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Study of some Biological characteristics of the Dolphinfish (*Coryphaena hippurus*) in the western Libyan coast

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دراسة بعض الخصائص البيولوجية لسمكة اللمبوكة (*Coryphaena hippurus*) بالشاطئ الغربي الليبي

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Abstract

This study presents the first report on the bbiological characteristics of the Dolphinfish (*Coryphaena hippurus* Linnaeus, 1758) in the Libyan coast. Samples were collected from Fishing ports in the western Libyan coast, during the period from August to November (2021). The total length and weight ranged from 28 to 85cm (mean 48.98 cm), and 141.6 to 3654 (mean 838.62 g) respectively. The growth in the relationship of height and weight was homogeneous isometric ($W = 0.0081L^{3.02}$), and the strength of the correlation between height and weight was strong ($R^2 = 0.98$). As for the highest value of the gonad somatic index (GSI), it was in October (0.28), and the monthly average of the condition factor (CF) for the three months August, September and October, respectively (0.84, 0.92, 0.88), and the sex ratio of males to females was (1: 2), and by examining the stages Sexual maturity the spawning period is between September and October.

Keywords: *Biology, Dolphinfish, Coryphaena hippurus, Western Libyan coast.*

الملخص

تقدم هذه الدراسة تحليلاً لبعض الخصائص البيولوجية لسمكة اللمبوكة *Coryphaena hippurus* (Linnaeus, 1758)، في الفترة ما بين شهري أغسطس – ديسمبر2021 بالشاطئ الغربي الليبي. سُجلت الأطوال والأوزان لسمكة اللمبوكة حيث تراوح الطول الكلي ما بين 28 –85 سم، بمتوسط 48.98 سم، وتراوح الوزن الكلي ما بين 141.6– 3654 جم، وبمتوسط 838.62 جم. كان النمو في علاقة الطول بالوزن أيزومترياً متجانساً $W= 0.0081L^{3.02}$ ، وكانت قوة الارتباط بين الطول و الوزن قوية ($R^2 = 0.98$). أما أعلى قيمة لمؤشر الحالة التناسلية فكان في شهر أكتوبر (0.28)، والمتوسط الشهري لمعامل الحالة الصحية للأشهر الثلاث أغسطس، سبتمبر وأكتوبر على التوالي (0.84، 0.92، 0.88)، وكانت نسبة الذكور للإناث (1: 2)، وبفحص مراحل النضج الجنسي تبين أن فترة وضع البيض ما بين شهري سبتمبر وأكتوبر.

الكلمات الدالة: الساحل الغربي الليبي، الخصائص البيولوجية، سمكة لامبوكا، كوريفاينا هيبوروس.

1. Introduction

The Dolphinfish (***Coryphaena hippurus***) is a surface fish that lives far from the shore in tropical and subtropical waters, at where temperatures range between 21°C and 31°C. It is a migratory fish that swims quickly, grows quickly, and reproduces (Moltó *et al*., 2020). The Dolphinfish is characterized by a long, compressed body and the mouth contains several rows of teeth. The dorsal fin extends from above the head to the tail, while the anal fin extends from the middle of the body to the neck of the tail. The caudal fin is concave. The fish has a bright blue-green color on the back and bright yellow on the sides. It is a predatory fish that feeds on fish and cephalopods (Abdulkarim *et al*., 2024). It reproduces from the beginning of the summer along the Libyan coast. The lengths of adult fish range from 40 to 70 cm and may reach 200 cm (Shakman, 2008 and Qasim *et al*., 2009). The species reaches sexual maturity from the first year of life and it is first sexual maturity was recorded at the length of 44 cm (Gatt *et al*., 2015 and Moltó *et al*., 2020). This type of fish is caught with nets and is also caught incidentally with a long line (Barr *et al*., 2003). Libyan fisheries for the Dolphinfish are considered traditional fisheries that have undergone major developments in recent years, targeting this type of fish using (FADs) made of palm fronds and fixed with heavy tiles in depths from shallow coastal waters to far depths under which these fish gather. Special fishing nets are used, consisting of a surrounding net without a closing rope, known locally as (Dolphinfish nets), with a central bag and two side wings. Fishing for this fish is seasonal, starting in the second half of August and may continue until December (Al-Zaqouzi *et al*., 2020). This study aims to manage fisheries for this fish by monitoring it is biological characteristics.

2. Materials and methods

A total of 155 Dolphinfish were collected during field trips to ports where fishing for this fish is practiced in the western region of the Libyan coast, which extends from Qasr Ahmed Port in Misurata in the east to Abu-Kammash in the west, between August and November 2021. Fish samples were collected three times a month (every ten days) from the beginning of the fishing season to its end throughout the study period. The total length, standard length, total weight, and weight of the fish without entrails, stages of sexual maturity, weight of the equipment and gonads were taken. Then the following readings were taken: Reading fish groups by following the number of repetitions of fish lengths in relation to length periods, which is considered one of the general indicators (Methratta and Link, 2006). Comparing growth in length versus growth in weight, as well as determining the changes that occur in length and weight and evaluating the live mass through the relationship between length and weight (Liao *et al*., 1995; and Methratta and Link, 2006). By comparing what is seen from the gonads, the stages of sexual maturity and the sex ratio were determined (Adebiyi, 2013). The length at first sexual maturity (L_{50}) was determined using the equation Pr.mat= 1/ [1+exp-b*(Lmat-$Lm_{50\%}$)] (Soares *et al*., 2020). In the same context, the reproductive status coefficient (GSI) was calculated using the equation GSI = (W/Wev)*100 (Saleh and Ali,

2017). It is an important indicator to clarify the reproductive status that determines the spawning season and to compare the maturity status during the seasons of the year. (Chen *et al*., 2022). As for the health status coefficient (CF), its range was recorded using the equation K= (W/Lb)*100 ; (Saleh and Ali, 2017; Methratta and Link, 2006), as the coefficient can be used to compare two different species or one species coexisting in different conditions, and the extent of the impact of environmental factors on the health status of the fish, sexual maturity and nutrition. It is also used as a measure of the strength and activity of fish and the extent of stability in the environment surrounding the fish (Claireaux and Lefrançois, 2007).

3. Results and Discussion

Seventeen sites were recorded in the study areas that were engaged in fishing for the The Dolphinfish (*Coryphaena hippurus*) and it is known as Lampuka fish among to Libyan fishermen. Is a surface fish that lives far from the shore in tropical and subtropical waters, at. It was found that the largest occurrence of fish group lengths for males and females, was between 41 - 50 cm and 31 - 40 cm respectively, while the largest occurrence of fish group lengths for both sexes together was between 40 to 50 cm (Figures 1 and 2).

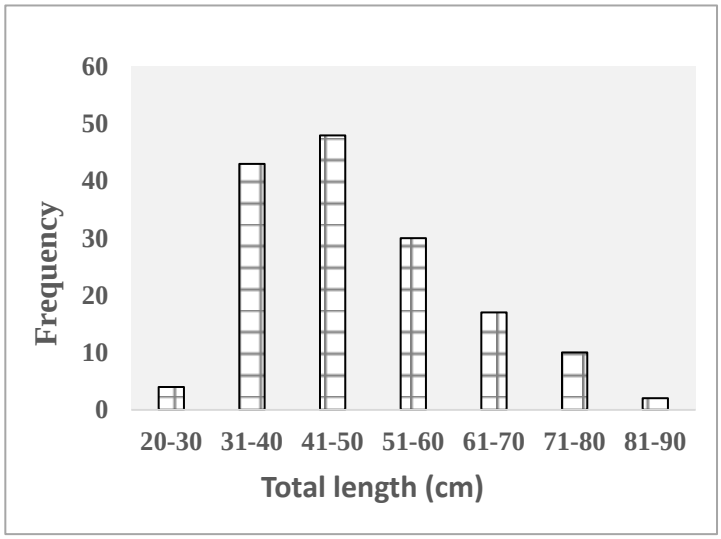

Figure 1. Frequency of lengths for both sexes

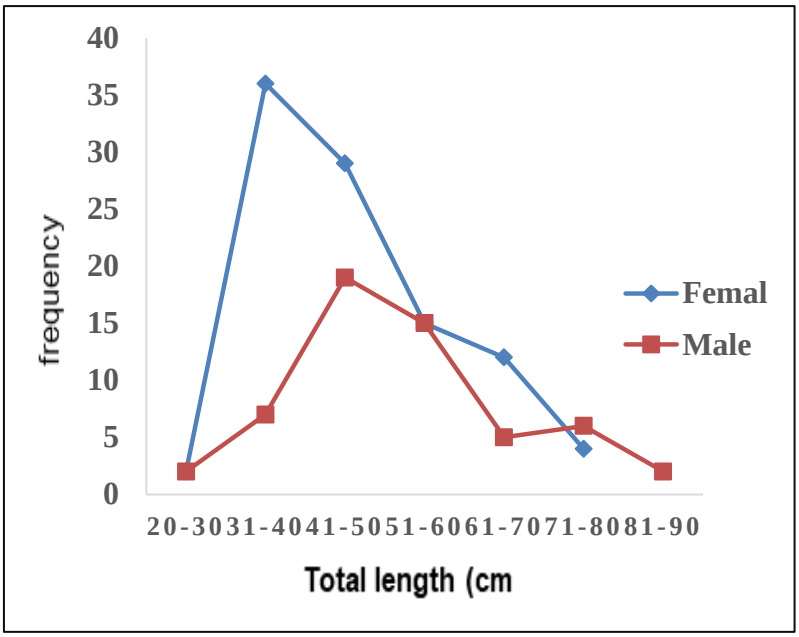

Figure 2. Frequency of lengths for both males and females.

3.1 Length-weight relationship

The relationship between height and weight it was shown from the length-weight relationship that the fish growth was isometric and the value of b = 3.02, and that the strength of the correlation between the two variables was strong R^2 = 0.98 (Figure 3).

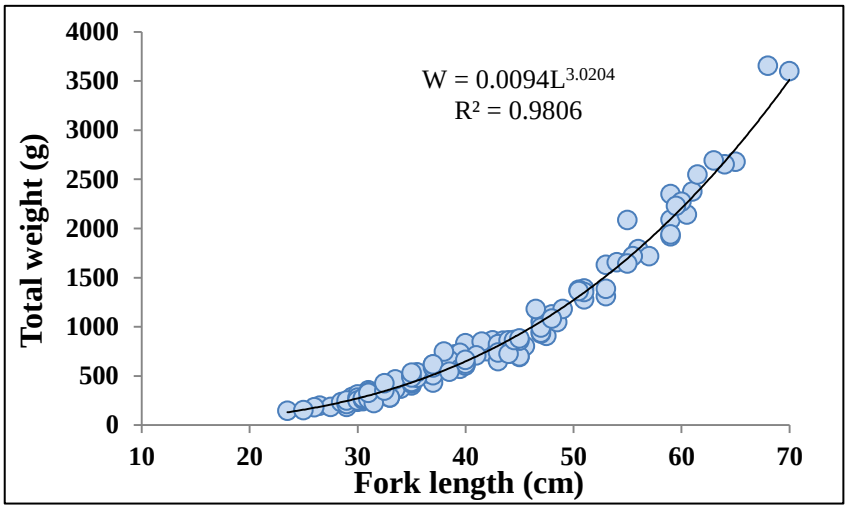

Figure 3. Relationship between height and weight

3.2 Reproductive Status Index (GSI)

By highlighting the monthly sexual cycle, the monthly Reproductive Status Index (GSI) showed that the highest value of the average Reproductive Status Index was in October (0.49), followed by September (0.34), and then August (0.25) (Figure 4). The sex ratio between males and females was (1:2) (Figure 5).

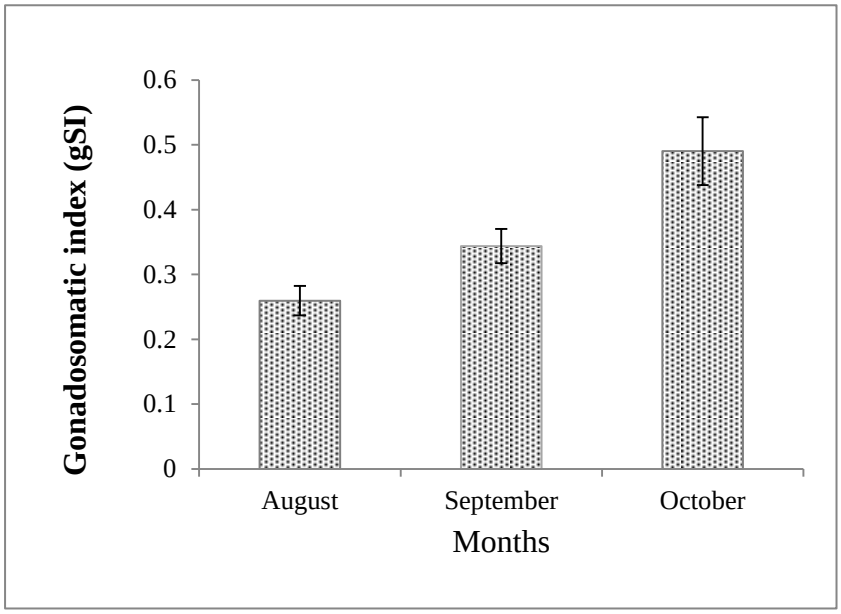

Figure 4. Reproductive status index (GSI)

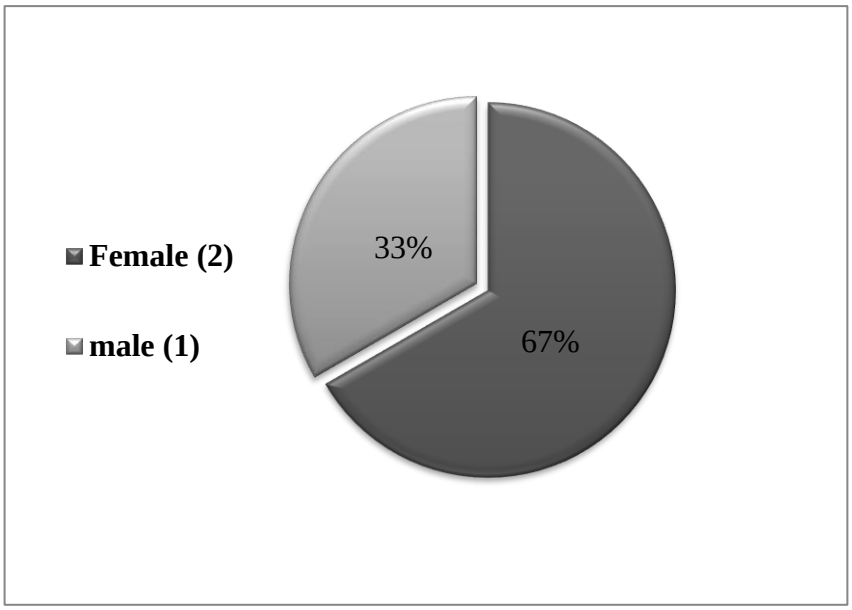

Figure 5. Sex ratio between males and females

3.3 Health condition coefficient (C.F)

It was found that the average value of the coefficient during the three months of August, September and October were (0.84, 0.92, 0.88) respectively (Figure 6).

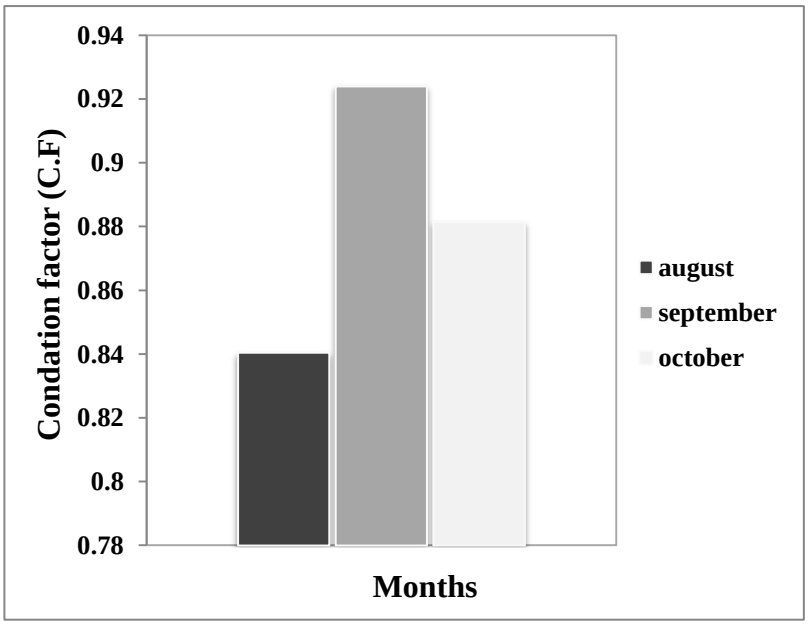

Figure 6. Health status factor (C.F)

3.4 Sexual maturity stages

The stages of sexual maturity were determined by observing the gonads, and it was found that the highest percentage of the appearance of the sexual stages for males was respectively stage III, then IV, II, V (Figure 7), while for females, the highest percentage of the appearance of the sexual maturity stages was respectively stage III, then IV, II, V (Figure 8). The egg laying period is between September and October.

About the length at first sexual maturity for both sexes, the branch length was used to calculate it and it was found that the length at first sexual maturity for males was at a branch length of 33.5 cm (Figure 9), while the length at first sexual maturity for females was at a branch length of 26.5 cm (Figure 10).

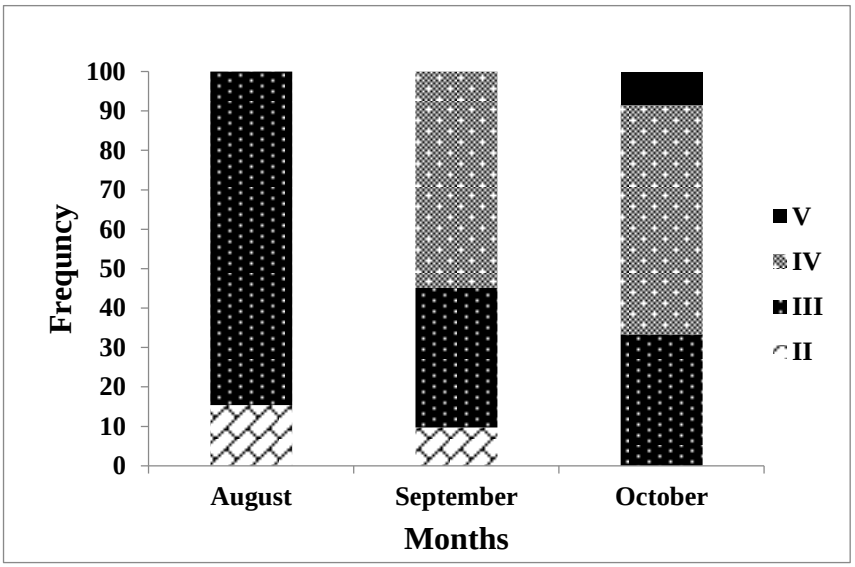

Figure 7. Stages of male sexual maturity

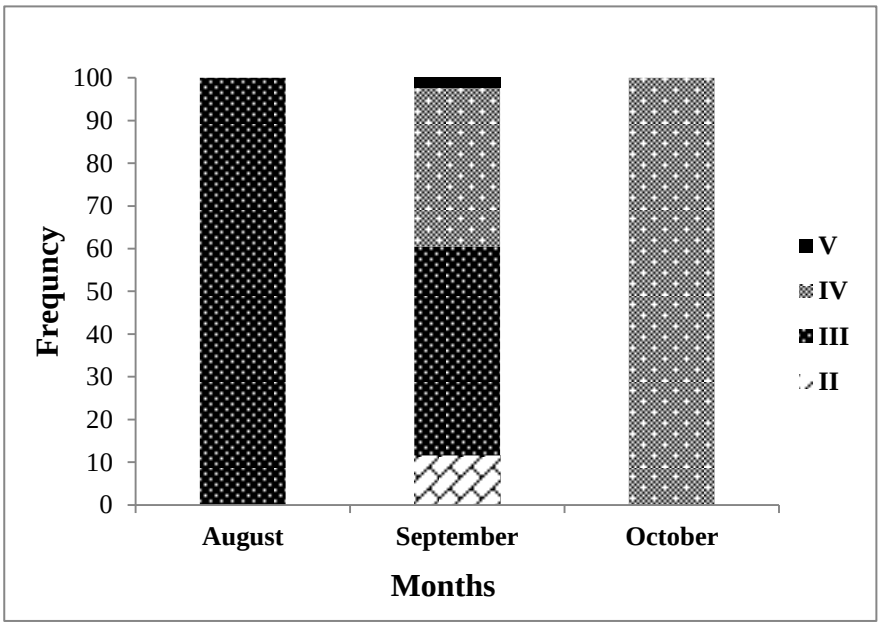

Figure 8. Stages of female sexual maturity

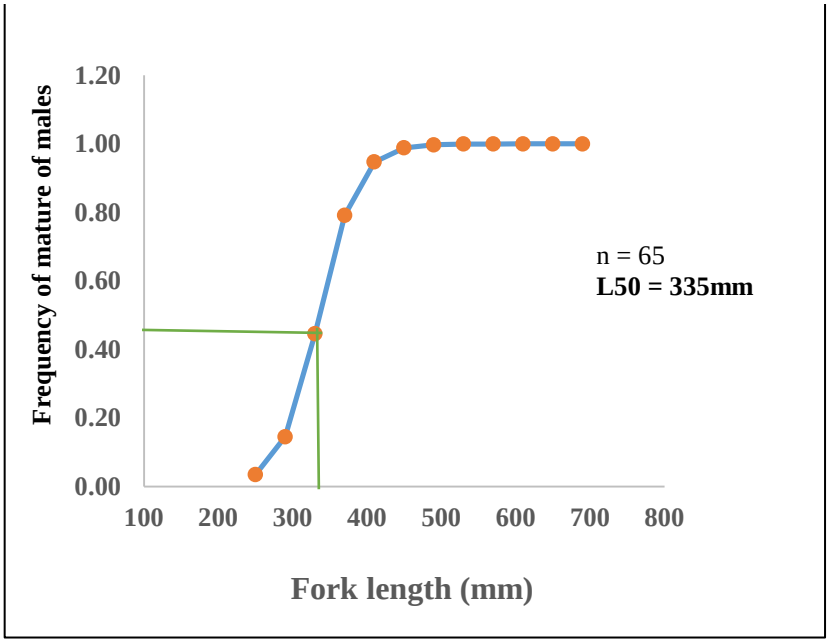

Figure 9. Branchial length at first sexual maturity in males.

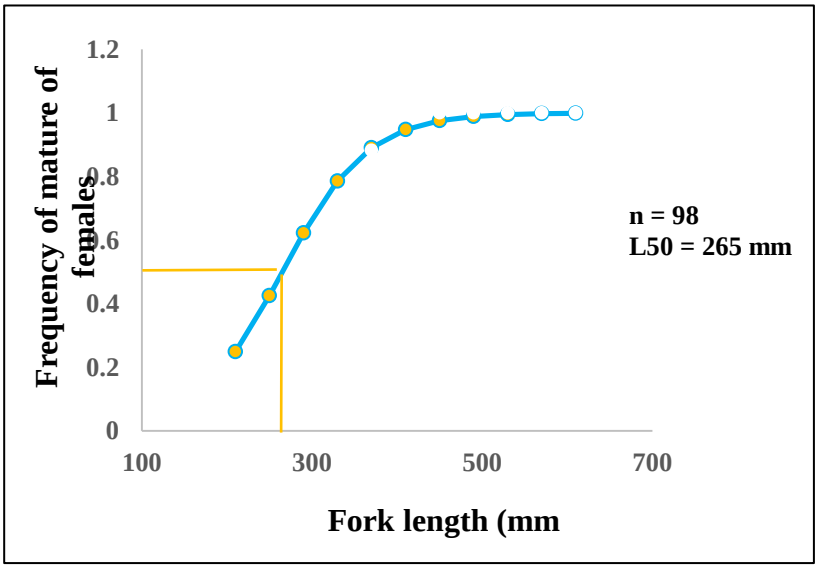

Figure 10. Branchial length at first sexual maturity in females.

This study was conducted for the Libyan coast, where the length of the female branch was recorded, ranging from 23.5 to 65 cm. This differs from the Maltese coast, where the length of the female branch was recorded between 11 and 142 cm (Gatt *et al*., 2015), which may be attributed to the longer sample collection period on the Maltese coast. The combined length of

the male and female branch ranged from 23.5 to 70 cm, which is very similar to the length of the branch on the Tunisian coast, which ranged from 24 to 65 cm (Nasri *et al*., 2021). Allometric growth was positive (3.0204) in weight compared to length, which is largely consistent with comparative studies (Table 1).

Table 1. Comparison of the length-weight relationship for the (2021) season with other studies.

Location	Branch length (cm)	Sex	Parameter value (b)	Parameter value (a)	Reference
Western coast of Libya	23.5-70	M&F	3.0204	0.0094	Current study
Spain (Mallorca Island)	14.4-124	M&F	2.96	0.0113	(Massutí and Morales-Nin, 1999)
Spain (Mallorca Island)	14.4-124	M	3.01	0.0092	(Bannister, 1976)
Spain (Mallorca Island)	14.4-124	F	2.89	0.0139	(Massutí and Morales-Nin, 1999)
Tunisia	24-65	M&F	3.0669	0.0081	(Benseddik *et al*., 2011)
Tunisia	24-65	M	3.0893	0.0077	(Benseddik *et al*., 2011)
Tunisia	24-65	F	3.0281	0.0091	(Benseddik *et al*., 2011)
Malta	22.2 -54.3	M	2.95	0.00001637	(Bannister, 1976)
Malta	54.5-22.4	F	2.91	0.00001637	(Bannister, 1976)
Malta	142-111	M	2.85	0.0178	(Gatt *et al*., 2015)
Malta	142-111	F	2.79	0.0216	(Gatt *et al*., 2015)

As for the sex ratio that was determined from observing the gonads, which is (2:1) for males and females, it was largely consistent with most previous studies, except for those studies in which samples were collected with a long line (hook), in which the catch quantities were less, and therefore the ratio of males and females differed, as is the case in the Maltese beach study (Gatt *et al*., 2015) (Table 2).

Table 2. Comparison of the sex ratio for the 2021 season with other studies.

Territorial waters	Study area	Male:Female sex ratio	Reference
Average	west coast of Libya	1: 2	Current study
Average	Tunisia	2: 1	(Benseddik *et al*., 2019)
Average	Malta *	1.54: 1	(Gatt *et al*., 2015)
Average	Malta **	0.76: 1	(Gatt *et al*., 2015)

(*) indicates FAD fishing, (**) indicates longline fishing.

It was found that the length at first sexual maturity may vary depending on the fish's location (Hossain *et al*., 2012) and (Tsikliras and Stergiou, 2014); Comparing the western Atlantic and central and western Mediterranean regions, it was found that the L_{50} values in the western Atlantic were sometimes higher than in the central and western Mediterranean, and that the L_{50} values in the Mediterranean usually did not exceed 60 cm for both sexes (Benseddik *et al*., 2019). By comparing the length at first sexual maturity, the following was found (Table 3).

Table 3. Comparison of the length at first sexual maturity for the 2021 season with other studies.

Territorial waters	Study area	Sex	L_{50}	Reference
Average	west coast of Libya	M F	33.5 26.5	Current study
West Atlantic	Florida	M F	45 35	(Beardsley Jr, 1967)
West Atlantic	-	M F	80.5 84	(Oxenford, 1999)
Western and Central Mediterranean	Tunisia	M F	60.5 53.5	(Benseddik *et al*., 2019)
Western and Central Mediterranean	Malta	M F	58.9 62.6	(Gatt *et al*., 2015)

4. Conclusion

This study presents the first report on the biological characteristics of the Dolphinfish (*Coryphaena hippurus*) it is known as (Lampuka fish) among Libyan fishermen.17 sites are recorded in the study area that is engaged in fishing for the Dolphinfish. It is found that the largest occurrence of fish group lengths for males and females is between 41-50 cm and 31-40 cm respectively, while the largest occurrence of fish group lengths for both sexes together is between 40 to 50 cm. The total length and weight ranged from 28 to 85cm (mean 48.98 cm), and 141.6 to 3654 (mean 838.62g) respectively. The growth in the relationship of height and weight is homogeneous isometric (W = 0.0081L3.02), and the strength of the correlation between height and weight is strong (R^2 = 0.98). As for the sex ratio that is determined from observing the gonads, which is (2:1) for males and females. As for the highest value of the gonads somatic index (GSI), it was in October (0.28), and the monthly average of the condition factor (CF) for the three months August, September and October, respectively (0.84, 0.92, 0.88), and the sex ratio of males to females is (1: 2), and by examining the stages Sexual maturity the spawning period is between September and October. Finally, it is found that the length at first sexual maturity may vary depending on the fish's location. Comparing the western Atlantic and central and western Mediterranean regions, it is found that the L_{50} values in the western Atlantic were sometimes higher than in the central and western Mediterranean, and that the L_{50} values in the Mediterranean usually did not exceed 60 cm for both sexes.

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