.7 | 3.6 | **69.6** |
| | **16-18** | **17** | 3 | **66.7** | 12.1 | 6.1 | 12.1 |
| | **18-20** | **19** | 2.7 | 8.1 | **78.4** | 5.4 | 5.4 |
| | **20-22** | **21** | 10.3 | 6.9 | 62.1 | 17.2 | 3.4 |
| | **22-24** | **23** | 4 | 4 | 68 | 12 | 12 |
| | **24-26** | **25** | 67 | 22 | 0 | 0 | 11 |
| | **26-28** | **27** | **79.2** | 14.2 | 0 | 0 | 6.7 |
| | **28-30** | **29** | 40 | 50 | 0 | 0 | 10 |
| | **30-32** | **31** | 17.9 | 57.1 | 25 | 0 | 0 |

| Site | Size Class (cm) | Mid-Length (cm) | Empty | Trace (25%) | ½ Full (50%) | ¾ Full (75%) | Full (100%) |
|---|---|---|---|---|---|---|---|
| Egyptian Mediterranean Sea | **8-10** | **9** | 6.7 | 43.3 | **26.7** | 10 | 13.3 |
| | **10-12** | **11** | 0 | 8.2 | 14.3 | 8.2 | 69.4 |
| | **12-14** | **13** | 28 | 10 | 12 | 8 | 42 |
| | **14-16** | **15** | 16 | 0 | 0 | 4 | **80** |
| | **16-18** | **17** | 9.7 | 20 | 20 | 10 | 40.3 |
| | **18-20** | **19** | 39.3 | 13.3 | 17.3 | **23.3** | 6.7 |
| | **20-22** | **21** | 53.3 | 16 | 12 | 13.3 | 5.3 |
| | **22-24** | **23** | 35 | 10 | 35 | 7.5 | 12.5 |
| | **24-26** | **25** | 30 | **44** | 6 | 10 | 10 |
| | **26-28** | **27** | **79.4** | 17.6 | 0 | 0 | 2.9 |
| | **28-30** | **29** | 50 | 37.5 | 12.5 | 0 | 0 |
| | **30-32** | **31** | 73.3 | 16.7 | 6.7 | 0 | 3.3 |

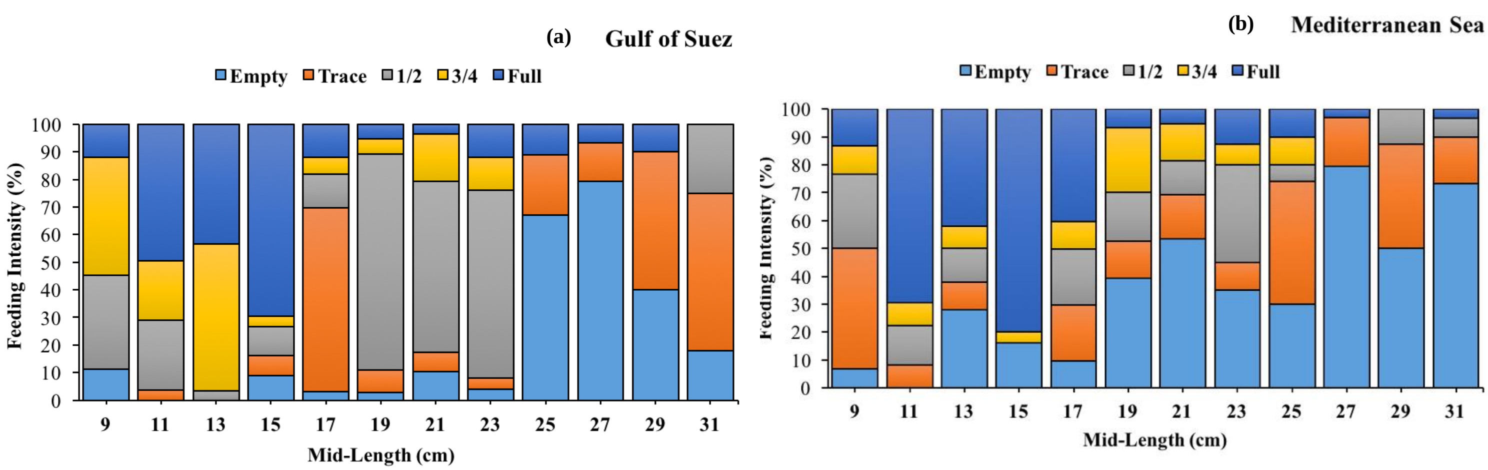


**Fig. 8.** Variations in the feeding intensity of *Saurida undosquamis* with the different size classes collected from **(a)** Gulf of Suez and **(b)** Mediterranean Sea

**5. Variations in the diet compositions in relation to size**

For the Gulf of Suez population, fish remains were the most abundant food items for specimens of almost all size classes. They were dominant in the stomachs of individuals of all size classes from the Mediterranean Sea. Crustacean and molluscs followed the same trend at both sites, and their absence was recorded at length groups of 8- 10 and 28- 32cm. Digested food was more frequent in stomachs of small size specimens, while never occurred in those of large-sized fishes from both populations (Table 5 & Fig. 9).

**6. Gastro-somatic index ($G_aSI$)**

The monthly averages of gastro–somatic index are shown in Table (6). Table (6) reveals that both study sites had fluctuation in values, with the highest in September (10.8± 0.50) for the Gulf of Suez population and in May (11.7± 1.20) for the Mediterranean Sea. The minimum average value of $G_aSI$ was in April (5.6± 1.11) for the Gulf of Suez individuals, and in February (6.5± 1.59) for the Mediterranean Sea individuals (Fig. 10).

**Table 5.** Variations in the diet compositions of *Saurida undosquamis* with the different size classes collected from both sites

| Site | Mid-Length (cm) | Food items % | | | |
|---|---|---|---|---|---|
| | | Fish Remains | Molluscs | Crustaceans | Digested food |
| Gulf of Suez | 9 | 0 | 0 | 0 | **100** |
| | 11 | 48.1 | 22.2 | 29.6 | 0 |
| | 13 | 45.1 | 36.6 | 18.3 | 0 |
| | 15 | 34.4 | **45.2** | 19.4 | 1.1 |
| | 17 | 56.4 | 21.8 | 12.7 | 9.1 |
| | 19 | 57.1 | 9.5 | 11.9 | 21.4 |
| | 21 | 71.8 | 7.7 | 15.4 | 5.1 |
| | 23 | 57.1 | 23.8 | 16.7 | 2.4 |
| | 25 | 28.1 | 31.3 | **34.4** | 6.3 |
| | 27 | 57.1 | 14.3 | 28.6 | 0 |
| | 29 | **100** | 0 | 0 | 0 |
| | 31 | **100** | 0 | 0 | 0 |
| Egyptian Mediterranean Sea | 9 | 30 | 0 | 0 | **70** |
| | 11 | 30 | **25.0** | 5 | 40 |
| | 13 | 68.3 | 19.5 | 12.2 | 0 |
| | 15 | 80.6 | 5.6 | 8.3 | 5.6 |
| | 17 | 50 | 11.5 | 16.3 | 22.1 |
| | 19 | 67.9 | 11.3 | 12.3 | 8.5 |
| | 21 | 63.9 | 24.1 | 10.8 | 1.2 |
| | 23 | 59.3 | 22.2 | **18.5** | 0 |
| | 25 | 70 | 20 | 10 | 0 |
| | 27 | 66.7 | 20 | 13.3 | 0 |
| | 29 | **100** | 0 | 0 | 0 |
| | 31 | **100** | 0 | 0 | 0 |

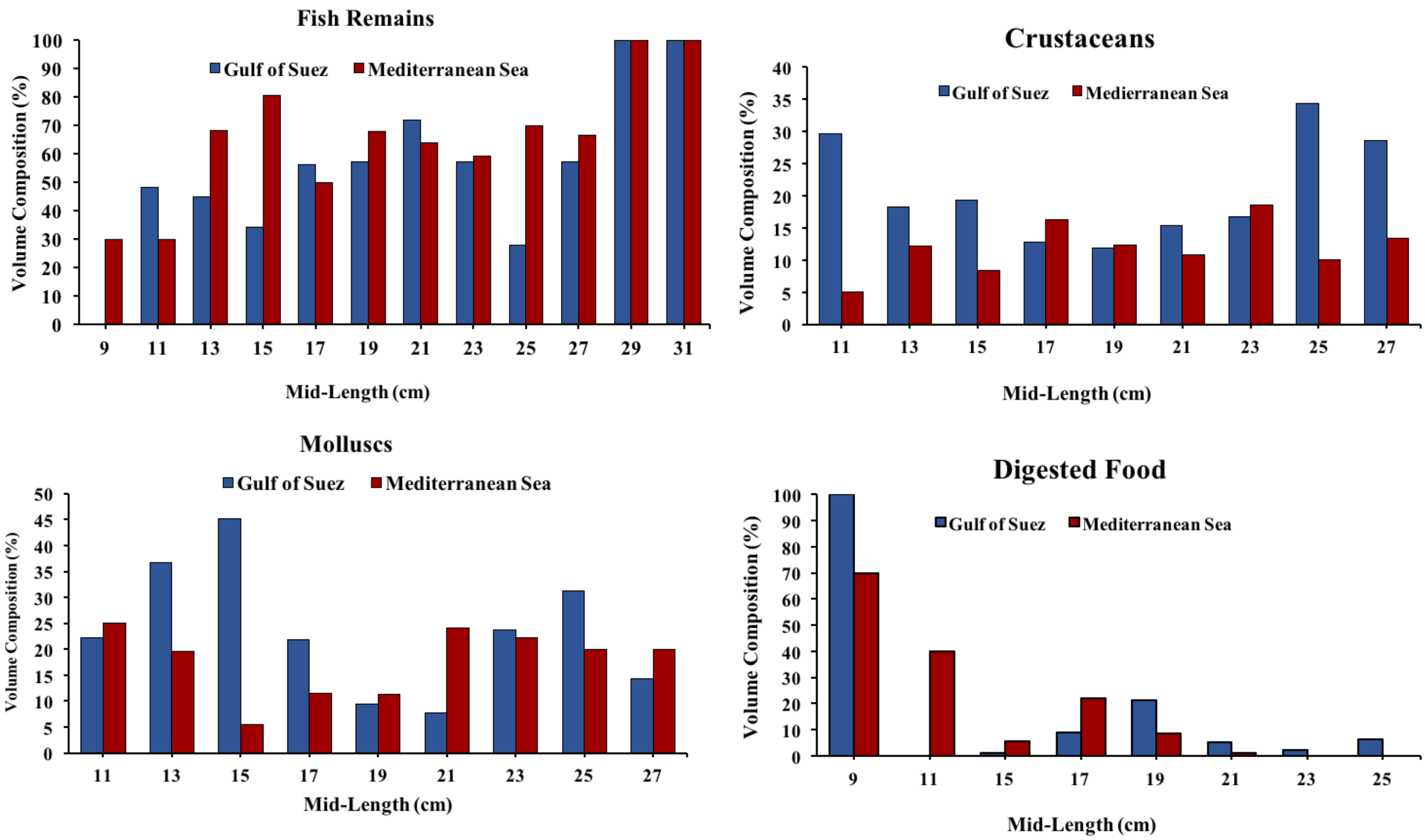


**Fig. 9.** Variations in the diet composition of *Saurida undosquamis* with the different size classes from both study sites

**Table 6.** Gastro-somatic index **(**$G_aSI$) averages (± standard deviation) of *Saurida undosquamis* collected from both study sites

| Season / Month | | Gulf of Suez ($G_aSI$) | Mediterranean Sea ($G_aSI$) |
|---|---|---|---|
| **Spring 2018** | **Mar** | - | 9.2±0.49 |
| | **Apr** | NA | 10.7±0.73 |
| | **May** | NA | **11.7±1.20** |
| **Summer 2018** | **Jun** | NA | 7.0±1.52 |
| | **Jul** | NA | 6.8±1.37 |
| | **Aug** | NA | 8.3±0.58 |
| **Autumn 2018** | **Sep** | **10.8±0.50** | 9.9±0.42 |
| | **Oct** | 9.7±1.39 | 9.5±0.56 |
| | **Nov** | 9.6±0.55 | 8.9±1.42 |
| **Winter 2019** | **Dec** | 7.1±0.38 | 8.7±0.48 |
| | **Jan** | 8.5±0.69 | 7.8±0.42 |
| | **Feb** | 7.6±1.56 | 6.5±1.59 |
| **Spring 2019** | **Mar** | 6.8±0.48 | 8.2±0.41 |
| | **Apr** | 5.6±1.11 | - |

**Legend: NA = not available (Closed Fishing Season).**

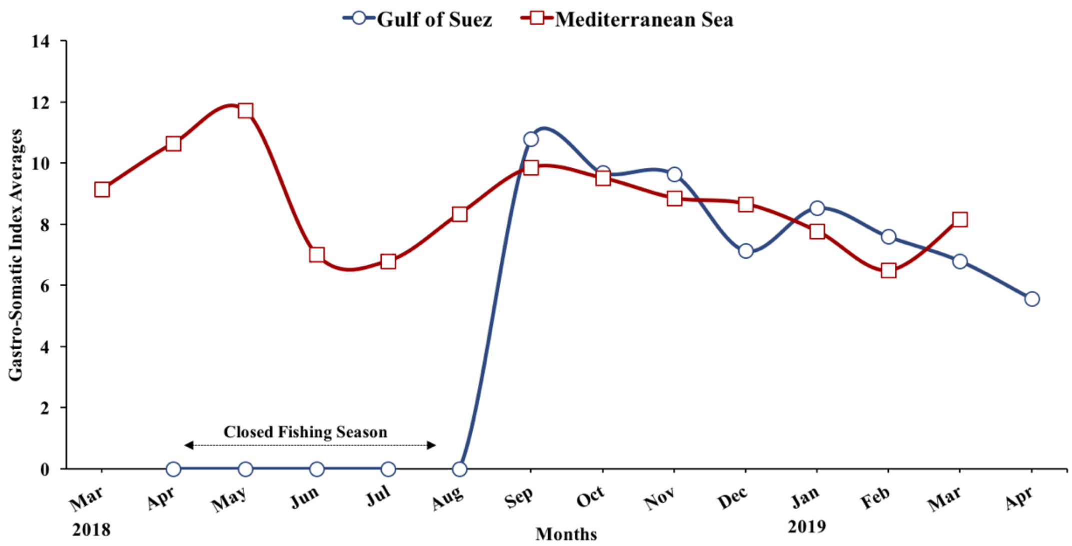


**Fig. 10.** Gastro - somatic index ($G_aSI$) averages of *Saurida undosquamis* collected from both study sites

## DISCUSSION

Survival, growth, migration, reproduction, and other biological activities of any fish depend mainly on the incoming energy; accordingly, they are influenced by species, feeding habits, and the ingested food items **(Wootton, 1990; Shehata, 1994)**. In fisheries, dietary habits have been essential for conducting future management plans, conservation strategies, and predicting population trends for fish species in their habitats.

### 1. Diversity of food items and diet composition

The diversity of food items was high according to the number of identified and unidentified prey found in the examined stomachs. Both populations' diet composition confirms that this species is a carnivore, consuming mixed types of prey with a preference for fishes (piscivores). Even though *S. undosquamis* is a lessepsian migrant species in the Mediterranean Sea, it had almost the same diversity of food items found in the stomachs of the population from the native region (Red Sea). This indicates that this predator is commonly trying to maintain its diet composition at a high level of diversity. Regarding the presence of small-sized prey of *S. undosquamis* in the stomachs of the largest members of the same species; many authors have reported the predation by the adults of this species on their juveniles **(Rao, 1981)**. **El-Ganainy (2003)** recorded the cannibalism of *S. undosquamis* from the Gulf of Suez for all length groups and stated that it was recorded more for individuals larger than 15cm. This behavior is suggested to be a mechanism for the fish to control its population **(Rao, 1981)**. In most studies on the feeding of *S. undosquamis*, teleosts were the leading food group **(Bingel & Avşar, 1988a , b; Rao, 1981; Euzen, 1989; Yamashita *et al.*, 1991; Golani, 1993; Torcu, 1994; El-Ganainy, 2003; Rajkumar *et al.*, 2003; Hadzley *et al.*, 2005; Kadharsha *et al.*, 2013)**. Among the teleosts, the clupeiformes were dominant.

In this study, the family Clupeidae was the most abundant among the teleosts. Therefore, our results are consistent with those from previous studies, specifically with **El-Ganainy (2003)**, who stated that Clupeids was dominant in the stomach of *S.*

*undosquamis* from the Gulf of Suez. Additionally, few studies stated that other groups occurred more than teleosts; for instance, **Hadzley *et al.* (2005)** recorded that Leiognathidae was dominant in the stomachs of *S. undosquamis* from Malaysia.

Different studies concluded that it is not known whether this species prefers an accidental or a deliberate feeding strategy. However, with the high number of different species encountered in the stomach content, the idea that *S. undosquamis* uses a nonselective approach strengthens over time **(Ozyurt *et al.*, 2017)**. **Ibrahim *et al.* (2003)** put forward a similar determination regarding the feeding of eight demersal species in the south China Sea; they found the widest prey diversity in the stomach contents of *S. undosquamis*.

The studies conducted by **Bingel *et al.* (1993)** and **Gücü (1995)** support that *S. undosquamis* follows an opportunistic feeding strategy, and its food selection is related to the presence of prey. According to **Griffiths *et al.* (2009)**, this type of predator exerts top-down control in the marine food webs, thereby regulating other organisms lower down the food web. Therefore, this species can strongly influence the native fauna by both competition and predation pressure, as stated by **Ozyurt *et al.* (2017)**, who quoted the decrement of hake stocks in the Levant Basin (Turkey). That was attributed to several factors, such as overfishing and the feeding competition with *S. undosquamis* **(Gücü & Bingel, 2011)**. Hence, this lessepsian migrant might potentially impact the native food web in the new habitats **(Ozyurt e*t al.*, 2017)**.

**2. Intensity of feeding**

The seasonal fluctuations in the stomach fullness percentages might be due to the different digestion degrees during capture, or according to **Nikolsky (1963)**, the availability of food supply during seasons may significantly influence the amount of food content in the fish stomach. Additionally, in many studies, the feeding intensity increases before and after the reproduction period **(Argillier *et al*., 2003; Jardas *et al*., 2004)** and decreases during the spawning period **(El-Ganainy, 2003; Jardas *et al*., 2004)**. Furthermore, the feeding intensity regarding the size indicated that empty stomachs were observed with the highest percentages in medium to large-sized specimens from both studied sites, i.e., mature individuals with weighty gonads. These observations are related to the fact that the gonads press the stomach as they enlarge and thus take up more space in the body **(Golikatte & Bhat, 2011)**.

The results obtained during this study show that the food consumption declined during spawning and increased again after that period. Therefore, a relationship between the feeding intensity and the spawning season could be confirmed. This result agrees with that of **Ozyurt *et al*. (2017)** on *S. undosquamis* distributed in the İskenderun Bay, Turkey. Moreover, it is similar to the finding of **EL-Ganainy (2003)**, who recorded low feeding intensity for individuals in the 3$^{rd}$ and 4$^{th}$ stages of maturation.

**3. Variations in the diet compositions in relation to the size**

This study concluded that diet composition regarding body size followed the same pattern for both populations, where a variety of food items occurred at almost all length groups. However, the largest-sized fishes' stomachs (28- 32cm) were distinguished with only fishes of more or less large intact bodies. In the previous studies in which the stomach content of *S. undosquamis* was examined, the presence of fish prey increased with the predator length **(Rao, 1981; Bingel, 1988b)**.

The absence of other food items in the guts of those large fishes could be attributed to the individuals' selectivity, or that *S. undosquamis* is commonly a piscivores species. This is in addition to the possibility that large "mature" individuals need certain nutrients that fish prey provides to develop their gonads. These findings agree with those of **Mali *et al.* (2017)** on the North-West coast of India and **Ozyurt *et al*. (2017)** in the İskenderun Bay, Turkey.

### 4. Gastro-somatic index

Quantitative variations in food during the study were observed and verified by the determination of the gastro-somatic index. The results depict that during the spawning season, the feeding intensity decreases and increases immediately after spawning, which could be related to the fact that individuals feed voraciously to compensate for the energy loss during the spawning. A similar observation was documented by **Rahimibashar *et al.* (2012)** in the North of the Persian Gulf on *Saurida tumbil* and **Kadharsha *et al.* (2013**) on the Southeast coast of India.

## REFERENCES

**Argillier, Ch.; Barral, M. and Irz, P.** (2003). Growth and diet of pikeperch *Sander lucioperca* (L.) in two French reservoirs. Arch. Polish Fish., 11: 99– 114.

**Ben-Yami, M. and Glaser, T.** (1974). The invasion of *Saurida undosquamis* (Richardson) into the Levant Basin-an example of biological effect of interoceanic canal. Fish. Bull., 72: 359–373.

**Bingel, F.** (1988b). Prey size of *Saurida undosquamis* in the Northern Cilician Basin (Eastern Mediterranean). Rapp. Comm. Int. Mer. Medit., 31: 262.

**Bingel, F. and Avsar, D.** (1988a). Food items of *Saurida undosquamis* in the Northern Cilician Basin (Eastern Mediterranean). Rapp. Comm. Int. Mer. Medit., 31: 261.

**Bingel, F. and Avsar, D.** (1988b). Time series of the stomach fillings of *Saurida undosquamis* in the Northern Cilician Basin (Eastern Mediterranean). Rapp. Comm. Int. Mer. Medit., 31: 262.

**Bingel, F.; Ozsoy, E. and Unluata, U.** (1993). A review of the state of the fisheries and the environment of the Northeastern Mediterranean (Northern Levantie Basis). In: Studies and Reviews, General Fisheries Council for the Mediterranean, 65. FAO, Rome.

**Cardone, I. B.; Lima-Junior, S.E. and Goitein, R.** (2006). Diet and capture of *Hypostomus strigaticeps* (Siluriformes, Loricariidae) in a small Brazilian stream: relationship with limnological aspects. Braz. J. Bio., 66: 25-33.

**Desai, V.R.** (1970). Studies on fishery and biology of *Tor Tor* (Hamilton) from river Narmada, II: Maturity, Fecundity and Larval Development. J. Fish. Soc. of India., 2:101-112.

**El-Ganainy, A.A.** (1992). Biological studies on Lizard fishes *Saurida undosquamis* (Pisces, Synodontidae) from the Gulf of Suez. (M.Sc. Thesis), Zoology Department, Faculty of Science, Ain shams University, Egypt.

**El-Ganainy, A.A.** (2003). Food and feeding habits of the lizard fish *Saurida undosquamis* (Richardson, 1884) with special reference to its biological interaction with clupeids in the Gulf of Suez. Egy. J. Zool., 41: 327-340.

**Euzen, O.** (1989). Food habits and diet composition of some fishes of Kuwait. The Eight Shrimp and Fin Fisheries Management conference. Kuwait Bull. Mar. Sci., 10: 65-85.

**Godfriaux, B.L.** (1969). Food of the predatory demersal fish in Hauraki Gulf I: food and feeding habits of snapper. New Zealand J. Mar. Freshwater Res., 3: 518-544.

**Golani, D.** (1993). The biology of the Red Sea migrant, *Saurida undosquamis* in the Mediterranean and comparison with the indigenous confamilial *Synodus saunis* (Teleostei: Synodontidae). Hydrobiologia., 271: 109-117.

**Golikatte, R.G. and Bhat, U.G.** (2011). Food and feeding habits of the Whipfin silver Biddy *Gerres filamentosus* from Sharavati estuary, central west coast of India. World J. Sci. Tech., 1(2): 29-33.

**Griffiths, S.P.; Kuhnert, P.M.; Fry, G.F. and Manson, F.J.** (2009). Temporal and size-related variation in the diet, consumption rate, and daily ration of mackerel tuna (*Euthynnus affinis*) in neritic waters of eastern Australia. ICES J. Mar. Sci., 66:720-733.

**Gücü, A.C.** (1995). A Box Model for the basic elements of northeastern Levant Sea (Mediterranean) trawl fisheries. Isr. J. Zoo., 41: 551–568.

**Gücü, A.C. and Bingel, F.** (2011). Hake, *Merluccius merluccius* L., in the northeastern Mediterranean Sea: a case of disappearance. J. App. Ichthyo., 27: 1001-1012.

**Hadzley, H.; Ibrahim, J. and Sallehudin, J.** (2005). Feeding habits of five selected demersal fish species in coastal waters off east Johore. Mala. Fish. J., 4 (1): 1-12.

**Hynes, H.B.N.** (1950). The food of freshwater sticklebacks (*Gasterosteus aculeatus* and *Pygosteus pungitius*) with a review of methods used in studies of the food of fishes. J. Ani. Eco., Oxford, 19: 36-58.

**İbrahim, S.; Muhammad, M.; Ambak, M.A.; Zakaria, M.Z.; Mamat, A.S.; İsa, M.M. and Hajisamae, S.** (2003). Stomach contents of six commercially important demersal fishes in the south China Sea. Turk. J. Fish. Aqua. Sci., 3: 11-15.

**Jaiswer, A.K.; Chakraborty, S.K.; Prasad, R.R.; Palaniswamy, R. and Bommireddy, S.** (2002). Population dynamics of lizardfish *Saurida undosquamis* (Teleostomi/Synodontidae) from, Mumbai, west coast of India. Ind. J. Mar. Sci., 32: 147-150.

**Jardas, I.; Santic, M. and Pallaoro, A.** (2004). Diet composition and feeding intensity of horse mackerel, *Trachurus trachurus* (Osteichthyes: Carangidae) in the eastern Adriatic. Mar. Bio., 144: 1051-1056.

**Kadharsha, K.; Mohanchander, P.; Lyla, P.S. and Khan, S.A.** (2013). Feeding and reproductive biology of *Saurida undosquamis* (Richordson1848) from Parangipettai Coast, Southeast Coast of India. Paki. J. Bio. Sci., 16(22):1479-1487.

**Kislaioglue, M. and Gibson, R.M.** (1977). The feeding relationship of shallow water fish. J. Fish. Bio., 11:257-266.

**Laban, H.A.** (2008). Biological studies on Egyptian sole *Solea aegyptiaca*, (Chabanaud, 1927), collected from the Mediterranean Sea (Port Said) (M.Sc. Thesis), Zoology Department Faculty of Science, Suez Canal University, Egypt.

**Mali, K.S.; Farejiya, M.K. and Rao, K.R.** (2017). Reproductive Biology of *Saurida tumbil* (Bloch 1795) and *Saurida undosquamis* (Richardson 1848) Inhabiting North West Coast of India. Ind. J. Pure & App. Biosci., 5 (6): 957-964.

**Mequilla, A.T. and Campos, W.L.** (2007). Feeding relationships of dominant fish species in Visayan Sea. Sci. Diliman., 19: 35-46.

**Mohan, M.V. and Sankaran, T.M.** (1988). Two new indices for stomach content analysis of fishes. J. Fish. Bio., 33: 289-292.

**Nikolsky, G.V.** (1963). The ecology of Fishes. Academic Press, London.

**Oronsaye, C.G. and Nakpodia, F.A.** (2005). A comparative study of the food and feeding habits of *Chrysichthys nigrodigitatus* and *Brycinus nurse* in a tropical River Pakistan. J. Sci. Industrial Res., 48: 118-121.

**Ozyurt, C.E.; Yesilcimen, H.O.; Mavruk, S.; Kiyaga, V.B. and Perker, M.** (2017). Assessment of Some of the Feeding Aspects and Reproduction of *S. undosquamis* Distributed in the İskenderun Bay. Turk. J. Fish. Aqua. Sci., 17: 51-60.

**Pillay, T.V.R.** (1952). A critique of the methods of study of food of fishes. J. Zoo. Soci. India., 4: 185-200.

**Post, D.; Conners, M. and Goldberg, D.** (2000). Prey preference by a top predator and stability of linked food chains. Ecology., 81: 8-14.

**Rahimibashar, M.R.; Alipour, V.; Hamidi, P. and Hakimi, B.** (2012). Biometric Characteristics, Diet and Gonad Index of Lizardfish (*Saurida tumbil*, Bloch 1795) in North of the Persian Gulf. World J. Fish Mar. Sci., 4 (1): 2078-4589.

**Rajkumar, U.K.; Narayana, R. and Kingsly, H.J.** (2003). Lizardfish fishery, biology and population dynamics of *Saurida undosquamis* (Richardson) off Visakhapatnam. Ind. J. Fish., 50: 149–156.

**Rao, K.V.** (1981). Food and Feeding of lizard fishes (*Saurida* spp.) from North Western part of Bay Bengal. Ind. J. Fish., 28:47-64.

**Shehata, S.M.** (1994). Food and feeding habits of yellow tail emperor fish *Lethrinus mahsena* (Forsskal) (Lethrinidae: perciformes). Al-Azhar Bull. Sci., 5(2): 647-663.

**Torcu, H.** (1994). Studies on the biology and ecology of Indo-Pacific origin fish species and *Upeneus mollucensis* (Bleeker, 1855) and *Saurida undosquamis* (Richardson, 1848) distributed in the Mediterranean and South Aegean coasts. PhD Thesis. Konya: University of Selcuk.

**Wootton, R.J.** (1990). Ecology of Teleost Fishes. Chapman and Hall, New York.

**Yamashita, Y.; Mochizuki, K. and Piamthipmanus, M.** (1991). Gut contents analysis of fishes sampled from the gulf of Thailand. Bull. Jap. Soc. Fish Oceanogrphy., 55 (3): 197-207.