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Research article

A new maximum size record for red porgy, *Pagrus pagrus* (Linnaeus, 1758) in the North Aegean Sea, Mediterranean

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Abstract: On December 14, 2023, a single specimen of red porgy, *Pagrus pagrus*, was caught around the North Aegean Sea. The sex, total length, total weight, and age of the male individual were determined as 74.5 cm, 8560 g, and 20 years-old, respectively. This individual represents the second maximum length record and the first maximum weight record in the world and the biggest size record for all Mediterraneans.

Keywords: Red porgy, maximum length, North Aegean Sea, maximum weight

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Introduction

Red porgy, *Pagrus pagrus* (Linnaeus, 1758), is a marine benthopelagic fish species that usually ranges at depths below 250 m and finds mostly rocky and rubbled areas. The young of the years mostly have shallower distribution on sandy and seagrass beds. It has a great geographical distribution of subtropical waters from the Eastern Atlantic, including the Mediterranean, to the Western Atlantic, including the Caribbeaan Sea (Robins & Ray, 1986; Cervigón, 1993). *Pagrus pagrus* is one of the 23 species of family Sparidae identified in Turkish waters, which distribute all seas except from the Black Sea (Bilecenoğlu et al., 2014). It is one the most economical fish species among family members in Turkish waters. By 2023, the average price for selling is 15 Euros (equivalent to 500 Turkish Liras) per kilogram.

Its high economic value, it attracts especially small-scale fishermen attention, who mostly catch it with longlines, baited deep-water handlines, or silicone fishing lures. It usually cannot be caught using trawls, seine nets and gillnets as it is found mainly on rocky substrates. Due to its habitat preferences, it usually feeds on crustaceans, fish, and mollusks (Bauchot & Hureau, 1990).

Previous studies related to the population biology of the wild stocks of *P. pagrus* are scarce. Some works were conducted around the Caroline coasts of the Western Atlantic (Manooch, 1976; Manooch & Huntsman, 1977; Manooch & Hassler, 1978), north-western coasts of Africa (Alekseev, 1983), and Kastellorizo island in the Southern Aegean Sea (Vassilopoulou & Papaconstantinou, 1992). The common length of *P. pagrus* is stated as 35 cm SL (Bauchot & Hureau, 1990). The maximum length recorded was 91 cm TL in the Indo-Pasific region (Lieske & Myers, 1994). According to the International Game Fish Association, the maximum

weight was recorded at 7.72 kg in Gibraltar on July 12, 1997 (IGFA, 2001).

This study presents the second maximum length record for all regions of the world, the maximum length record for the Mediterranean, and the maximum weight record for all regions of the world in the scientific literature.

Matherial and Methods

On December 14, 2023, a single specimen of *P. pagrus* was caught around the North Aegean Sea (39°39.486′ N and 25°47.879′ E) (Figure 1) with a demersal handline, 3/0 straight shank hook, and a silicone fishing rule (Figure 2). The specimen was caught over the shelf break of the continental slope at a depth of 96 m. Due to the high economical value, the specimen could not be preserved, whereas some measurements (TL, FL, body girth, and body weight) and some biological information (get scales for age determination, view gonads for sex and sexual maturity determination) were obtained just before it was sold in the fish market. Sex and the 5-staged maturity scale (Holden & Raitt, 1974) were determined by macroscopic observation of individual's gonad. The age was determined from the ctenoid scales of the individual due to annuli formation expressed as more accurate than otoliths (Machias et al., 1998). Scales from the back of the pectoral fin were removed, cleaned, rinsed, dried, and annuli growth rings interpreted.

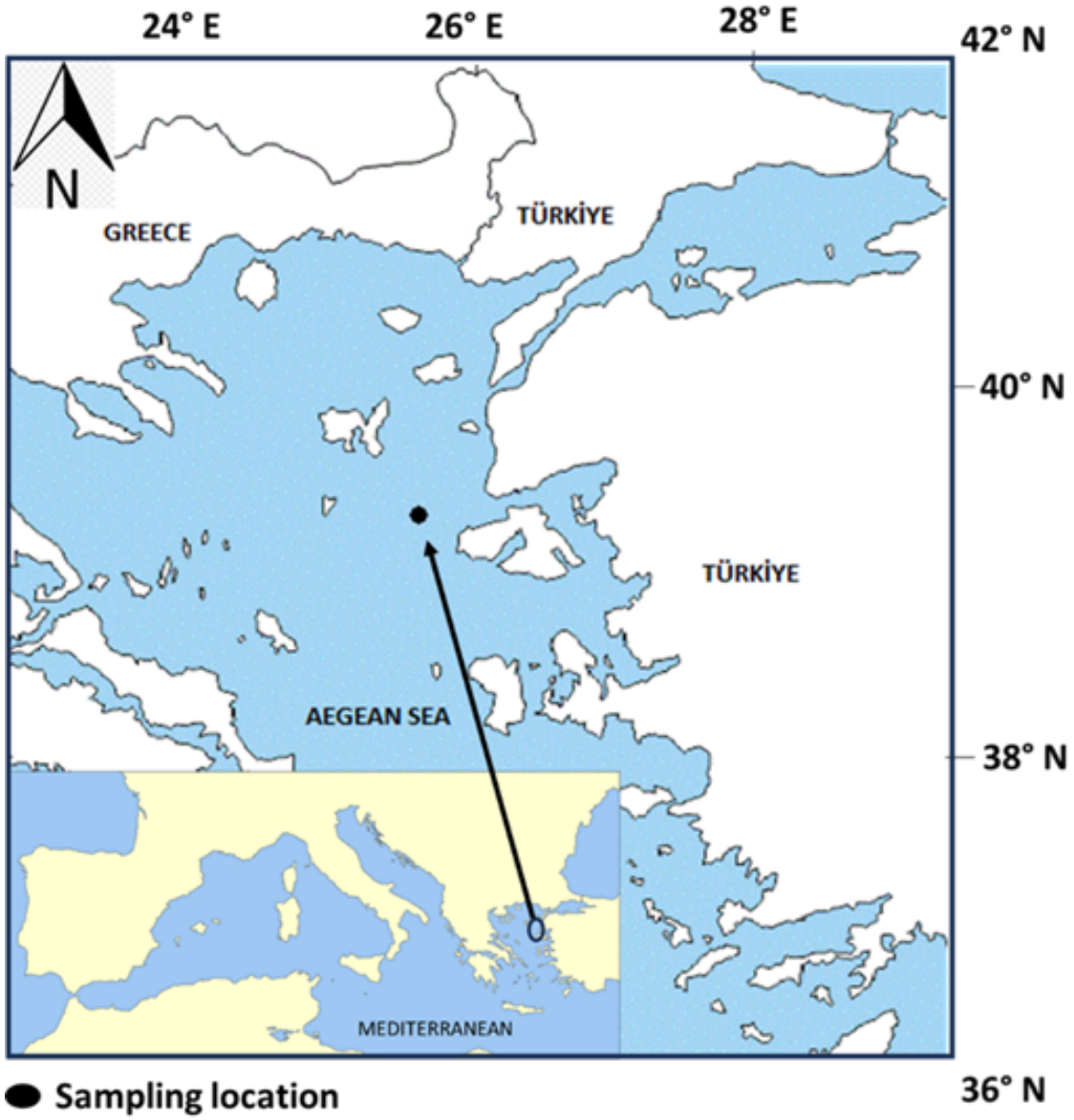

Figure 1. Sampling location of red porgy, *Pagrus pagrus* in the North Aegean Sea

Figure 2. Silicone fishing rule donated 3/0 straight shank hook

Results

The TL, FL, SL, and total weight of the individual were measured at 74.5 cm, 69.5 cm, 65.7 cm and 8560 g, respectively (Figure 3, 4). The body girth and the maximum body height were detected at 63.7 cm and 23.9 cm, respectively. The detailed morphometric measurements are given in Table 1. According to the annual age rings on the ctenoid scale, the age of the individual is estimated at 20 years old (Figure 5). The sex was determined to be male and macroscophic observation of the gonad showed the maturity stage as a maturing stage in the 2nd phase (Figure 6).

Table 1. Morphological measurements and meristic counts of red porgy, *Pagrus pagrus* in the North Aegean Sea

Morphometric characteristics	**Measurement (cm)**
Total Length	74.5
Fork Length	69.5
Standard Length	65.7
Maximum Body Height	23.9
Eye Diameter	2.9
Pre-dorsal Length	21.5
Pre-anal Length	43.5
Body-girth	63.7
Meristic characteristics	**Count #**
Dorsal Fin Rays	XIII+10
Anal Fin Rays	III+7
Scale on Lateral Line	54
Age of Individual Based on Scale	20
Body weight	**Total weigth (g)**
Total body weight	8560

Figure 4. The total weight of the red porgy, *Pagrus pagrus* in the North Aegean Sea (the maximum record of the world)

Figure 3. The body measurements of red porgy, *Pagrus pagrus* in the North Aegean Sea (A: Body girth; B: Total Length; C: Maximum body height)

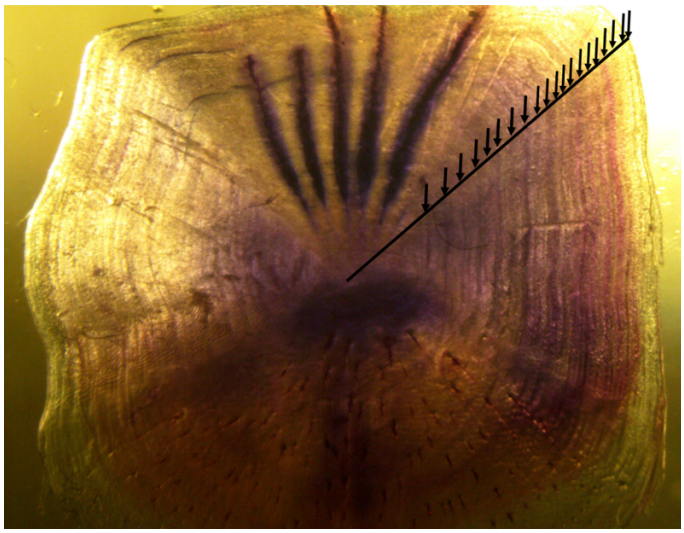

Figure 5. Ctenoid scale image of red porgy *Pagrus pagrus* and annual increaments

Figure 6. The maturing stage male gonad of the of the red porgy, *Pagrus pagrus* individual

Discussion

The Aegean Sea is defined as having oligotrophic and unproductive characteristics due to its high saline and temperate waters. Whereas the northeastern part of the Aegean Sea differs due to the vicinity of the Çanakkale Strait, which carries nutrient-rich, less temperate and saline waters of the Black Sea flow. Thus, the area becomes enriched with mesotrophic Black Sea water, and the high primary production enable to enhances the biodiversity of the area (Somarakis et al., 2002; Isari et al., 2011; Daban & İşmen, 2020). Beside its high biodiversity, the area has a sudden deepening continental shelf and mostly has rocky demersal areas due to mountains running perpendicular to the sea. Hence, the area becomes favorable for fish species, which are distribute mostly between rocky areas, such as red porgy. Although the area has relatively intensive fishing pressure from demersal trawl and seine net fisheries, these rocky areas create protection areas for some fish species. According to Daban & İşmen (2020), İşmen et al. (2013), and Ayyıldız et al. (2020), it was understood that red porgy constituted successful spawning stock in the Northern Aegean Sea due to both larvae and mature individuals observed. As far as the authors know, the given length record of 74.5 cm TL constitutes the second maximum length record after 91.0 cm TL in the Red Sea (Lieske & Myers, 1994) in the world and the maximum length record for the remaining areas (Table 2). Additionally, individual was weighted as a 8.560 g, which is the maximum weight record of the species in the world. These reasons explain why the world's largest individual is seen in this region.

The length-weight relationship studies and growth studies revealed a low somatic growth rate of red porgy in the Western Atlantic. As can be seen in Table 2, although the TL of individuals was close, the weight values were relatively lower (Potts & Manooch, 2002; Haimovici & Velasco; 2000, Costa et al., 2021). It can be related to several aspects, such as more suitable conditions of seawater physico-chemical conditions, favorable habitat structure, feeding conditions, predation, and competition.

Table 2. Comparison of maximum length and weight records of *Pagrus pagrus*

Author	Study Area	Length (cm)	Weight (g)
İşmen et al. (2013)	Northeastern Aegean Sea	44.4 TL	1372
Ayyıldız et al. (2020)	Northeastern Aegean Sea	50.0 TL	*
Costa et al. (2021)	Southeastern Brazil	50.0 TL	3625
Moutopoulos & Stergiou (2002)	Aegean Sea	51.7 TL	*
Crec'hriou et al. (2013)	French Catalan Coast	52.0 TL	2815
Pajuelo & Lorenzo (1996)	Canary Islands	57.2 TL	3358
Haimovici & Velasco (2000)	Southeastern Brazil	60.5 TL	3630
Serafim & Krug (1995)	Azorean waters	63.0 FL	*
Rosa et al. (2006)	Azores Archipelago	66.0 FL	6020
Potts & Manooch (2002)	Southeastern USA	73.3 TL	5895
IGFA (2001)	Gibraltar	*	7720
Lieske & Myers (1994)	Red Sea	91.0 TL	*
Present study	Northeastern Aegean Sea	74.5 TL	8560

The spawning season of the red porgy shows differences between areas. It spawns in winter period in the Western Atlantic (Hood & Johnson, 2000), between October and January and peaked in November when the sea surface temperature was 17.8°C (Costa et al., 2021) ranged from December to May, and peaked in February and March, when the SST ranged from 18 to 20°C in the Canary Islands (Pajuelo & Lorenzo, 1996). Pajuelo and Lorenzo (1996) stated that the optimum SST for the spawning of *P. pagrus* should ranged from 16 to 22°C. Also, spawning occurred between spring and early summer in the Kastellorizo island, Southern Aegean Sea, Eastern Mediterranean (Vassilopoulou and Papaconstantinou, 1992). Beside Daban & İşmen (2020) found postlarvae of *P. pagrus* on May 18 around Gökçeada Island, North-eastern Aegean Sea, Eastern Mediterranean, when the SST was 17.8°C.

This information confirm the 2nd stage development phase of the male gonad examined in this study due to it being caught in December when the SST was 15.4°C. It would probably have spawned between May and June in the sampling area if it hadn't been caught.

Protogynous hermaphroditism is identified for red porgy, and it is stated that individuals larger than 44.0 cm TL were male individuals (Vassilopoulou & Papaconstantinou, 1992). Protogynous hermaphroditism was also detected by Kokokiris et al. (1999), where sex reversal was detected from female to male in some 5-6 year old individuals. Based on the maximum size of the presented individual, we can infer that the sex of protogynous hermaphroditic fish species is male. The macroscobic observation of the gonad has proved this.

The age of the red porgy individual is estimated at 20 years old for a 74.5 cm TL, according to the count of annual rings on the scale. In previous studies, age was determined as a 12 years old for 48.8 cm TL in the Southern Brazil, as a 12 years old for 49 cm FL in the Hellenic Seas (Stergiou et al., 1997) , as a 12 years old for 50 cm TL in the North Aegean Sea (Ayyıldız et al., 2020), as a 13 years old for 63 cm FL in the Azorean Sea (Serafim & Krug, 1995), as a 13 years old for 40.4 cm TL in the Kastellorizo Island, Aegean Sea (Vassilopoulou & Papaconstantinou, 1992), as a 17 years old for 48.9 cm TL in the Gulf of Mexico (Hood &Johnson, 2000), as a 18 years old for a 73.3 cm TL in the Southern USA (Potts & Manooch, 2002), and as a 21 years old for from the scales and 26 years old from the otoliths of the same individual of 60.5 cm TL in the Southern Brazil (Haimovici et al., 2020). When the age-length distributions of the previous studies were revealed and compared, the estimated age of the present individual was consistent.

The detection of the largest-sized individuals in the stocks was closely related to some factors, such as fishing method and habitat type. Pope et al. (2005) stated that the size-selective fishing gears cannot be effective in detecting the maximum size of fish species. The size-selective fishing gear should be eliminated for smaller individuals rather than the largest sizes. Thus, we thought that habitat and related bottom structure, such as rocky areas, should be more effective parameters for the coincidence of the largest sized fish species due to preventing the operation of fishing gear that causes intense fishing pressure, such as trawls and purse seines. The largest individual presented in this study was caught with a silicone fishing rule and a 3/0 straight shank hook on the rocky areas. This finding supports the hypothesis that the fishing rules can be used to detect the largest-sized individuals in the fish stock. Also, geographical differences and ecological conditions were stated as the effective parameters for the occurrence of these individuals (Helfman et al., 2009; Geldiay & Kocataş, 2012; Paruğ & Cengiz, 2020). The maximum size records should be valuable outputs to examine the theoretical maximal length estimation of the evaluated species in the same area. Furthermore, the maximum size information can give valuable data on life span, fecundity, and developing length-based models.

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Ethical Approval

A fisherman took the sample. Therefore, there is no need to etichal approve.

Conflicts of Interest

The author declares that he has no conflict of interest.

Funding Statement

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