Food spectrum and some biological characteristics of the sea Catfish *Plotosus lineatus* (Thungerg, 1787) in the marine waters of Latakia Governorate, Syria

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□ ABSTRACT □

The research was conducted with the aim of studying the qualitative composition of food items included in the dietary spectrum of the fish *Plotosus lineatus*, some biological parameters (Condition factor, General gut fullness factor and Hepato-Somatic Index), and the length, weight, and sex structure of the studied individuals. The research was conducted for one year from 31/9/2024 to 3/9/2025, *P. lineatus* 136 fish individuals were collected from the coastal waters of Latakia using Bottom Traps. The research showed that the studied species feeds on (8) Prey items belonging to three taxonomic groups: (Crustaceans, Molluscs, and Fish). Crustaceans ranked first, represented by (*Penaeidae* and the *Crab Thalamita* sp.), followed by Molluscs and then by fish. The results also showed that the sizes of the sea Catfish were similar, and there were no significant differences between the average standard length of males and females. For the average digestive tract fullness index, significant differences between the 2 sexes were found but there was no significant difference between the average Somatic Hepatic index. Growth was allometric, irregular, and negative. There was a strong positive correlation between length and weight, for both males and females, and for all individuals.

Keywords: *Plotosus lineatus*, demersal fish, food spectrum, Latakia coast, Syrian marine waters.

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الطيف الغذائي وبعض الخصائص البيولوجية لسمك القط البحري *Plotosus lineatus* (Thungerg, 1787) في المياه البحرية لمحافظة اللاذقية – سورية

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ملخّص

أُجري البحث بهدف دراسة التركيب النوعي للعناصر الغذائية الداخلة في الطيف الغذائي لسمكة *Plotosus lineatus* وبعض المعاملات البيولوجية (معامل الحالة، معامل الامتلاء العام و الدليل الكبدي) والتركيب الطولي والوزني والجنسي للأفراد المدروسة، أُجري البحث لمدة عام من 2024/9/31 – 2025/9/3 و جُمع 136 فرداً من أسماك *P. lineatus* المصطادة في المياه البحرية لساحل اللاذقية باستخدام الأفخاخ القاعية، أظهر البحث أن النوع المدروس يتغذى على (8) عناصر غذائية (فرائس) تعود لثلاث مجموعات تصنيفية (قشريات، رخويات و أسماك)، احتلت القشريات المرتبة الأولى ممثلة بـ (Penaeidae وسرطان البحر *Thalamita* sp.)، تلتها الرخويات ثم الأسماك.

بينت النتائج أن أحجام سمكة القط البحري متقاربة، ولا يوجد فروق معنوية بين متوسط الطول القياسي للذكور والإناث، لكن وُجد فروق معنوية بين متوسط معامل امتلاء القناة الهضمية بينهما، في حين لم يكن هناك فرق معنوي بين متوسط معامل دليل الكبد للذكور و الإناث ($P>0.05$)، النمو من النمط Allometric Growth (نمو غير منتظم سلبي)، كما أظهرت نتائج البحث علاقة الطول بالوزن لأفراد سمكة *P.lineatus* لكل من الإناث والذكور و لجميع الأفراد بأنها علاقة ارتباط طردية قوية.

الكلمات المفتاحية: *Plotosus lineatus*، الأسماك القاعية، الطيف الغذائي، ساحل اللاذقية، المياه البحرية السورية.

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Introduction:

The opening of the Suez Canal, along with the effects of climate change, has led to an increase in the number of Alien species introduced to the Mediterranean Sea [1,2]. The family (Plotosidae) in the Mediterranean is represented by only one species, the sea Catfish *Plotosus lineatus* (Thunberg.1787) migrated from the Red Sea via the Suez Canal.

This family includes 5 genres and 42 species worldwide [3]. The sea Catfish is widespread in the Indo-Pacific region, from Japan to Australia East Africa, and the Red Sea. It is generally found in shallow coastal areas [4].

Its first appearance in the Mediterranean was documented on the coasts of Palestine by [5]. The Sea Catfish has become part of the benthic organisms of the Mediterranean Sea: it has been recorded for the second time on the Egyptian coasts near the city of EI Arish [6], the third time on the Syrian coasts near Tartus [7], the fourth time in Turkish territorial waters [8], and for the fifth time in norther Cyprus [9]. This species has experienced a remarkable increase in numbers within just a few years of its initial appearance in the Mediterranean [10].

Several studies have been conducted on the sea Catfish, such as:

[11] studied the growth, mortality, and some biological characteristics of the sea Catfish, off the coast of northern Andhra Pradesh, India. The study showed that the sea Catfish reaches maturity at a length of approximately 159 mm, feeds on benthic marine organisms, and exhibits a cyclical pattern of reproduction.

Another study [12] studied the sizes and growth parameters of the sea Catfish in Kulono Bay, Southeast Sulawesi, Indonesia. In this study, the sea Catfish exhibited positive divergent growth patterns, and the breeding season occurred in July.

The study [13] studied reproductive characteristics and spawning activity in Kulono Bay, Indonesia, and showed that the reproductive stages were most pronounced during July and August, with increased breeding activity peaking during this period. Females was found to reach sexual maturity more rapidly than males.

[14] studied sexual dimorphism and the relationship between length, weight, fertility, and diet in Catfish on the southwestern coast of Taiwan. Male specimens were larger than females, and the main prey were shrimp, Crabs, and Fish.

[15] determined growth parameters, mortality rates, and exploitation of Catfish in the Gulf of Agaba, Egypt, as an important fish resource in Egypt. The study provides baseline information on size and growth and the results indicate that the Catfish stock in the Gulf of Agaba is not overfished but rather within safe exploitation limits.

Recently, [16] studied some biological characteristics and growth parameters of the sea Catfish. They collected 1011 sea Catfish specimens from the Gulf of Iskenderun, Turkey, ranging in length from 5.1 to 16.8 cm. Most of the specimens were female, and the sea Catfish groups showed negative variations in growth patterns.

Locally, the sea Catfish was first recorded in Syrian marine waters by [17] also made four additional recordings of the sea Catfish found off the Syrian coast.

These studies in Syrian marine waters did not address the biology of the species *P. lineatus*. Therefore, the current study focuses, for the first time, on some biological characteristics and the diet of the sea Catfish *P. lineatus* in the first time.

Research Significance and Objectives:

Understanding the biological characteristics of the sea Catfish contributes to assessing its role in the marine ecosystem of Latakia Governorate and developing sustainable fisheries management strategies in the Syrian Arab Republic. This research aims to study the diet of
P. lineatus, as well as some biological parameters such as: Condition factor, Hepatic somatic index, General gut fullness factor, and Feeding index.

Materials and Methods:

136 individuals of *P. lineatus* were collected from the marine waters of Latakia Governorate using Bottom Traps, during the year 2024-2025, and transported to the postgraduate Laboratory in the Department of Zoology, Faculty of Science, Latakia University.
Total length, standard length, maximum height, and weight were measured, and the sex was determined. The digestive tract was dissected and preserved in 7% formaldehyde in a containers labeled with the fish number, the date of collection, and the collection location [18,19].

Figure (1) General appearance of a *P. lineatus* Catfish Length 18.5 cm, weight 28.4 g, caught in Syrian marine waters on 11/4/2024

The following biological characteristics were studied:

1- Length-Weight Relationship:

For both sexes, the relationship between length and weight was calculated. The value b ranged between 2-4 which indicated the fish's growth patter (b>3 Regular growth, b<3 Positive irregular growth: length increase greater than weight increase, b=3 Negative irregular growth: weight increase greater than length increase).
The mathematical model of this relationship is characterized by [20] as an exponential curve: $W= a . l^b$
Where: W: Total weight of the fish at catch (g)
l: Standard length of the fish at catch (cm)
a , b: Constants

Study of the Food Spectrum: The following were calculated:

General gut fullness factor:

Applying the relationship according to [21]:

$$GGFF = W / WF * 100$$

WF: Fish Weight W: Food Mass Weight

General Feeding factor:

Expressed as a percentage according to [22]:

$$GFf= SW / BW *100$$

GFf: General feeding factor , SW: Stomach weight (g) , BW: Body weight (g)

Condition factor:

The status index reflects the fish's condition, rising during the breeding season due to increased gonadal weight, and is also affected by the feeding activity of the species under study.

It is calculated by applying Fulton's law [23]:

$$K = W * 100 / L^3$$

W: Fish weight in grams , L: Length of fish in centimeters

The relationship between liver weight and body weight (Hepato-Somatic Index):

The Hepato-Somatic Index is the ratio of liver mass to body, expressed a percentage, an important indicator expressing the fish's condition due to changes in the surrounding environmental conditions and according to its physiological state. Under good nutritional conditions, fish store excess nutrients as reserves in the liver to be used later in cases of food scarcity.

The Hepato-Somatic Index (HSI) is expressed according to [24]

$$HIS = LW / EW * 100$$

EW: Total body weight (g)

LW: Liver weight (g)

Statistical analysis: Data were processed using:

SPSS Statistics software was used to calculate means, standard deviations, and Student's test for independent samples, and (test Chi-square) test of fit. Significance level was determined at ($a \leq 0.05$) and the graphs were prepared using Excel software.

Results and Discussion:

1- Morphological Characteristics:

Table (1) shows the morphological characteristics of the *P. lineatus* individuals during the research period. It is noted that the standard lengths of the studied individuals ranged between (6.5) and (21) cm, with an average of (3.72± 14.82), Their weights ranged between (1.8-69.5) grams, with an average of (13.38± 24.26). The average standard length for all individuals reached its highest value (18.71±4.41) cm, and the average body weight for this fish species reached its highest value (46.93±6.44) g. Tables (1 and 2) showed that female sea Catfish are larger than males, with an average length of (15.39±3.62) cm, Males averaged (13.77±3.72) cm.

Table (1) Average standard length (cm) and weight (g) of female and male *P. lineatus* caught off the coast of Latakia during the study period 2024 – 2025

Collection date Day/Month/Year	Number individuals	Standard length /cm Mean±SD		Body Weight \ g Mean±SD	
		Min- Max Value	Average ± Deviation	Min-Max Value	Average ± Deviation
31/9/2024	9	6.5-16.5	8.38±2.69	33.3– 1.8	6.31±10.14
27/10/2024	1	17.5	17.5	41.90	41.9
4/11/2024	3	21 – 17	18.66±2.08	69.5 – 28.4	45.46±21.42
1/12/2024	9	12 – 8	10.06±1.17	7.8 – 3.3	5.45±1.57
30/3/2025	10	16.5-14.4	15.48±0.91	41.6 – 26.97	33.51±5.69
26/4/2025	8	13 – 11.5	12.7±0.89	26.3 – 12.75	16.31±4.45
28/4/2025	25	16.7 –13.1	18.71±4.41	37.59 – 8.2	25.60±5.44
6/5/2025	30	14.9 –11.6	13.21±0.73	24.71 – 5.65	17.54±3.62
15/6/205	15	15.5 –12.3	14.33±0.86	27.62 –17.51	22.56±3.15
23/7/2025	7	15.2 –12.1	1.2±13.8	26.70-18.32	3.35±22.47
30/8/2025	10	19 – 16.8	17.83±0.62	52.52 –36.78	46.53±4.89
3/9/2025	9	19.1 –16.9	17.97±0.75	54.27 –37.59	46.93±6.44
Total	136	-	-	-	-
Average	-	-	3.72±14.82	-	13.38±24.26

Table (2) Some standard characteristics of individual sea Catfish *P. lineatus* caught from the coast of Latakia City during the 2024 – 2025 period

Collection date	Total number	Number of females	Standard height for females\cm Mean±SD	Females weight\g Mean±SD	Number of males	Standard height for males\cm Mean±SD	Males weight\g Mean±SD
31/9/2024	9	1	16.5	33.3	8	7.87±0.74	2.93±0.65
27/10/2024	1	1	17.5	41.9	-	-	-
4/11/2024	3	1	18	38.5	2	19±2.83	48.95±29.06
1/12/2024	9	5	10.7±1.03	6.12±1.32	4	9.27±0.86	4.2±0.71
30/3/2025	10	7	15.5±1.03	34.26±6.04	3	15.43±0.66	31.73±5.42
26/4/2025	8	2	12.35±0.63	16.17±1.49	6	12.81±0.99	17.02±4.98
28/4/2025	25	15	20.9±4.47	23.97±5.67	10	15.43±0.88	28.03±4.24
6/5/2025	30	25	13.14±0.77	17.35±3.66	5	13.54±0.47	18.49±3.64
15/6/205	15	15	14.33±0.86	22.56±3.15	-	-	-
23/7/2025	7	7	1.2±13.8	3.35±22.47	-	-	-
30/8/2025	10	6	17.88±0.41	48.28±3.36	4	17.75±0.93	43.9±6.12
3/9/2025	9	3	18.23±0.91	47.53±8.32	6	17.85±0.73	46.64±6.19
Total	136	-	-	-	-	-	-
Average	-	-	3.62±15.39	11.15±24.27	-	3.72±13.77	16.85±24.2

The statistical study (T-TEST) showed no significant differences between the average standard height for females (3.62±15.39) cm and the average standard height for males (3.72±13.77) cm. As for the average weight of females (11.15±24.27) and the mean weight of males (16.85±24.2), -significant differences were found between them-, which is attributed to the amount of food in the digestive tract at the time of capture.

Length-weight relationship in *P. lineatus* fish:

Determining the relationship between length and weight has numerous applications in fish biology and physiology and fishery evaluation [25]. The weight-length relationship varies depending on location, food availability, and sexual maturity in fish.

Figure (2) shows the mathematical equations representing the length-weight relationship in *P. lineatus* fish, where the regression coefficient values for females (b= 1.286), males (b= 1.629), and all individuals (b= 1.454) indicate that the growth is allometric (irregular growth), meaning that the rate of increase in length is greater than the rate of increase in weight (negative irregular growth). The results are consistent with the study of Dogdu *et*

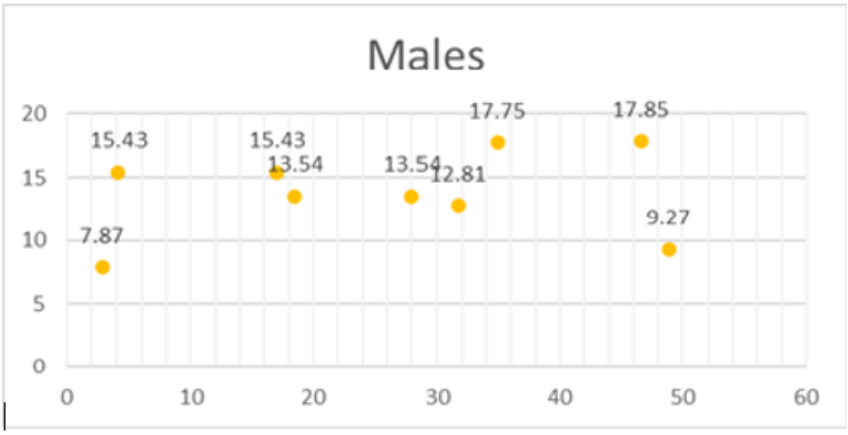
al. (2024), where the coefficient values were (b= 2.28) for females, (b= 2.25) for males, and (b= 1.454) for all individuals, while both recorded (Edelist *et al*. 2012), the value was (b=3.34) for all individuals, (negative logarithmic growth), and (Ueng *et al*.,2022), females (b= 3.29), males (b= 3.29), all individuals and (b= 3.23), (negative logarithmic growth).

The results of the length-weight relationship study for *P. lineatus* fish individuals for both females and males, and for all individuals showed a strong positive correlation (R^2 = 0.980, 0.213, and 0.738 respectively).

The results of the current research are consistent with the study of [16], where a group of sea Catfish in the Gulf of Iskenderun showed heterogeneous negative growth patterns (strong positive correlation).

Differences in R values can be explained by several factors such as gonadal maturation, sex, diet, stomach fullness, health status, and preservation techniques, all of which affect the length-weight relationship in fish [26].

A



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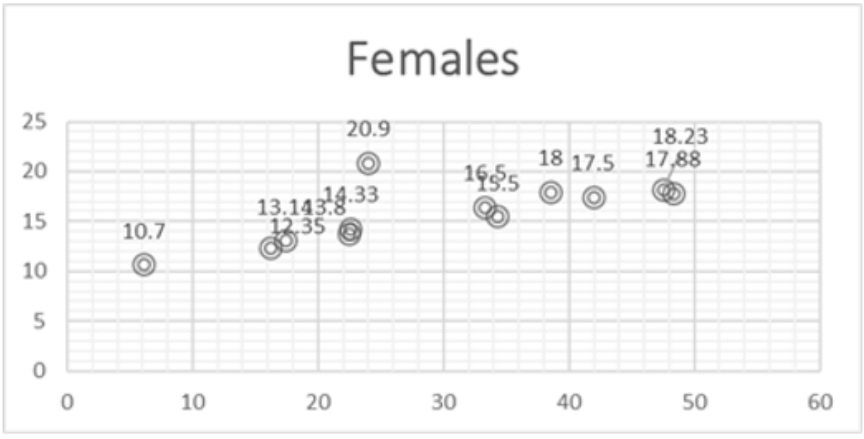

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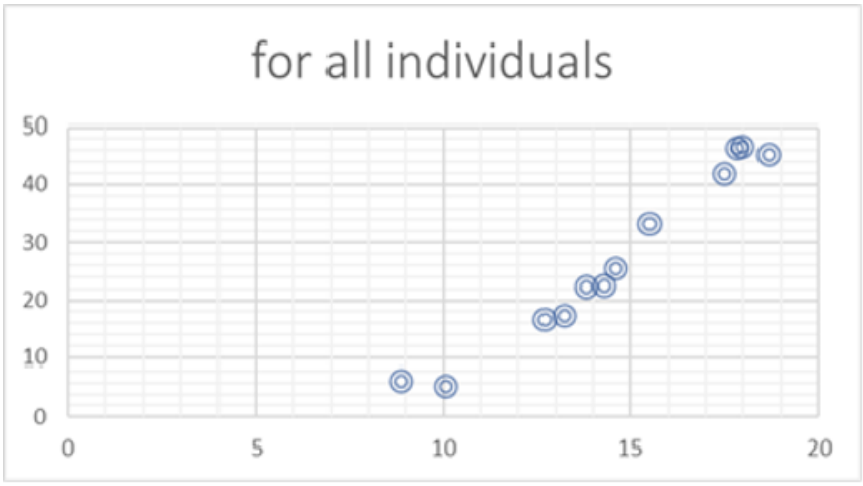


Figure (2) The relationship between weight and standard length of *P. lineatus* fish during the research period (A: Males, B: Females, C: All individuals)

Quantitative and qualitative composition of the Food spectrum of *P. lineatus*:

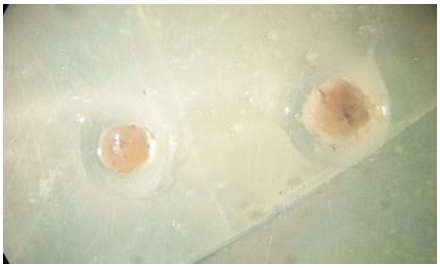
A study of the qualitative composition of the food components revealed a slight seasonal variation in feeding habits, with the dominant prey throughout the year being crustaceans such as (Penaeidae*)* (shrimp) and *Thalamita* sp.(marine Crabs). The feeding rate decreased in winter due to the lower temperature, which reduced food items available for fish. The fish's diet consisted solely of the larvae of certain crustaceans and mollusks. Most of the tested stomachs contained only digested food, likely due to the fish being caught after a feeding period that allowed the fish to digest the ingested food.

The feeding rate increased in spring and summer due to the availability of nutrients and prey items. The diet was based mainly on crustaceans, and to a lesser extent Amphipoda, Decapoda, Foraminifera, mollusks eggs, crustacean larvae, and Anomura, Hermit crab. Seasonal changes in feeding are observed in many fish, which are related to the individual developmental stages of the invertebrates, and fish that constitute the elements of their food spectrum, their migration and the possibility of obtaining an element in one season, as well as the physiological state of the fish themselves [27,28].

A

B

C



D

Figure (3) A: Penaeidae, B: Marine Crab (*Talamita* sp.) , C: Part of a fish (Spine) , D: Mollusk eggs, Magnification (4 ×10)

The Qualitative composition of food spectrum elements in the fish *P. lineatus*:

The qualitative composition of food does not remain constant throughout the fish life, but changes according to age, feeding location (dispersal), physiological state, as well as separation and the ability of the fish to obtain prey [29,28].

The Food spectrum of the studied species during the research period 2024-2025 consisted of (8) main prey items belonging to (3) taxonomic groups: crustaceans, mollusc, and fish. Crustaceans occupied the first rank:(Penaeidae, Decapoda, Amphipoda, *Thalamita* sp., Hermit crab), followed by molluscs, then by fish. This is consistent with the study of [14,30,31].

The diet of the marine Catfish includes crustaceans, crabs, fish, and molluscs. The results indicate that crustaceans were the most common component of the diet, followed by the crabs.

Monthly Changes in Condition Factor (K%):

The condition factor is used as an indicator of obesity [19], but does not remain constant throughout the year as it as affected by seasonal variations, food availability, and sexual maturation.

Figure (4) shows the mean values of the Condition Coefficient (K%) in female sea Catfish. No significant changes occurred in the values of this coefficient throughout the months of the year. The highest value of the state coefficient was reached during March, followed by a peak in July. The lowest value was reached during May, while the values were similar in the remaining months. This indicates that these fish feed all year-round [32].

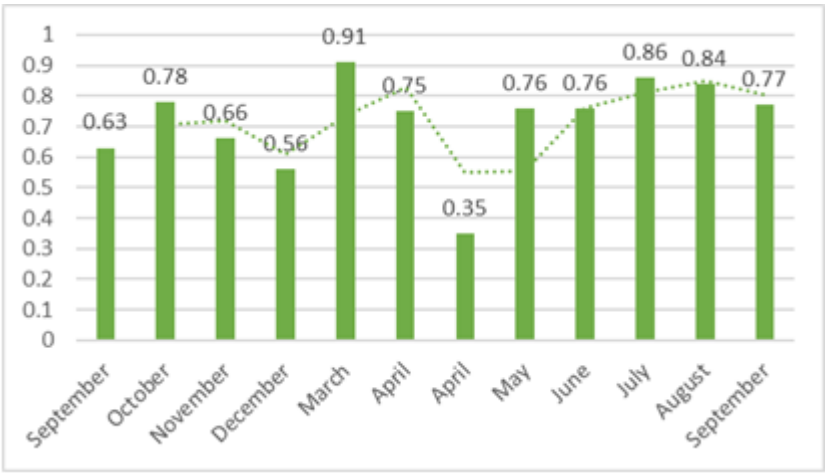


Figure (4) Monthly changes in the Condition factor (K%) of females *P. lineatus* fish

Figure (5), which represents the average values of the Condition Coefficient (K%) in male *P. lineatus* fish, shows that no significant changes occurred in the value of this coefficient during the months of the year. The highest value was reached in March, and the lowest value was reached in December. The values fluctuated up and down during the months of the year and did not show significant differences. This is attributed to its being affected by seasonal changes in environmental conditions, especially temperature and food availability, as well as the difference in energy requirement associated with sexual maturity and reproduction. Again, there were no significant differences ($P > 0.05$) between the mean state Coefficients of males and females.

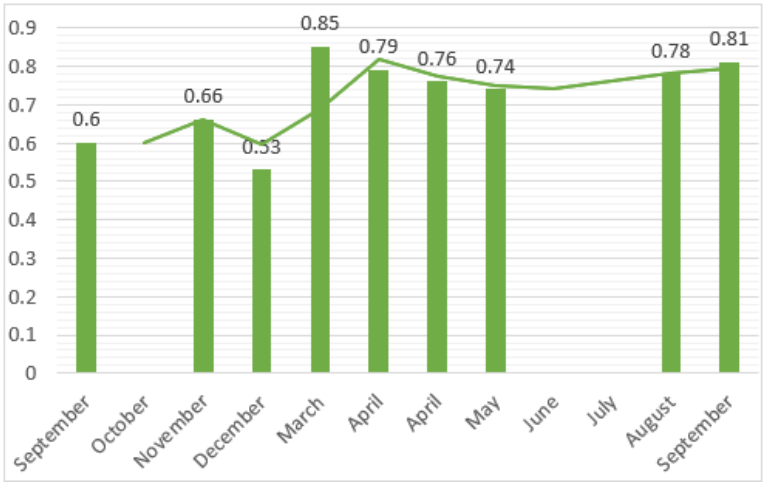


Figure (5) Monthly changes in the Condition factor (K%) of male *P. lineatus* fish

General gut fullness:

Figure (6), shows that the highest value for the degree of gastrointestinal fullness of females was in April, and the lowest value was in September. The values were similar throughout the months of the year, starting to rise during March and peaking in April.

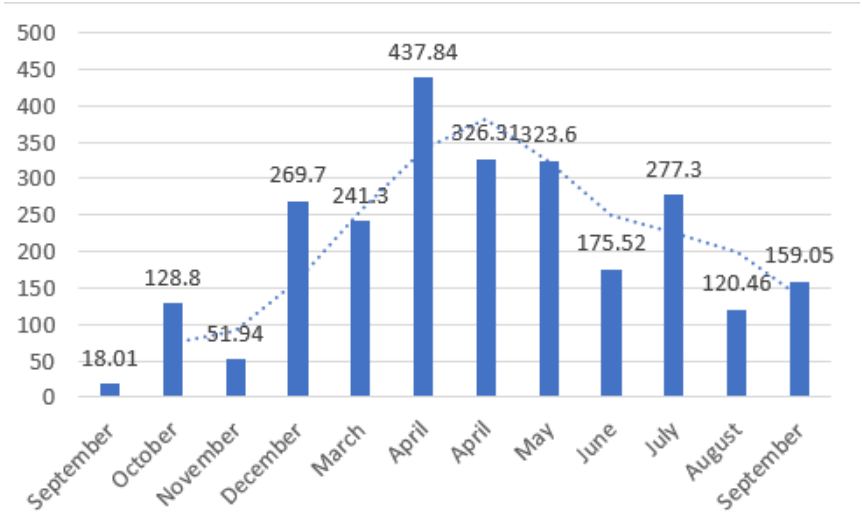


Figure (6) Monthly changes in the General gut fullness Coefficient of female *P. lineatus* during the period of research

Figure (7) shows that the highest value of the mean gut fullness index in male *P. lineatus* fish was in September, and the lowest value was in October. Statistical analysis revealed significant differences between the mean gastric fullness index of male and female ($P < 0.05$).

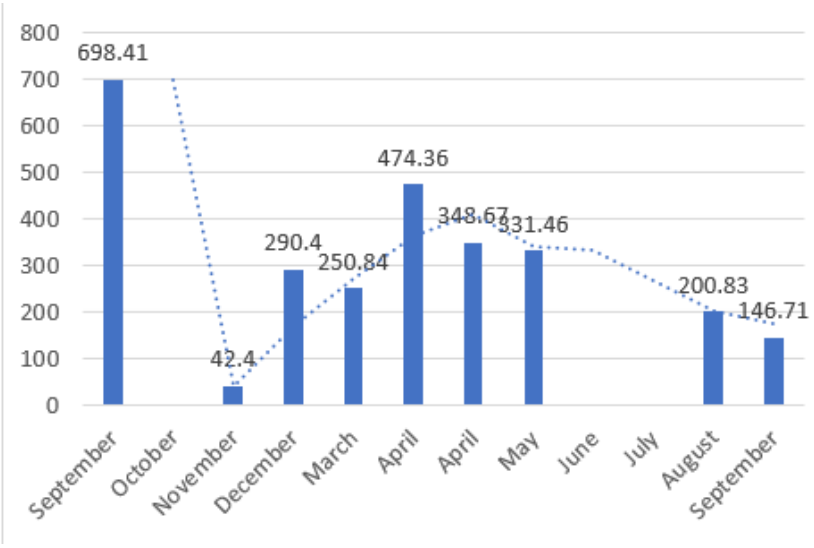


Figure (7) Monthly changes in the gut fullness Coefficient of male *P. lineatus* during the research period

General Feeding Factor:

The overall feeding coefficient indicates how well the fish utilizes the prey items. Figure (8) shows that the highest value of the overall feeding coefficient for the studied females was in April. This is attributed to the improved environmental conditions, higher temperatures, and the availability of natural food, which led to increased fish activity and feeding appetite. The lowest value was in September. Similarly, the highest value of the overall feeding coefficient for males was in September, and the lowest value was in May. In winter, temperatures decrease, and the feeding rate decreases, as the *P. lineatus* fish

relies on its liver reserves. Statistical analysis revealed no significant difference between the mean overall feeding Coefficient of the studied males and females (P > 0.05).

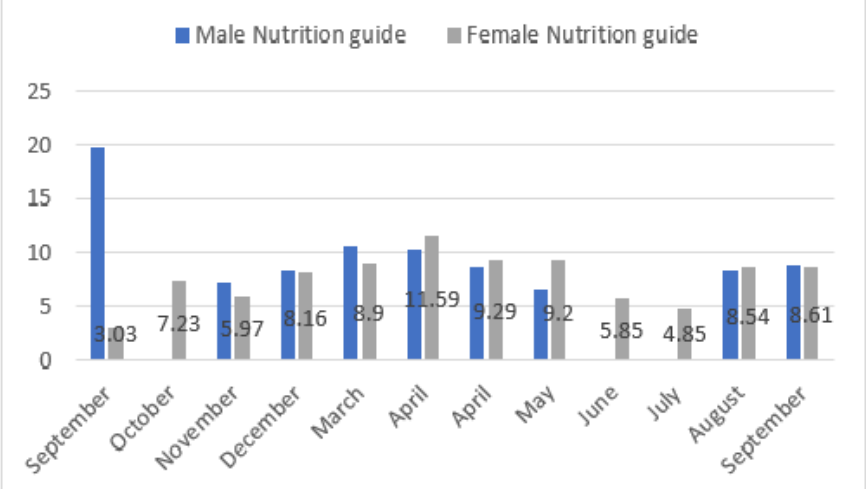


Figure (8) General Feeding Factor for male and female *P. lineatus* fish during the research period

Monthly change in the Somatic Hepatic index (HI%) IN *P. lineatus* fish:

Figure (9) shows that the hepatocyte index recorded its highest value in July and its lowest value in September. This indicates the fish's reliance on liver reserves during the winter.

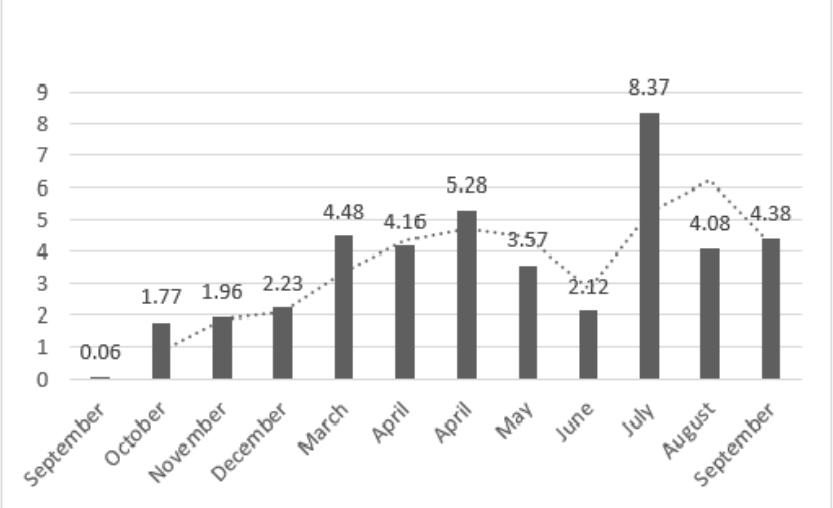


Figure (9) Hepatic index Coefficient in female *P. lineatus* fish

Figure (10) shows that the highest Somatic Hepatic index value for males was in March, and the lowest value was in November, as a result of the consumption of food reserves during the winter months. It then begins to rise with increasing food availability. Statistical analysis reveals no significant difference between the average Somatic Hepatic index for males and females (P >0.05).

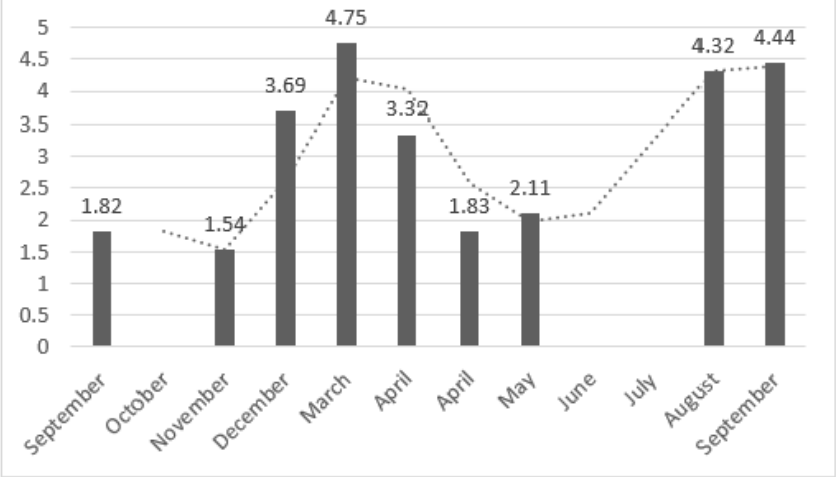


Figure (10) Somatic Hepatic index in Male *P. lineatus*

Conclusions and Recommendations:

Conclusions

Based on the above results, we can conclude the following:
(1) The sea Catfish *P. lineatus* is a Carnivorous bottom-dwelling fish (Camicornis) that feeds on [8] prey items belonging to three taxonomic groups (crustaceans, molluscs and fish).
(2) Crustaceans constitute the main food source for the sea Catfish in Syrian marine waters: Penaeidae ranked the first, with the sea Crab (*Thalamita* sp.) being present.
(3) The feeding behavior of male and female *P. lineatus* Catfish in the local benthic marine environment was similar. Significant differences were found between the mean gastrointestinal fullness index between them, while there was no significant difference between the mean Somatic Hepatic index for males and females ($P > 0.05$).

Recommendations:

(1) It is recommended to conduct regular, long-term surveys to monitor temporal changes in the abundance and spread of the *P. lineatus* fish in Syrian waters, thus enabling a more extensive database.
(2) Studying the environmental impact of the species on local species, particularly small demersal fish, and Crustaceans that form part of its food spectrum.
(3) Strengthening coordination between research and environmental bodies, with the aim of monitoring and assessing any potential impacts of this species on local habitats and biodiversity.

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