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Age, Growth and Maturity of the Bogue, *Boops boops* (Linnaeus, 1758), Caught off the Egyptian Mediterranean Water

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ABSTRACT
The Bogue, *Boops boops* (Linnaeus, 1758), is one of the common and economically important demersal species in the Egyptian Mediterranean waters. A total of 1,725 specimens were collected from the Egyptian Mediterranean waters off Alexandria between January and December 2023. The length range varied from 6.7 to 22.8 cm total length, and the total weight ranged from 2.12 to 128.32 g. Otoliths were used to determine the age of the specimens, revealing that the fish ranged in age from I to IV years, with the maximum age recorded as 4 years. The length-weight relationship was calculated as $W = 0.0052 * L^{3.202}$, indicating a positive allometric growth pattern. Growth parameters of *Boops boops* were estimated using the von Bertalanffy growth function (vBGF) as follows: $L\infty = 31.6$ cm, $K = 0.238$ year^{-1} and $t_0 = -1.473$ year. Monthly analysis of the maturity stage distribution for females showed that *Boops boops* has a long spawning season extending from January to April, with the peak in March. Length at first sexual maturity (L_{m50}) was found to be 14.2 cm. This study provides essential insights into the age, growth, and reproductive parameters of *Boops boops*, offering valuable information for future research and the development of effective fisheries management in the Egyptian Mediterranean.

INTRODUCTION

Sparidae family, which includes many different species commonly called porgy or bream **(EL-Agamy *et al.*, 2005)**, comprises about 22 genera in four subfamilies containing 41 species **(El-Maremie & El-Mor, 2015)**. *Boops boops* is one of the important fish species in the Sparidae family **(Allam, 2003)**. The genus *Boops* is represented by two biologically similar species: *Boops boops* and *Boops lineatus* **(El Samman *et al.*, 2022)**. *Boops boops* (Linnaeus, 1758), commonly known as Bogue, tends to avoid highly brackish waters and is primarily found in the Eastern Atlantic, ranging from Norway to Angola, and throughout the Mediterranean Sea, including the Black Sea **(Monteiro, 2005)**. It is a demersal or semi-pelagic species that inhabits a variety of substrates, such as mud, rocks, seaweed, and sand, typically at depths up to approximately 350 meters, however, it is more commonly found in the upper 100 meters,

moving in aggregations and ascending to the surface mainly at night **(El Samman *et al.*, 2022)**.

Boops boops is a medium-sized species, generally measuring between 100 and 200 mm in total length, with a maximum size of 400 mm and a recorded weight of up to 455 g along the Portuguese coast **(Ceyhan, 2018)**. It is a hermaphrodite that has a long spawning season extending from January to May and peak in March **(Allam, 2003; Massaro, 2012)**. The biological characteristics of *Boops boops* in the Egyptian Mediterranean waters have been the focus of several previous studies, including those by **Allam (2003)**, **Mehanna (2014)**, **Azab *et al*. (2019)**, and **El Samman *et al* (2022)**. While previous studies have provided valuable insights into the biology of *Boops boops*, differences in focus, location, and timing mean that some important questions about its population and life cycle still remain unanswered. The present study seeks to fill this gap by providing current insights into the age, growth, and reproductive maturity of *Boops boops*, thereby contributing to a more comprehensive understanding of the species and supporting future management efforts.

MATERIALS AND METHODS

1. Sampling and data collection

Monthly samples of *Boops boops* were collected from the commercial purse seine fishery operating off the coast of Alexandria in the Egyptian Mediterranean waters. A total of 1,725 specimens were obtained over the course of one year, from January to December 2023.

Total length (TL) was measured to the nearest centimeter, whereas total weight (W) and gutted weight (GW) were recorded to the nearest gram. Otoliths were removed for age determination. Gonads were carefully extracted from each individual to determine sex and to measure the gonads weight.

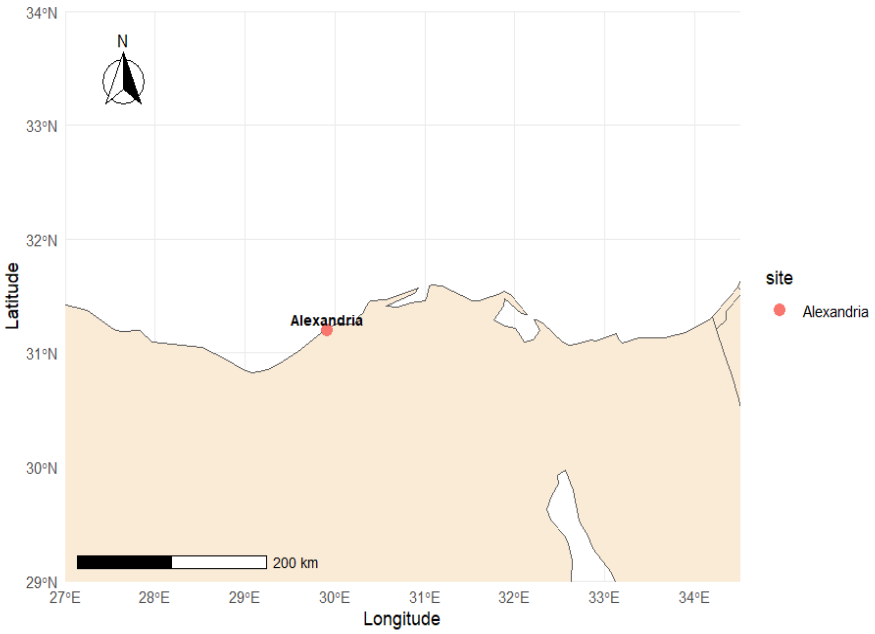

Fig. 1. A map showing the Egyptian Mediterranean coast and Alexandria fish landing site

2. Length-weight relationship

The length–weight relationship of *Boops boops* was estimated using the power equation: $W = aL^b$ **(Le Cren, 1951)**

Where: W represents the total weight of the fish (g), L is the total length (cm), a is the intercept (a constant specific to the species and population), and b is the slope which indicates the growth type.

3. Gonadosomatic index (GSI) and length at first maturity (Lm50)

The maturity stages of the gonads were determined based on the MEDITS maturity scale for bony fish **(Follesa *et al.*, 2020)**.

The monthly variations in the gonadosomatic index (GSI) of females were analyzed to determine the spawning season.

Gonadosomatic index (GSI) was calculated according to **Sokal and Rohlf (1969)** using the following formula: GSI = (GW /W) *100.

Where:

- GW is the gonad weight (g),
- W is the gutted body weight (g).

The length at first sexual maturity (Lm50) was estimated by determining the total length at which 50% of individuals were sexually mature. The maturity stages of the gonads were classified according to the MEDITS maturity scale for bony fish **(Follesa *et al.*, 2020)**.

4. Age determination

The otoliths of fish were examined to determine their age. Pairs of otoliths were carefully removed from each fish using fine forceps, rinsed with water to remove any adhering organic material and then stored in labeled Eppendorf tubes. For age reading, whole otoliths were immersed in water and examined under reflected light using a Leica S9i

Digital Stereo Microscope against a black background. The annual growth rings that were visible on the otolith surface consist of translucent and opaque zones, each pair of opaque and translucent zones in these rings was considered to indicate a year of growth.

5. Estimating growth parameters

The von Bertalanffy Growth Function (vBGF) was used to calculate growth parameters **(von Bertalanffy, 1938)**. Using the following equation: $Lt = L\infty (1- e^{-k (t-t0)})$, where Lt is the length at age t, $L\infty$ is the asymptotic length, K is the growth coefficient and t_0 is the theoretical age at which the fish's length is assumed to be zero.

RESULTS

1. Length-weight relationship

A total of 1,725 specimens of *Boops boops* were analyzed, with total lengths ranging from 6.7 cm to 22.8 cm and body weights ranging from 2.12 g to 128.32 g, including individuals of both sexes. The relationship between total length and body weight is presented in Fig. (2).

The derived regression equation, which describes this relationship, is:

$W = 0.0052 \times TL^{3.202}$

The exponent value (b = 3.202) indicates positive allometric growth, shows that the fish's weight increases faster than its length as it grows.

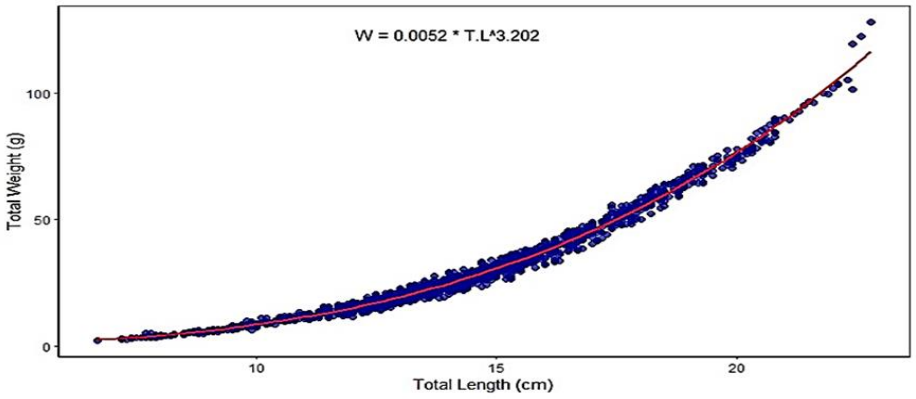

Fig. 2. Length-weight relationship of *Boops boops* collected from the Egyptian Mediterranean waters

2. Length frequency distribution analysis

The length frequency distribution is presented in Fig. (3). The data exhibit a normal distribution, with the majority of individuals falling within the 13 cm length class, which recorded the highest frequency. Length classes between 12 and 14 cm dominated the population structure, indicating a prevalence of intermediate-sized individuals.

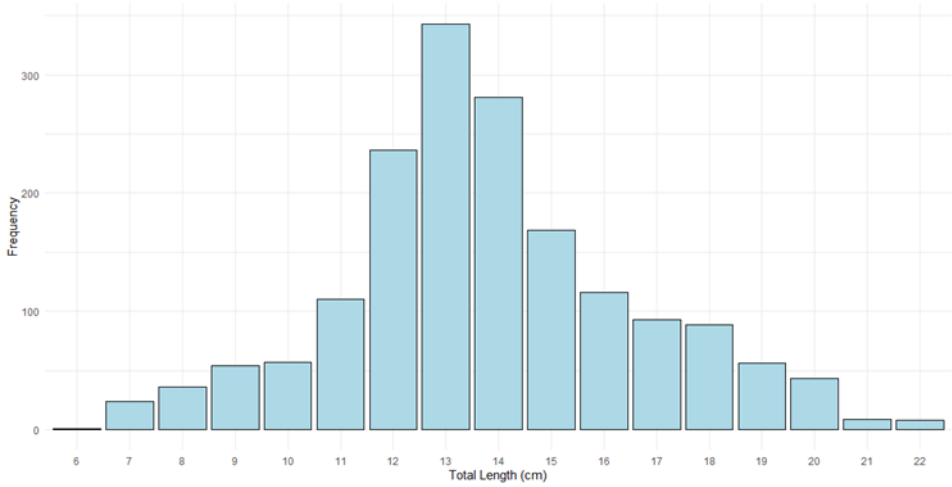

Fig. 3. Length frequency distribution of *Boops boops* for the sexes combined, from the Egyptian Mediterranean waters

3. Gonadosomatic index (GSI)

GSI peaked in March, indicating the main spawning period. After April, there was a noticeable drop, with June and July showing the lowest values, indicating a reproductive resting phase. The onset of gonadal development in anticipation of the subsequent spawning season was reflected in the steady rise in GSI values from August to December, as illustrated in Fig. (4).

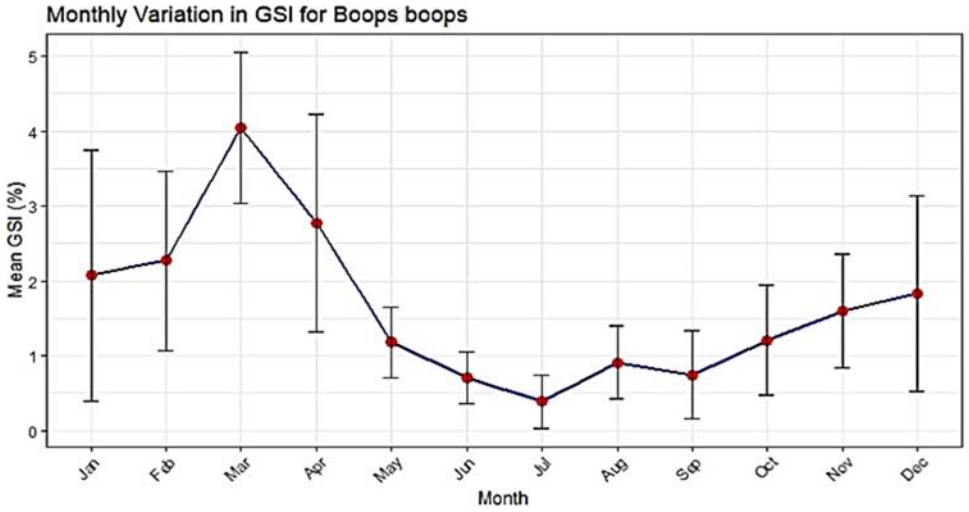

Fig. 4. Gonadosomatic Index (GSI) of *Boops boops* for females, from the Egyptian Mediterranean waters

4. Length at first sexual maturity (L_{m50})

The relationship between total length and sexual maturity in *B. boops* females is illustrated in Fig. (5). The length at which 50% of *B. boops* females reach sexual maturity (Lm50) was estimated at 14.2 cm. The logistic regression model accurately predicted maturity based on total length, with an R^2 value of 0.92. The proportion of mature females increased around this length, with nearly all individuals above 15 cm being mature, while those below 13 cm were mostly immature.

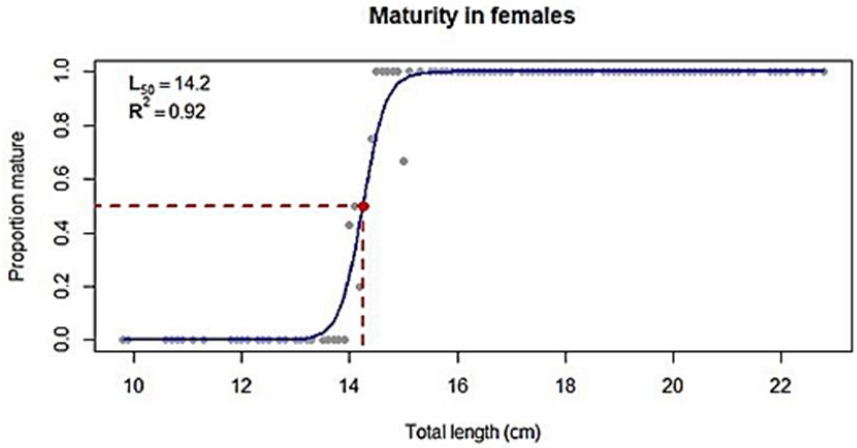

Fig. 5. Length at first sexual maturity of *Boops boops* for females, from the Egyptian Mediterranean waters

5. Estimating growth pameter

The otolith of *Boops boops* (22.1 cm TL), collected from a specimen caught off the Alexandria coast, shows clearly visible growth increments indicative of an age of four years. The otolith was examined under reflected light using a Leica S9i Digital Stereo Microscope to identify the annual age rings (Fig. 6).

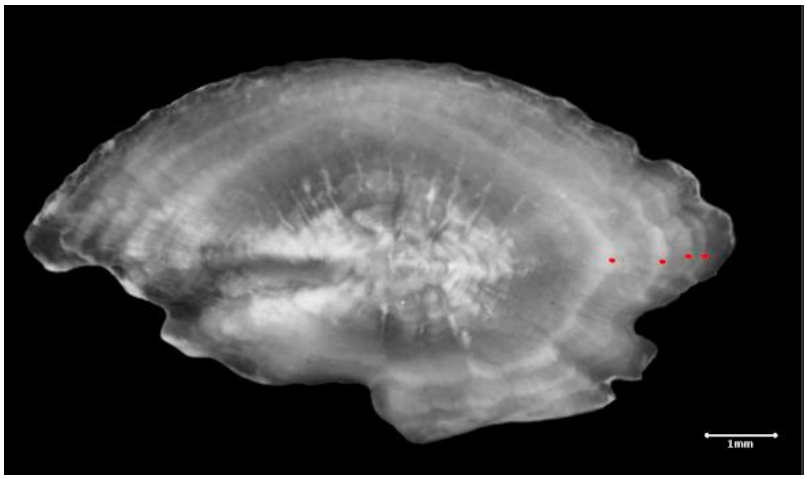

Fig. 6. Otolith of *Boops boops* with 22.1 cm of TL.

The von Bertalanffy Growth Function (vBGF)-based fitted growth curve for *Boops boops* is shown in Fig. (7). The estimated growth parameters were: asymptotic length ($L\infty$) = 31.6 cm, growth coefficient (K) = 0.238 $year^{-1}$, and theoretical age at zero length (t_0) = –1.473 years. These values indicate a typical growth pattern, with rapid length increase during the early life stages.

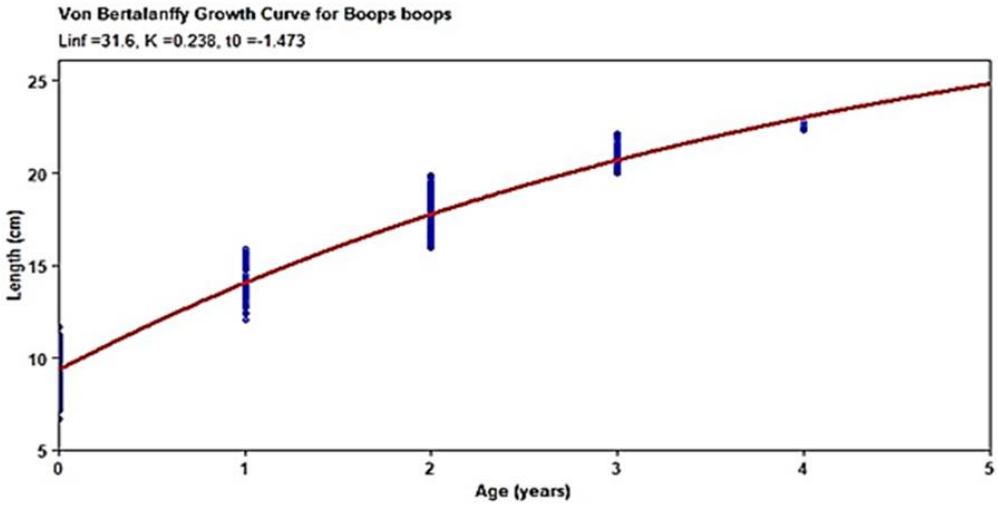

Fig. 7. Growth parameters of *Boops boops* from the Egyptian Mediterranean waters

DISCUSSION

The present study provides essential data for effective fisheries management by updating the biological and population parameters of *Boops boops* in the Mediterranean waters of Egypt.

One of the most important biological characteristics of fish is the relationship between length and weight, where the weight increases as a function of length. According to **Pauly and Gayanilo (1997)**, b values typically range from 2.50 to 3.50. Variations in the exponent "b" values among fish populations from different locations may be attributed to differences in environmental conditions and geographical factors **(Andreu-Soler *et al*., 2006; Olim & Borges, 2006)**. The study reveals a positive allometric growth pattern for *Boops boops* (b = 3.202), indicating that the species' weight increases at a faster rate than its length, this finding is consistent with similar results observed by **Allam (2003)** and by **Kara and Bayhan (2015)**.

While previous studies such as **Allam (2003)** were conducted in the same area, it's important to recognize that environmental conditions in Egypt's Mediterranean waters have changed over time. Factors like warmer sea temperatures and increased fishing activity may have influenced the biology of *Boops boops*. This study offers an updated perspective that reflects the species' current response to these conditions. By comparing present data with earlier findings, we gain valuable insight into how the population may be shifting, that is essential for developing effective, up-to-date fisheries management strategies.

The length at first sexual maturity (Lm50) was found to be 14.2 cm. In the present study, the spawning season extended from January to April, with a peak observed in March, as previously reported by **Azab *et al*. (2019)**. After April, a decline in GSI values signaled the conclusion of the reproductive phase. The GSI values in the post-reproductive phase suggest a period of rest or recovery before the onset of the next reproductive cycle.

In the present study, the age structure of *Boops boops* was determined based on otolith readings, revealing a maximum lifespan of four years. The analysis showed that age groups 0 and I were the most dominant in the population, comprising a significant proportion of the individuals examined. On the other hand, age groups II+, III+, and IV+ appeared in much lower proportions. Growth parameters of *Boops boops* have been reported from various locations (Table 1), with $L\infty$ values ranging between 23.5 and 37.5 cm, K values from 0.11 to 0.54 $year^{-1}$, and t_0 values from -2.91 to -0.16 year. In the present study, the estimated growth parameters $L\infty$ = 31.6 cm, K = 0.238 $year^{-1}$, and t_0 = –1.473 year fall well within these reported ranges, indicating consistency with previous findings in the Mediterranean region. Variations in growth parameters among different studies may be attributed to differences in fish size structure, fishing pressure, and local ecological conditions. The values of von Bertalanffy growth parameters estimated in this

study reflect a moderate growth pattern and are indicative of a species with relatively slow growth. The low k value indicates that *Boops boops* takes longer to reach its asymptotic length, which could be a reproductive or ecological adaptation strategy. These characteristics of growth suggest that the species may be more susceptible to overfishing, especially if smaller and younger individuals are targeted by fishing pressure before they mature. As a result, knowing these factors is essential to creating sustainable management options that aim to protect the stock.

Table 1. Growth parameters of *Boops boops* ($L\infty$,k, t_0) from various locations

Reference	Location	L_∞	*K*	t_0
Zúñiga, 1967	Spain	35.6	0.17	-2.14
Anato & ktari, 1986	Tunis	32.27	0.11	-1.688
Girardin & Quignard, 1986	Gulf of Lyon	33.5	0.19	-0.75
Hernandez, 1989	Adriatic	33.2	0.168	-1.48
Tsangridis & Filippousis, 1991	Greece	36.0	0.40	-0.91
Campillo, 1992	France	30.2	0.18	-1.02
Allam, 2003	Egypt	31.68	0.153	-1.78
Abdel-Rahman, 2003	Egypt	33.5	0.09	-2.64
El-Haweet *et al*., 2005	Egypt	31.9	0.15	-1.53
Khemiri, 2005	North Tunis	28.7	0.20	-1.41
Khemiri, 2005	Gulf of Tunis	24.3	0.23	-1.65
Khemiri, 2005	East Tunis	26.7	0.22	-1.43
Khemiri, 2005	South Tunis	23.5	0.21	-1.98
Monteiro, 2006	Portugal	28.06	0.22	-1.42
El-Okda, 2008	Egypt	30.11	0.15	-1.508
Ramdene, 2013	Algeria (♂)	27.0	0.24	-1.53
Ramdene, 2013	Algeria (♀)	27.5	0.28	-1.20
Benina, 2014	Algeria	29.66	0.33	-
Mehanna, 2014	Egypt	27.24	0.54	-0.33
Soykan, 2015	Turkey	29.58	0.266	-1.14
Houria & Abdellatif, 2015	Algeria	30.0	0.11	-2.91
Kara & Bayhan, 2015	Turkey (♀)	30.79	0.243	-0.90
Kara & Bayhan, 2015	Turkey (♂)	29.87	0.266	-0.98
Layachi, 2015	Morocco	30.00	0.41	-0.30
Kherraz, 2016	Algeria (♀)	34.13	0.26	-1.50
Kherraz, 2016	Algeria (♂)	36.78	0.38	-0.75
A. Massaro, 2018	Canary Islands (♀)	32.3	0.44	-0.81
A. Massaro, 2018	Canary Islands (♂)	35.3	0.38	-0.80
Dahel, 2019	Algeria	32.03	0.28	-1.13
Azab *et al*., 2019	Egypt	30.65	0.279	-0.16
El Samman *et al*., 2022	Egypt	27.85	0.38	-0.443
Cengiz, 2022	Turkey	27.9	0.21	-1.57
Habil U. Koca, 2023	Turkey	37.50	0.15	-1.32
Mokbel *et al*., 2024	Egypt	24.15	0.34	-1.2916
Present study	Egypt	31.6	0.238	-1.473

CONCLUSION

In conclusion, this study provides updated insights into the biology and growth dynamics of *Boops boops* in the Egyptian Mediterranean waters. The species exhibits positive allometric growth and a defined spawning season peaking in March, with females reaching maturity at 14.2 cm. Growth parameters indicate moderate development, suggesting potential vulnerability to overfishing. These findings support the need for size- and season-based management measures to sustain this important local resource.

REFERENCES

Abdel-Rahman, M. (2003). Biological studies on fisheries of family Sparidae in Alexandria water (PhD thesis). Alexandria University.

Allam, S. M. (2003). Growth, mortality and yield per recruit of bogue, *Boops boops* (L.), from the Egyptian Mediterranean waters off Alexandria. *Mediterranean Marine Science, 4*(1), 87–96. https://doi.org/10.12681/mms.244

Anato, C. B.and Ktari, M. H. (1986). Age et croissance de *Boops boops* (Linné, 1758) poisson téléostéen Sparidaé des côtes tunisiennes. *Bulletin de l'Institut National Scientifique et Technique d'Océanographie et de Pêche, Salammbô, 13*(1), 33–54.

Andreu-Soler, A.; Oliva-Paterna, F. J. and Torralva, M. (2006). A review of length–weight relationships of fish from the Segura River basin (SE Iberian Peninsula). *Journal of Applied Ichthyology, 22*, 295–296.

Azab, A. M.; El-Far, A. M. and El-Sayed, A. M. (2019). Age, growth and population structure of bogue, *Boops boops*, in the Mediterranean waters front Alexandria, Egypt. *Egyptian Journal of Aquatic Biology & Fisheries, 23*(3), 69–81. https://doi.org/10.21608/ejabf.2019.35327

Benina, R.; Mouffok, S. and Boutiba, Z. (2014). Estimation of the exploitable biomass and the reference biological point, F0.1, of bogue *Boops boops* L., in the bay of Bou-Ismail, centre Algerian. *Journal of Biodiversity and Environmental Sciences, 5*(2), 420–427.

Campillo, A. (1992). Les pêcheries françaises de Méditerranée: Synthèse des connaissances. *Institut Français de Recherche pour l'Exploitation de la Mer*.

Cengiz, Ö. (2022). Some biological aspects and population status of the bogue, *Boops boops* (Linnaeus, 1758) caught by gillnets from the Egyptian Mediterranean waters off Alexandria. *Egyptian Journal of Aquatic Biology & Fisheries, 26*(6), 229–242. https://doi.org/10.21608/ejabf.2022.271923

Ceyhan, T.; Ertosluk, O.; Akyol, O. and Özgül, A. (2018). The maximum size of bogue, *Boops boops* (Perciformes: Sparidae) for the Mediterranean. *Acta Aquatica Turcica, 14*(4), 399–403.), 399–403.

Dahel, A.; Rachedi, M.; Tahri, M.; Benchikh, N.; Diaf, A. and Djebar, A. B. (2019). Fisheries status of the bogue *Boops boops* (Linnaeus, 1758) in the Algerian East Coast (Western Mediterranean Sea). *Egyptian Journal of Aquatic Biology & Fisheries, 23*(4), 577–589. https://doi.org/10.21608/ejabf.2019.60554

El-Agamy, A.; El-Okda, N. and El-Bokhty, E. B. E. (2004). Reproductive biology of *Boops boops* (Family Sparidae) in the Mediterranean environment. *Egyptian Journal of Aquatic Research, 30*(B), 241–254.

El-Bokhty, E. B. E.; Mehanna, S. F. (2023). Length-weight relationship, condition factor and length frequency distribution of the common sole Solea solea in Lake Manzalah, Egypt. *Egyptian Journal of Aquatic Biology & Fisheries, 27*(5), 749–758.

El-Haweet, A.; El-Okda, N. and El-Bokhty, E. B. E. (2005). Validation of length frequency analysis for *Boops boops* (Bogue) growth estimation. *Egyptian Journal of Aquatic Research, 31*(1), 399–408.

El-Maremie, H. and El-Mor, M. (2015). Feeding habits of the bogue, *Boops boops* (Linnaeus, 1758) in Benghazi Coast, Eastern Libya. *Journal of Life Sciences, 9*(5), 189–196. https://doi.org/10.17265/1934-7391/2015.05.001

El-Okda, N. (2008). Age and growth of *Boops boops* (L.) from Egyptian Mediterranean waters off Alexandria. *Egyptian Journal of Aquatic Biology & Fisheries, 12*(1), 13–23. https://doi.org/10.21608/ejabf.2008.1968

El Samman, A.; El-Okda, N. and El-Bokhty, E. B. E. (2022). Some biological aspects and population status of the bogue, *Boops boops* (Linnaeus, 1758) caught by gillnets from the Egyptian Mediterranean waters off Alexandria. *Egyptian Journal of Aquatic Biology & Fisheries, 26*(6), 229–242. https://doi.org/10.21608/ejabf.2022.271923

Follesa, M. C.; Agus, B.; Bellodi, A.; Cannas, R.; Capezzuto, F.; Casciaro, L.; Cau, A.; Cuccu, D.; Donnaloia, M.; Fernandez-Arcaya, U.; Gancitano, V.; Gaudio, P.; Marongiu, M. F.; Mulas, A.; Pesci, P.; Porcu, C.; Rossetti, I.; Sion, L.; Vallisneri, M.; & Carbonara, P. (2015). The MEDITS maturity scales as a useful tool for investigating the reproductive traits of key species in the Mediterranean Sea. *Scientia Marina, 83*, 235–256. https://doi.org/10.3989/scimar.04965.15a

Girardin, M. and Quignard, J. P. (1986). Growth of the *Boops boops* Linne, 1758 (Sparidae) in the Gulf of Lion. *Journal of Applied Ichthyology, 2*, 22–32.

Habil, U. K. (2023). Age, growth, and mortality of bogue (*Boops boops*, Linnaeus, 1758) from the Antalya Bay (Northwest Mediterranean Sea, Türkiye). *Israeli Journal of Aquaculture - Bamidgeh, 75*(2).

Houria, H. and Abdellatif, N. (2015). Growth and mortalities of *Boops boops* (Walbaum, 1792) in the Western Region of Algeria. *Journal of Fisheries International, 10*(4), 28–32.

Kara, A. and Bayhan, B. (2015). Age and growth of *Boops boops* (Linnaeus, 1758) in Izmir Bay, Aegean Sea, Turkey. *Journal of Applied Ichthyology, 31*(4), 620–626. https://doi.org/10.1111/jai.12680

Khemiri, S.; Gaamour, A.; Zylberberg, L.; Meunier, F. and Romdhane, M. S. (2005). Age and growth of bogue, *Boops boops*, in Tunisian waters. *Acta Adriatica, 46*(2), 159–175.

Kherraz, A.; Kherraz, A. and Boutiba, Z. (2016). Interrelationship between age and growth of *Boops boops* (Linnaeus, 1758) in Western Mediterranean coasts of Algeria. *Advances in Environmental Biology, 10*(4), 140–145.

Layachi, M.; Idrissi, M. H.; Ramdani, M.; Sahnouni, S. and Flower, R. (2015). Growth and reproduction of the bogue *Boops boops* L., 1758 in the Mediterranean coastal area between Nador and Sidia (Morocco). *Bulletin de l'Institut Scientifique, Rabat, Section Sciences de la Vie, 37*, 53–59.

Le Cren, C. D. (1951). The length-weight relationship and seasonal cycle in gonad weights and condition in the perch (Perca fluviatilis). *Journal of Animal Ecology, 20*, 201–219.

Massaro, A. (2012). Reproductive biology of *Boops boops* (Linnaeus, 1758) off Gran Canaria (Canary Islands): A preliminary study (Unpublished master's thesis). University of Las Palmas de Gran Canaria, Faculty of Marine Science.

Massaro, A. and Pajuelo, J. G. (2018). Life-history traits of seabream *Boops boops* (Linnaeus, 1758) in the Central Eastern Atlantic Ocean (Canary Islands). *African Journal of Marine Science, 40*(4), 423–437. https://doi.org/10.2989/1814232x.2018.1543133

Mehanna, S. (2014). Stock assessment of bogue, *Boops boops* (Linnaeus, 1758) from the Egyptian Mediterranean waters. In M. Behnassi (Ed.), *Vulnerability of agriculture, water and fisheries to climate change: Toward sustainable adaptation strategies* (pp. 313–322). Springer.

Mokbel, S. A.; Attia, S.; Abd Elnabi, H. E.; El Aiatt, A. and Khalid, D. K. (2024). Growth, mortality and yield per recruit of the bogue *Boops boops* (Linnaeus, 1758) from the Mediterranean coast, North Sinai, Egypt. *Egyptian Journal of Aquatic Biology & Fisheries, 28*(3), 693–707.

Monteiro, P.; Bentes, L.; Coelho, R.; Correia, C.; Gonçalves, J. M. S.; Lino, P. G.; Ribeiro, J. and Erzini, K. (2006). Age and growth, mortality, reproduction and relative yield per recruit of the bogue, *Boops boops* Linné, 1758 (Sparidae), from the Algarve (south of Portugal) longline fishery. *Journal of Applied Ichthyology, 22*(4), 345–352. https://doi.org/10.1111/j.1439-0426.2006.00756.x

Pauly, D. and Gayanilo, F. (1997). A Bee: An alternative approach to estimating the parameters of a length-weight relationship from length frequency samples and their bulk weights. *NAGA, The ICLARM Quarterly, 20*(4), 20–23.

Ramdane, Z.; Trilles, J. P.; Mahé, K. and Amara, R. (2013). Metazoan ectoparasites of two teleost fish, *Boops boops* (L.) and *Mullus barbatus* (L.) from Algerian coast: Diversity, parasitological index and impact of parasitism. *Cybium, 37*(1–2), 59–66.

Sokal, R. R. and Rohlf, F. J. (1969). *Biometry* Freeman and Company, San Francisco, Ca, pp 776.

Soykan, O.; İlkyaz, A. T.; Metin, G. and Kınacıgil, H. T. (2015). Growth and reproduction of *Boops boops*, *Dentex macrophthalamus*, *Diplodus vulgaris*, and *Pagellus acarne* from East-Central Aegean Sea, Turkey. *Acta Ichthyologica et Piscatoria, 45*(1), 39–55. https://doi.org/10.3750/aip2015.45.1.05

Tsangridis, A. and Filippousis, N. (1991). Use of length-frequency data in the estimation of growth parameters of three Mediterranean fish species: bogue (*Boops boops* L.), picarel (Spicara smaris L.) and horse mackerel (Trachurus trachurus L.). *Fisheries Research, 12*, 283–297.

Von Bertalanffy, L. (1938). A quantitative theory of organic growth. *Human Biology, 10*(2), 181–213.

Zúñiga, L. R. (1967). Estudio del crecimiento de *Boops boops* (L.) del Levante. *Investigación Pesquera, 31*(3), 383–418.