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**ON THE MAXIMUM LENGTH
FOR *SARDINELLA AURITA* (OSTEICHTHYES: CLUPEIDAE)
FROM THE MEDITERRANEAN SEA**

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Two specimens of round sardinella, *Sardinella aurita* Valenciennes, 1847, with a total length of 39.1 and 36.6 cm and a weight of 359.01 and 293.48 g, respectively, were caught by a purse seine net in Bouzedjar Bay, Algeria, on 8 August, 2019. These sizes of both specimens are the maximum recorded for this species in the Mediterranean Sea.

Keywords: round sardinella, *Sardinella aurita*, maximum size, measurements, Bouzedjar Bay, Algeria, Mediterranean Sea

Sardinella aurita Valenciennes, 1847 is a coastal, pelagic species preferring clear saline water with a maximum temperature below +24 °C (Bianchi et al., 1999). The species is distributed from in-shore and near surface to the shelf edge and down to 350 m in the Eastern Atlantic along African coast from Gibraltar to South Africa; in the Mediterranean Sea, but is rare in the Black Sea; and in Western Atlantic (Cape Cod to Argentina) including Bahamas, Antilles, Gulf of Mexico, and the Caribbean coast (Whitehead, 1985). It mainly feeds on zooplankton, especially copepods. Juveniles feed on phytoplankton (Bianchi et al., 1999). Gregarious; forms schools that migrate seasonally related to water temperature and richness in plankton. Growth is rapid, and young individuals can reach about 11 cm during their first year of life (Dahel et al., 2016). It breeds perhaps all year round; the breeding pattern is extremely complex, with two principal spawning periods in some areas linked to upwelling regimes off West Africa (Whitehead, 1985), while in Algerian waters one single period was noted June to October (Bouaziz, 2007). In the Black Sea, there is no spawning (Whitehead, 1984). Maturity occurs during the second year; batch fecundity is estimated at 9,397–176,712 eggs in Eastern Atlantic (Baali et al., 2021) and 11,680–40,348 eggs in central Algerian waters (Bouaziz, 2007). Maximum age of *S. aurita* is estimated in the range from 4.5 years in Congolese waters (Gheno, 1975) to 8 years on Brazilian coast (Richardson et al., 1960). It can be caught with purse and beach seines, lamparos, bottom gillnets, and bottom and pelagic trawls.

Herrings, sardines, and anchovies make up a major part of the total fish species landed in the Mediterranean Sea (44.3 %) and Black Sea (73.2 %) fisheries (FAO, 2020). For Algerian waters, *S. pilchardus* accounts for 59 %, and *S. aurita* accounts for 22 % of the total Algerian catch (DPRH, 2019). We have to mention that the third species, *Sardinella maderensis*, occurs in the fishing area and can easily be confused with two other sardines. Tous et al. (2015) noticed that landing statistics are not comprehensive due to inconsistent reporting of landings, and *S. aurita* catches are often mixed with *S. maderensis* ones.

MATERIAL AND METHODS

On 8 August, 2019, two large Clupeidae specimens were caught by a seiner at 100-m depth in Bouzedjar Bay ($35^{\circ}34'24.0''\text{N}$, $1^{\circ}09'58.9''\text{W}$) on the western Algerian coast. FAO identification sheets (Whitehead, 1985) were used to identify the specimens as *Sardinella aurita* (Fig. 1). Counts and proportional measurements were carried out using a caliper to the nearest 0.01 mm. Twelve morphometric characteristics were measured (Table 1).



Fig. 1. General view of two *Sardinella aurita* specimens, total length of 39.10 cm and 36.57 cm, caught in Bouzedjar Bay (the Mediterranean Sea)

Рис. 1. Общий вид двух особей *Sardinella aurita*, общая длина 39,10 см и 36,57 см, пойманных в заливе Бузеджар (Средиземное море)

RESULTS AND DISCUSSION

Data on morphometric measurements of the specimens studied are shown in Table 1.

The maximal length ever recorded for *S. aurita* was 41 cm for fish caught on the Mauritanian shelf of the Eastern Atlantic (Thuoc & Szygula, 1973) (Table 2). For the Mediterranean basin, it was stated as follows: this Clupeidae could attain 33 cm, with a common length between 15 and 25 cm (Fischer et al., 1987). The largest known *S. aurita* specimen in the Mediterranean Sea, measuring 36 cm, was caught in Greek waters (Moutopoulos et al., 2013). We found two *S. aurita* specimens in purse seine catches from Algerian waters, making this observation a new record for both Algerian and Mediterranean waters and the second one after reported from Eastern Atlantic.

Maximal length of *S. aurita* varied 19.7 to 27.0 cm in the Western Atlantic, 30 to 41 cm in the Eastern Atlantic, and 25.5 to 39.1 cm in the Mediterranean basin. The differences in the maximum length observed can be attributed to environmental conditions and fishing pressure. Helfman et al. (2009) stated that individuals from populations exposed to high fisheries mortality/pressure will respond by reproducing at reduced average sizes and ages. Our specimens demonstrated that this species can grow beyond maximum length data available in literature despite the fact that the specimens were caught in such an important fishing activity area as Bouzedjar Bay (Bensahla-Talet et al., 2019).

Environmental factors, such as temperature, food availability, nutrient availability, light regime, oxygen, salinity, pollutants, current speed, predator density, intraspecific social interactions, and genetics, are also known to affect growth rates and maximum size (Helfman et al., 2009), but in our case

two specimens sampled are insufficient to link these environmental factors to the largest length observed. Nevertheless, it is to be added that producing large specimens is due to the richness of Algerian waters generated by Algerian current which is considered to be the most energetic in the Mediterranean basin (Salas et al., 2001). The entrance of Atlantic waters through the Strait of Gibraltar generates important upwellings, enhancing the development of plankton first link of the aquatic food web (Bensahla-Talet et al., 2017), and primary production reveals a west–east decreasing trend (Bosc et al., 2004 ; Siokou-Frangou et al., 2010).

Table 1. Morphometric measurements of *Sardinella aurita* caught in Bouzedjar Bay (the Mediterranean Sea)

Таблица 1. Морфометрические измерения *Sardinella aurita*, выловленной в заливе Бузеджар (Средиземное море)

Morphometric characteristic, cm	Specimen 1	% of TL	Specimen 2	% of TL
Total length (TL)	39.10	100.00	36.57	100.00
Fork length	34.51	88.27	31.88	87.18
Standard length	33.68	86.13	31.13	85.12
Pre-orbital length	1.67	4.26	1.62	4.43
Eye diameter	1.53	3.92	1.42	3.88
Post-orbital length	3.99	10.20	3.45	9.43
Head length	7.16	18.31	6.45	17.64
Dorsal fin length	4.92	12.58	4.24	11.59
Anal fin length	3.77	9.65	3.66	10.01
Pectoral fin length	5.09	13.02	4.78	13.07
Minimum body height	2.27	5.81	2.20	6.01
Maximum body height	6.81	17.42	6.72	18.38
Total weight, g	359.01	–	293.48	–

Table 2. Maximum length of *Sardinella aurita* in the Western and Eastern Atlantic and Mediterranean Sea given by several authors

Таблица 2. Максимальная длина *Sardinella aurita* в Западной и Восточной Атлантике и в Средиземном море по данным нескольких авторов

Location		TL, cm	References	
Western Atlantic	USA	Gulf of Mexico	19.7	Johnson & Johnson, 1986
	Venezuela	Northeastern	26.6	Barrios et al., 2010
		–	27	Fréon & Mendoza, 2003
Eastern Atlantic	Morocco	Dakhla	35.5	Amenzoui & Baali, 2018
	Mauritania	Rio de Oro – Cap Verde	41	Thuoc & Szypula, 1973
	Senegal	Port Kafoutine – St Louis	37	Baldé, 2019
	Côte d'Ivoire	Côte d'Ivoire shelf	30	Marchal, 1993
Mediterranean Sea	Mediterranean	–	33	Fischer et al., 1987
	Egypt	Alexandria	26	Akel, 2009
	Turkey	Izmir Bay	28.5	Bayhan & Kara, 2012
	Greece	Corinthians Gulf	36	Moutopoulos et al., 2013
	Algeria	Bou Ismaïl Bay	31	Bouaziz, 2007
Eastern Algeria		25.5	Dahel et al., 2016	
Bouzedjar Bay		39.1	Present study	

Maximum length, weight, and age are the key indicators used in fisheries science. These data are applied in most models for stock assessment. Therefore, updating maximum length of an exploited species is important, and our results could constitute a starting point for further studies on factors that affect growth and/or longevity of other species.

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**О МАКСИМАЛЬНОЙ ДЛИНЕ
SARDINELLA AURITA (OSTEICHTHYES: CLUPEIDAE)
ИЗ СРЕДИЗЕМНОГО МОРЯ**

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Два экземпляра круглой сардины *Sardinella aurita* Valenciennes, 1847, общей длиной 39,1 и 36,6 см и весом 359,01 и 293,48 г соответственно, были пойманы кошельковой неводной сетью в заливе Бузеджар (Алжир) 08 августа 2019 г. Данные размеры обоих экземпляров являются максимальными для этого вида в Средиземном море.

Ключевые слова: круглая сардина, *Sardinella aurita*, максимальный размер, измерения, залив Бузеджар, Алжир, Средиземное море