

Article

Growth, Condition, and Age Structure of *Pagellus erythrinus* (Linnaeus, 1758) in the Elafiti Archipelago Area (Southern Adriatic): A Winter Baseline

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Abstract

Biological parameters of *Pagellus erythrinus* (Linnaeus, 1758) (common pandora) were determined from 252 specimens collected in the southern Adriatic Sea during November–December 2025 using a research vessel equipped with a bottom trawl. Total length ranged from 11.0 to 26.0 cm (mean $\pm$ SD: 18.63 ± 3.15 cm) and total weight from 20.5 to 208.0 g (mean $\pm$ SD: 84.67 ± 39.66 g). The length–weight relationship was described by $TW = 0.029283 \times TL^{2.7007}$ ($R^2 = 0.949$), with the allometric exponent $b = 2.7007$ (95% CI: 2.6228–2.7787) significantly below 3 ($t = -7.565$, $p < 0.001$), indicating negative allometric growth. Mean Fulton’s condition factor was $K = 1.235 \pm 0.155$ and mean relative condition factor $K_n = 1.006 \pm 0.110$. Body height and body width both scaled linearly with total length ($R^2 = 0.884$ and $R^2 = 0.732$, respectively). Six age classes were identified from sagittal otolith readings (ages 1–6 years), with age class 3 being dominant (46.4%). With L_∞ fixed at 30.0 cm, von Bertalanffy growth parameters were estimated as $K = 0.2296 \text{ year}^{-1}$ and $t_0 = -1.566$ years (95% CI: -2.209 – -0.922 ; $R^2 = 0.979$), with growth performance index $\phi' = 2.315$ and an estimated maximum lifespan of 11.5 years. The results are comparable to eastern Mediterranean *P. erythrinus* stocks and provide a preliminary winter biological baseline for this species from the southern Adriatic. These parameters can serve as inputs for future regional stock assessments and long-term monitoring, and allow for comparison with published Mediterranean and Adriatic populations within the context of the well-documented west-to-east productivity gradient. All results reflect winter sampling conditions and should be interpreted accordingly.

Keywords: common pandora; Sparidae; age structure; growth; population biology; Elafiti archipelago; southern Adriatic



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1. Introduction

Pagellus erythrinus (Linnaeus, 1758), commonly known as common pandora, is a demersal species of the family Sparidae, distributed across the eastern Atlantic and throughout the Mediterranean and Black Seas [1]. It inhabits sandy and muddy–sandy bottoms between 20 and 200 m depth, occasionally reaching up to 300 m, and is most abundant in the upper continental shelf [2,3]. The species is a protogynous hermaphrodite whose transition from female to male in Mediterranean populations typically occurs at around 17–18 cm

total length [4,5]. Its diet primarily consists of decapod crustaceans, bivalves, polychaetes, and small teleosts [6].

The population biology of *P. erythrinus* has been researched across a wide geographic range, from the Canary Islands [7] through the western Mediterranean [8,9], to the Aegean Sea [5,10,11], the eastern Mediterranean [12,13], and the Black Sea region [1]. These studies have shown considerable variability in growth parameters, length–weight relationships, condition indices, and mortality rates, broadly consistent with the west-to-east gradient of declining primary productivity across the Mediterranean basin [14,15].

In the Adriatic Sea, *P. erythrinus* is distributed along the entire eastern coastline, including the Dalmatian island region [16]. Given the commercial importance of *P. erythrinus* in Croatian fisheries, with relatively stable annual landings of approximately 60 t in recent years [17], understanding the local population structure and growth dynamics is essential for regional stock assessment and management.

The earliest scientific research on *P. erythrinus* in the Adriatic is the foundational studies by Zupanović and Rijavec [4,8], who characterised growth and population dynamics in the central Adriatic insular. Šantić et al. [6,9] subsequently described diet composition and biometric properties from the broader eastern Adriatic, while Milošević et al. [18] characterised the otolith biometry of *P. erythrinus* from Montenegrin coastal waters. Joksimović et al. [19] investigated trawl codend selectivity for *P. erythrinus* on the Montenegrin shelf, reporting growth parameters derived from an unpublished thesis, which served as the only available growth estimate for the adjacent southern Adriatic prior to this study. Length–weight relationships for eastern Adriatic *P. erythrinus* have previously been reported from Croatian coastal waters [20] and from a broader eastern Adriatic dataset [21], though both drew on coastal and littoral sampling rather than demersal trawl surveys, and neither covered the southern Adriatic specifically. However, none of these studies provided a simultaneous characterisation of the growth parameters, age structure, or body condition of *P. erythrinus* from the southern Adriatic, a hydrographically distinct sub-basin with different productivity regimes and benthic habitat characteristics compared to the central basin [22].

This study assesses the current biological status of *P. erythrinus* in the southern Adriatic and compares key population parameters with those reported for other Adriatic and Mediterranean populations. Such comparisons are essential for placing regional findings within a broader geographical context, particularly given that population parameters are inherently dynamic and influenced by fishing pressure, environmental variability, and climate-driven changes in productivity. Accordingly, the integration of both historical and recent data provides a robust framework for capturing this variability and establishes a baseline for future monitoring of the species in the southern Adriatic.

2. Materials and Methods

2.1. Study Area and Sample Collection

Sampling was conducted in the southern Adriatic Sea in the area of Lopud and Šipan Islands (Elafiti archipelago) during November–December 2025, using a research vessel equipped with a modified demersal otter trawl with 60 mm mesh wings (12.5 m length, 100 meshes height) and a codend composed of 26 mm diamond mesh and a 22 mm square mesh panel, with additional lower panel mesh sizes of 20–24 mm. Samples were collected during three field surveys, each consisting of three 30 min bottom-trawl hauls, for a total of nine hauls. The 252 specimens of *P. erythrinus* were collected from all nine hauls at depths of approximately 50 m. The same three trawl positions were repeated across each field survey: haul location 1 (off Lopud Island): 42°41′02.4″ N, 17°58′09.8″ E to 42°41′56.1″ N, 17°56′57.2″ E; haul location 2 (off Šipan Island): 42°43′12.1″ N, 17°55′12.9″ E

to 42°44'00.1" N, 17°53'54.0" E; haul location 3 (off Šipan Island): 42°44'12.2" N, 17°54'21.9" E to 42°43'27.2" N, 17°55'37.1" E. Each haul lasted 30 min at 2.5–3 knots; bottom water temperature at sampling was 12 °C (Figure 1).

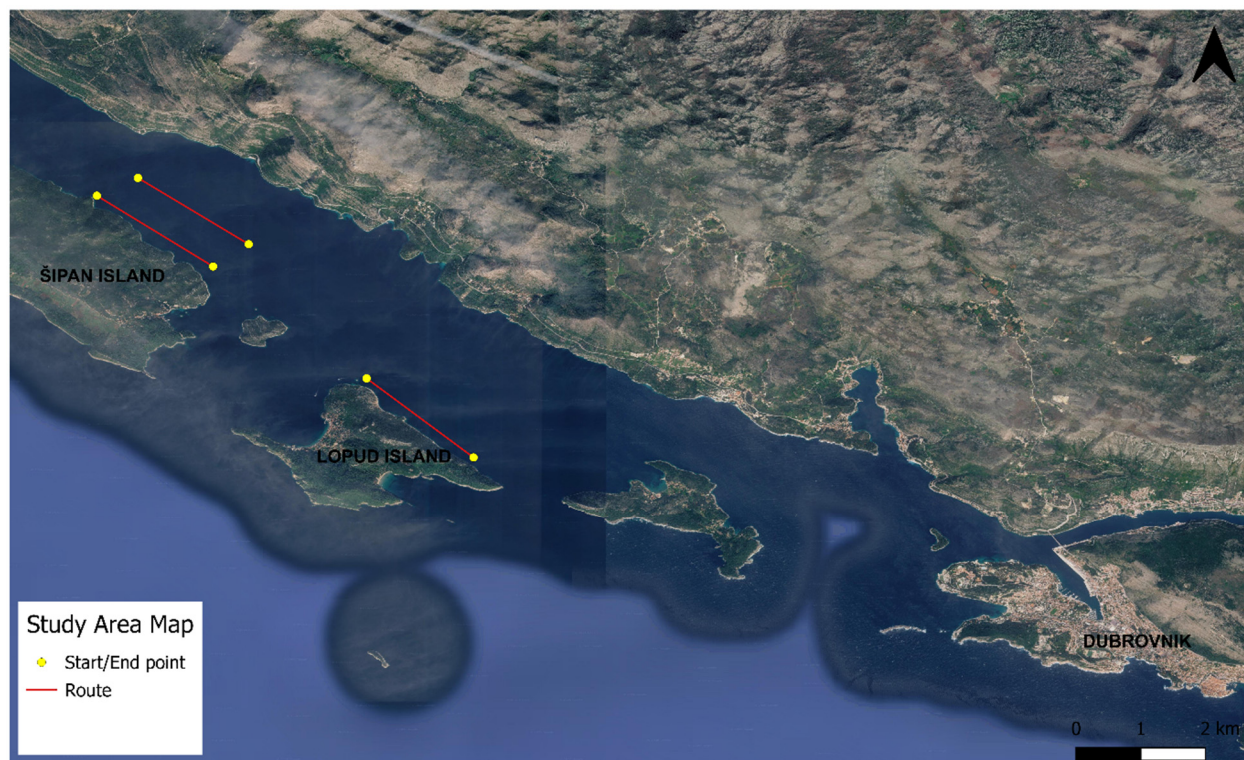


Figure 1. Study Area Map.

Specimens were transported on ice and processed in the laboratory within 24 h. For each individual, total length (TL) was measured to the nearest 0.1 cm, body height (H) and body width (W) to the nearest 0.1 mm with a digital calliper, and total weight (TW) to the nearest 0.1 g on a precision balance Tehnica ET-1111 (Tehnica, Železniki, Slovenia). Sagittal otoliths were extracted from the otic capsule via the gill cavity, rinsed with distilled water, dried, and stored in individually labelled paper envelopes. Prior to age-reading, otoliths were polished with progressively finer sandpaper (400, 600, and 1000 grit).

2.2. Length–Weight Relationship

The length–weight relationship (LWR) was estimated using the allometric power function:

$$TW = a \times TL^b$$

where TW is total weight (g), TL is total length (cm), a is the intercept coefficient, and b is the allometric exponent [13]. Parameters were estimated by linear regression on log-transformed data. The 95% confidence interval for b was derived from the standard error of the slope. Departure from isometric growth ($H_0: b = 3$) was tested with a Student's t -test; values below 3 indicate negative allometry and values above 3 indicate positive allometry [13]. Statistical significance was set at $\alpha = 0.05$.

2.3. Condition Factors

Fulton's condition factor (K) was calculated for each specimen as $K = (TW/TL^3) \times 100$, following Fulton [23] and as described by Froese [13]. Le Cren's relative condition factor (K_n) was calculated as $K_n = TW/TW^*$, where TW^* is the predicted weight at a given TL,

derived from the LWR of the present study [24]. Both indices were calculated per individual and summarised by a 2 cm length class.

2.4. Body Morphometrics

Relationships between TL and body height (TL-H) and between TL and body width (TL-W) were described by simple linear regression. Relative body depth (H/TL) and relative body width (W/TL) were calculated per specimen to characterise body form and assess whether proportions change systematically with length.

2.5. Age Determination

Age was determined from polished sagittal otoliths examined under a stereomicroscope (Leica Wild Heerbrugg Type 325400, Wild Heerbrugg AG, Heerbrugg, Switzerland) at [6×] magnification using both transmitted and reflected light. Otoliths were immersed in glycerol prior to examination to enhance the contrast between opaque and hyaline zones [25]. An annulus was defined as one complete opaque–hyaline zone pair, following Carbonara and Follesa [26]. Otolith edge type was recorded to verify annulus completion, but fractional ages were not assigned due to the winter-only sampling period. Otolith edge type (opaque or translucent) was recorded for each specimen at the time of reading. All specimens were collected during November–December, corresponding to the second half of the annual growth cycle for *P. erythrinus* (birth date: 1 July). During this period, otoliths consistently displayed opaque edges, indicating that the translucent winter ring had not yet begun to form. Following the standard ageing scheme for species with a 1 July birth date [26], age was assigned as N (number of translucent rings) without half-year adjustment, confirming that assigned ages are unambiguous for the sampling period.

Potential false rings were distinguished from true annuli by: (i) verifying ring continuity along at least two transects; (ii) alternating between transmitted and reflected light to confirm opaque–hyaline alternation; (iii) comparing increment width ratios between successive zones; and (iv) cross-referencing assigned age against expected mean length-at-age values [25–27]. All otoliths were read independently by two readers, and discrepancies were resolved by joint re-examination. Readers were blind to fish length during independent readings. Reading precision was assessed using the average percent error (APE) and coefficient of variation (CV), following Campana [27], as $APE = (1/N) \times \Sigma[(1/R) \times \Sigma(|X_{ij} - \bar{X}_i/\bar{X}_i|)] \times 100$ and $CV = [\sqrt{(\Sigma(X_{ij} - \bar{X}_i)^2/(R - 1))/\bar{X}_i}] \times 100$ where N is the number of fish aged, R is the number of readers, X_{ij} is the age estimate by reader j for fish i, and $\bar{X}_i$ the mean age estimate for fish i.

2.6. Growth Parameters

Individual growth was described using the von Bertalanffy growth function (VBGF) [28]:

$$L_t = L_{\infty} \times (1 - e^{-K(t - t_0)})$$

where L_t is predicted total length (cm) at age t (years), L_{∞} is asymptotic length (cm), K is the growth coefficient (year^{-1}), and t_0 is the theoretical age at zero length (years). Parameters were estimated by fitting the VBGF to mean length-at-age data using nonlinear least-squares regression [3]; fit quality was assessed by R^2 . Attempts to fit the VBGF to individual observations resulted in a singular gradient error during nonlinear optimisation, most likely due to the strong imbalance among age classes. For this reason, the model was fitted to mean length-at-age data, following the approach adopted by Somarakis and Machias [3]. Given that fitting a three-parameter model to six mean data points produced unreliable parameter uncertainty estimates (wide confidence intervals including biologically impossible values), L_{∞} was fixed to 30.0 cm following Rijavec (1975, cited

in [4]), the closest independent southern Adriatic estimate, and K and t_0 were estimated by nonlinear least-squares regression. This two-parameter formulation is more appropriate given the limited number of age classes available. The 95% confidence intervals were derived as $\pm 1.96 \times \text{SE}$ from the nonlinear fit.

The growth performance index ϕ' was computed as $\phi' = \log(K) + 2 \times \log(L_\infty)$, following Munro and Pauly [29], and maximum lifespan as $t_{\max} = t_0 + 3/K$, following Taylor [30].

2.7. Statistical Analysis

All analyses were performed in R (version 4.5.3) [31] with the packages readxl [32], ggplot2 [33], FSA [34], dplyr [35] and patchwork [36]. Statistical significance was set at $\alpha = 0.05$ throughout. Given that all sampling was conducted during a single season (winter), the biological parameters reported here should be understood as a winter baseline; seasonal variability in condition, growth, and body composition cannot be assessed from this dataset.

3. Results

3.1. Sample Characteristics and Length–Weight Relationship

A total of 252 specimens were examined. TL ranged from 11.0 to 26.0 cm (mean $\pm$ SD: 18.63 ± 3.15 cm) and TW from 20.5 to 208.0 g (mean $\pm$ SD: 84.67 ± 39.66 g). The length frequency distribution was unimodal, peaking at 17–18 cm (Figure 2).

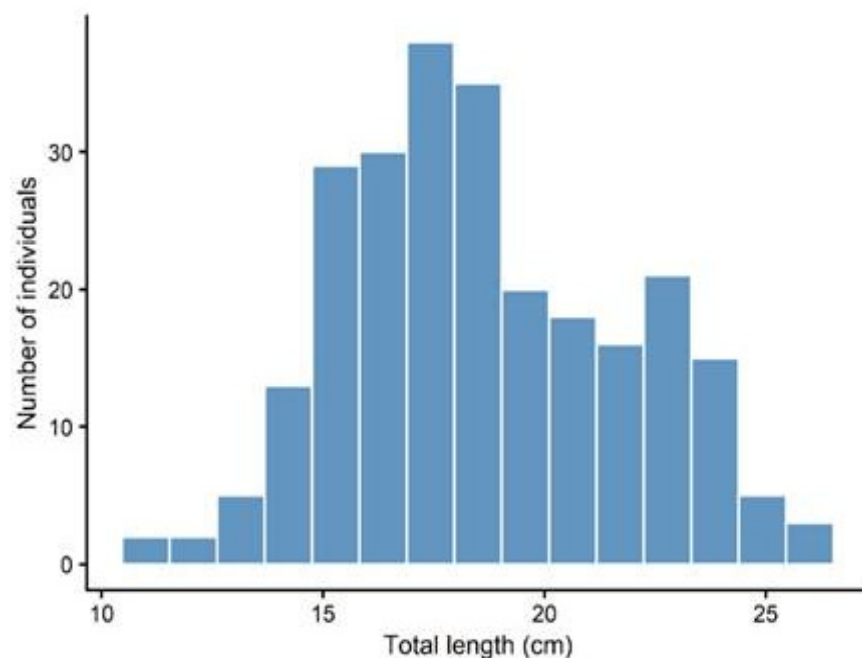


Figure 2. Length frequency distribution of *Pagellus erythrinus* from the South Adriatic ($n = 252$).

The LWR was described by $TW = 0.029283 \times TL^{2.7007}$ ($R^2 = 0.949$).

The allometric exponent $b = 2.7007$ (95% CI: 2.6228–2.7787) was significantly lower than 3 ($t = -7.565$, $p < 0.001$), indicating negative allometric growth (Figure 3).

3.2. Condition Factors

Fulton's K ranged from 0.823 to 1.985 (mean $\pm$ SD: 1.235 ± 0.155). Le Cren's K_n ranged from 0.687 to 1.426 (mean $\pm$ SD: 1.006 ± 0.110) (Figure 4).

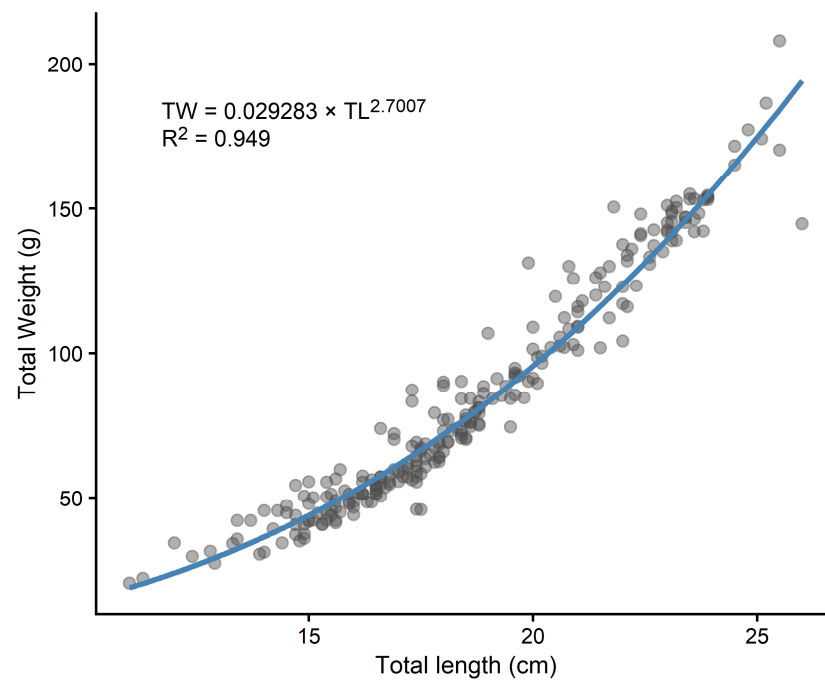


Figure 3. Length–weight relationship of *Pagellus erythrinus* from the South Adriatic.

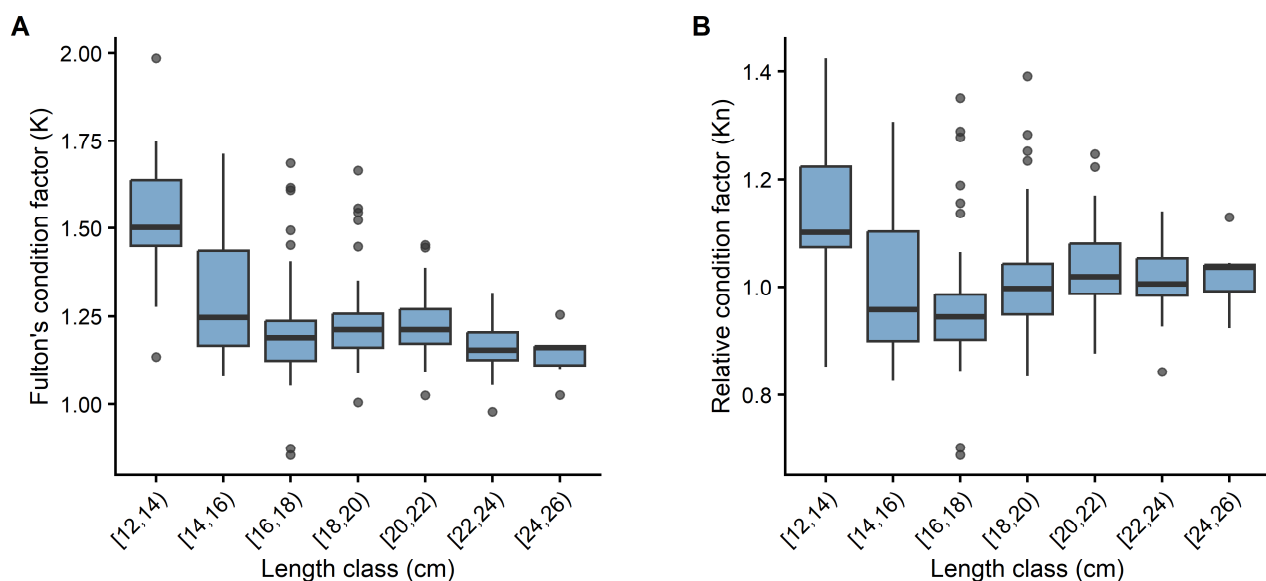


Figure 4. Fulton's condition factor (K) (A) and Le Cren's relative condition factor (K_n) (B) by 2 cm length class for *Pagellus erythrinus* from the South Adriatic.

3.3. Body Morphometrics

Mean relative body depth (H/TL) was 0.284 ± 0.018 and mean relative body width (W/TL) was 0.133 ± 0.012 . Body height scaled strongly with TL ($H = 0.1383 + 0.276 \times TL$; $R^2 = 0.884$) and body width showed a weaker but significant relationship ($W = 0.4896 + 0.1063 \times TL$; $R^2 = 0.732$) (Figure 5).

3.4. Age Structure and Von Bertalanffy Growth

A total of 251 otoliths were read by both readers independently. Inter-reader precision was $APE = 4.32\%$ and $CV = 6.11\%$, both within acceptable thresholds for Mediterranean sparid otolith age readings [26,27]. Discrepancies between readers were resolved by joint re-examination.

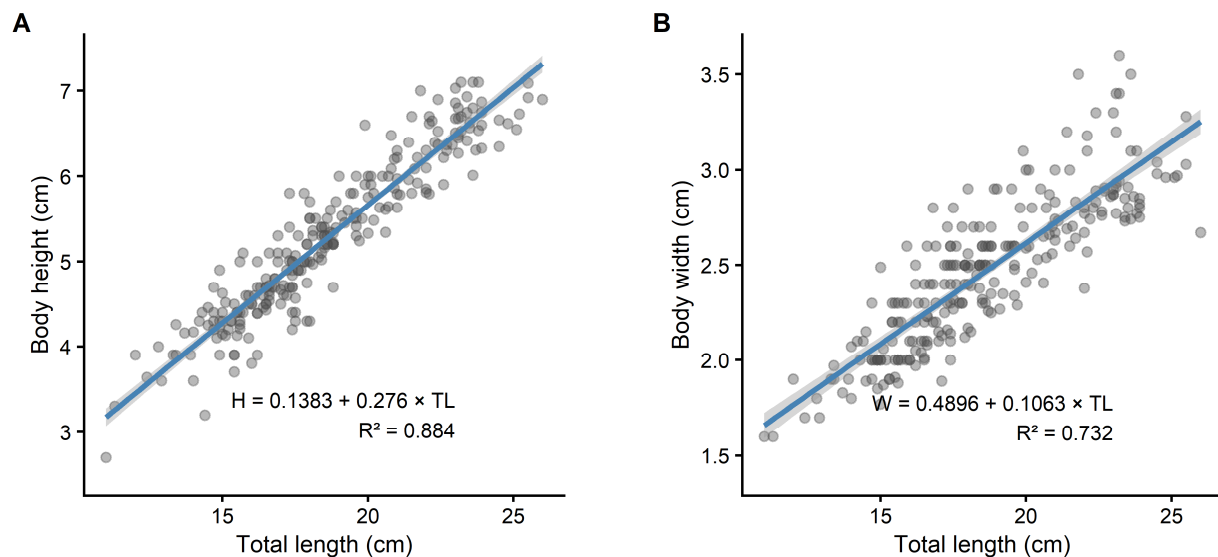


Figure 5. Relationships between total length and body height (A) and body width (B) in *Pagellus erythrinus* from the South Adriatic. Y-axes show absolute measurements (H and W in cm); equations describe absolute growth relationships. Mean relative body depth ($H/TL = 0.284 \pm 0.018$) and relative body width ($W/TL = 0.133 \pm 0.012$) are given in the text.

Six age classes were identified ranging from 1 to 6 years, with age class 3 being dominant (46.4%, $n = 117$), followed by ages 2 and 4 (Figure 6). Ages 5 and 6 were rare (2.0% and 0.8%, respectively). Mean TL increased consistently from age 1 to age 5; full age composition and mean lengths are provided in Table 1.

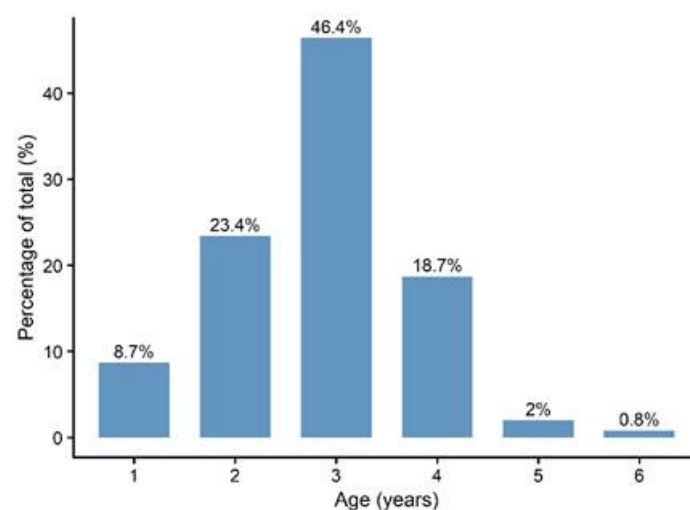
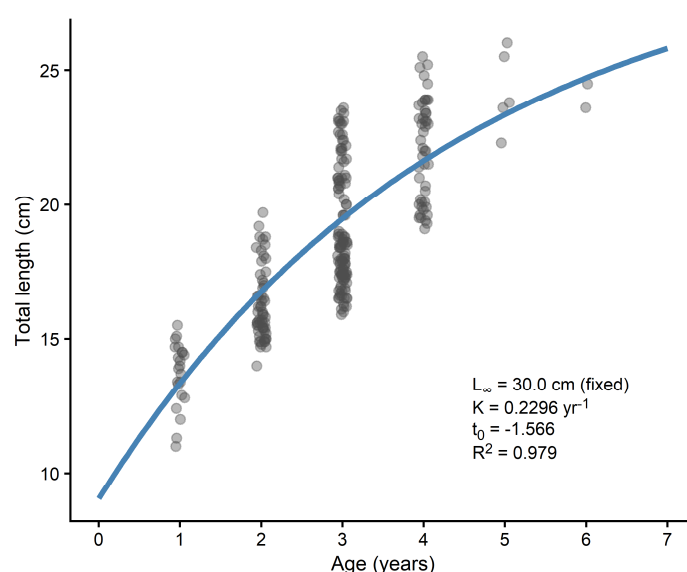


Figure 6. Age structure of *Pagellus erythrinus* from the South Adriatic ($n = 252$). Numbers above bars indicate specimen counts.

Von Bertalanffy growth parameters were estimated by fitting the VBGF to mean length-at-age data with L_{∞} fixed at 30.0 cm, following Rijavec (1975, cited in [4]). The estimated growth coefficient was $K = 0.2296 \text{ year}^{-1}$ (95% CI: 0.194–0.265) and $t_0 = -1.566$ years (95% CI: -2.209 – -0.922) ($R^2 = 0.979$) (Figure 7). Both parameters were statistically significant (K : $p = 0.00023$; t_0 : $p = 0.009$). The growth performance index ϕ' was 2.315 and estimated maximum lifespan was 11.5 years.

Table 1. Age composition and mean length-at-age of *Pagellus erythrinus* from the South Adriatic (n = 252).

Age Class	n (%)	Mean TL (cm)	SD (cm)	TL Range (cm)
1	22 (8.7)	13.68	1.21	11.0–15.5
2	59 (23.4)	16.28	1.34	14.0–19.7
3	117 (46.4)	19.04	2.17	15.9–23.6
4	47 (18.7)	22.03	1.88	19.1–25.5
5	5 (2.0)	24.24	1.50	22.3–26.0
6	2 (0.8)	24.05	0.64	23.6–24.5
Total	252 (100)	18.63	3.15	11.0–26.0

**Figure 7.** Von Bertalanffy growth curve fitted to mean length-at-age data for *Pagellus erythrinus* from the South Adriatic.

4. Discussion

4.1. Length-Weight Relationship

The allometric exponent $b = 2.7007$ indicates clear negative allometric growth in the sampled population from the Elafiti archipelago area (southern Adriatic), in accordance with several studies from the eastern Mediterranean area, and in contrast to Atlantic and western Mediterranean populations, which tend toward isometry. The 95% confidence interval lies entirely below 3 (2.6228–2.7787), confirming that this deviation is not a statistical artefact.

The values for allometric exponent b for *P. erythrinus* vary substantially throughout the literature. Theocharis et al. [25] reported $b = 2.49$ in the Central Aegean, Lteif et al. [12] reported $b = 2.912$ along the Lebanese coast, and Ayyidiz et al. [37] $b = 2.776$ in the North Aegean. On the other hand, Atlantic populations are more indicative of isometry: Pajuelo and Lorenzo [7] obtained $b = 3.013$ for the Canary Islands, with similar values documented from Portugal [11]. The southern Tyrrhenian population of Busalacchi et al. [2] ($b = 2.905$) is considered intermediate. This geographic gradient, ranging from near-isometric Atlantic growth toward more pronounced negative allometry in the eastern Mediterranean, is broadly consistent with the large-scale environmental patterns across the basin [14,15]. Regional and ecosystem-level studies have documented a west-to-east decline in primary productivity in the Mediterranean [12,14,15], which likely contributes to the observed

differences in fish growth, although the relationship between productivity and somatic growth in demersal fishes is mediated by multiple local factors. The present b value fits in with the values obtained for the eastern Mediterranean populations.

The two closest comparisons from the eastern Adriatic are those reported by Dulčić and Kraljević [20] ($b = 2.944$, $n = 193$, TL 10.9–46.0 cm) and Soldo [21] ($b = 2.8942$, $n = 1235$, TL 10.0–39.2 cm). Both studies indicate negative allometric growth in eastern Adriatic populations, although their estimates are slightly closer to isometry than the value obtained here. This difference is more likely due to methodological factors than to real biological variation. In particular, both earlier studies were based on samples collected in shallow coastal and littoral areas (≤ 40 m) during the warmer part of the year, whereas the present study relied on winter sampling using a bottom trawl. Under such conditions, individuals are likely to have lower energy reserves and reduced somatic condition, which can result in a lower allometric exponent.

Notably, within the Adriatic itself, the allometric exponent reported by Zupanović and Rijavec [4] for the central Adriatic insular zone was $b = 2.981$, approaching isometry which is a marked contrast to the negative allometry observed here. This difference may partly reflect the well-documented north-to-south decline in primary productivity within the Adriatic basin [22], with the more oligotrophic southern sub-basin supporting growth trajectories more consistent with eastern Mediterranean populations than with the more productive central Adriatic. The intercept $a = 0.029283$ should not be compared directly across studies, as a and b are negatively correlated. Lower b , as in this study, automatically produces higher a , which makes isolated comparisons of a uninformative [13].

4.2. Condition Factors

Mean Fulton's K (1.235) and K_n (≈ 1.006) suggest that individuals were in average physiological condition at the time of sampling. The K_n being close to 1 is expected, as reported in [24], since it reflects how well the individuals fit into the length–weight relationship of their own population, but it can be confirmed that there were no pronounced outliers in the sample caused by either poor condition or irregularly heavy fish, such as gravid females with large gonadal mass.

The relatively wide range of Fulton's K (0.823–1.985) is expected for a protogynous hermaphrodite, as gonadal development during sex transition independently influences body mass regardless of nutritional state [13,24]. Sex was not recorded in the present study because sampling was restricted to external biometrics, otolith extraction, and length and weight measurements; macroscopic gonad staging was not performed. Consequently, sex-specific condition analyses were not possible, and interpretations of condition variation in terms of gonadal state remain inferential. Since sex transition in Mediterranean populations occurs at around 17–18 cm [4,5], corresponding approximately to age class 3 in this sample (mean TL at age 3: 19.04 cm), individuals near the modal size class are most likely to span the transition period. Part of the observed variation in K around this length range may therefore reflect gonadal state rather than nutritional differences alone. Future sampling should include immediate post-catch gonad staging and macroscopic sex determination to enable sex-specific analyses, particularly for fish in the 15–22 cm TL range, which is when transition is most likely to occur in this population. These condition values should also be interpreted cautiously in light of the winter-only sampling design, as seasonal variability in condition is well-documented in Mediterranean sparids and winter samples are typically associated with reduced somatic energy reserves.

4.3. Body Morphometrics

The mean relative body depth ($H/TL = 0.284 \pm 0.018$) and relative body width ($W/TL = 0.133 \pm 0.012$) are consistent with the laterally compressed, deep-bodied form characteristic of Sparidae [1]. Body height scaled tightly with TL ($R^2 = 0.884$), suggesting proportional body depth growth across the sampled size range. Body width showed a weaker relationship ($R^2 = 0.732$), likely reflecting the greater variability introduced by seasonal fluctuations in gonadal mass and fat deposition, given that gonad weight constitutes a seasonally variable fraction of total body mass in teleosts [24]. A direct Adriatic comparison can be drawn from Šantić et al. [6], who examined the biometric characteristics of eastern Adriatic *P. erythrinus*, reported a mean maximum body height of 32.40% of standard length, combined with a mean standard length of 80.18% of total length, which leads to an H/TL of approximately 0.260. The somewhat higher H/TL in the present southern Adriatic sample (0.284) suggests a marginally deeper body form, though direct comparison is complicated by the use of standard length as the reference measure in the work of Šantić et al. [6] and by possible differences in the length range composition of the two samples.

4.4. Age Structure and Growth

The age structure of the sample was highly concentrated in the range 2–4 years, which made up 88.5% of the sample, with age class 3 dominating the sample, with a share of 46.4%. Older age groups were poorly represented. Individuals aged 5 and 6 years together made up only 2.8% of the sample ($n = 7$). This truncated age structure has also been recorded in other Mediterranean populations of *P. erythrinus*, for example, in the Central Aegean [25]. Such truncated age structures can arise from natural mortality, fishing gear selectivity, and ontogenetic habitat segregation, with larger individuals typically occupying deeper areas outside the sampled depth stratum [3]. Disentangling these contributions is not possible without mortality estimates, which could not be reliably derived from this seasonally restricted, age-imbalanced dataset.

Individuals of the youngest age group (age 1) were also poorly represented ($n = 22$), making up 8.7% of the sample. Their low representation is expected given the known patterns of the spatial distribution of the species. Namely, the youngest cohorts of *P. erythrinus* primarily inhabit shallow coastal areas and gradually move towards the continental shelf as they grow. Somarakis and Machias [3] on the Cretan shelf showed that individuals smaller than approximately 13 cm are most likely to remain in the shallowest parts of the stratum, while larger individuals prefer deeper areas. Consequently, the fishing gear used in this study, regardless of the mesh size, inherently undersamples younger and smaller individuals. Therefore, the low representation of age group 1 in the sample can be attributed to habitat-related sampling bias rather than poor recruitment. Conversely, the small codend mesh size (22–26 mm) ensured the retention of fish across all sampled size classes, including age-1 juveniles (mean TL 13.68 cm), confirming that the absence of older individuals (ages 5–6, $n = 7$, 2.8% of sample) is more consistent with the ontogenetic bathymetric segregation of larger fish toward deeper strata than with gear-based exclusion.

A similar pattern was also observed by Zupanović and Rijavec [4] in the Central Adriatic more than six decades ago, where they excluded age groups 1 and 2 from their growth analyses due to the pronounced gear selectivity.

Because L_∞ was fixed a priori at 30.0 cm from Rijavec (1975, cited in [4]), it cannot be meaningfully compared with values from other populations. The two independently estimated parameters, K and t_0 , form an appropriate basis for inter-population comparison. The estimated $K = 0.2296 \text{ year}^{-1}$ is consistent with values reported for Adriatic and central Mediterranean populations: Rijavec (1975, cited in [4]) reported $K = 0.245 \text{ year}^{-1}$ for the southern Adriatic shelf, and Joksimović et al. [19] reported $K = 0.202 \text{ year}^{-1}$ for the

Montenegrin shelf. The somewhat higher K reported by Somarakis and Machias [3] for the Cretan shelf ($K = 0.317 \text{ year}^{-1}$) likely reflects local differences in temperature regime and food availability, consistent with the west-to-east decline in primary productivity across the Mediterranean basin [14,15]. The estimated $t_0 = -1.566$ years falls within the range typically reported for Mediterranean populations [3,10,25], consistent with a July birth date and rapid early somatic growth. The growth performance index $\phi' = 2.315$ should be interpreted with caution because L_∞ was constrained rather than estimated independently; it is nonetheless broadly consistent with Mediterranean values reported for this species [3,25]. The similar mean lengths at ages 5 and 6 (24.24 vs. 24.05 cm) reflect the very small sample sizes at these classes ($n = 5$ and $n = 2$, respectively) and should not be interpreted as evidence of growth stagnation. The estimated maximum lifespan of 11.5 years is consistent with the growth coefficient, and eastern Mediterranean populations of this species tend to be shorter-lived than their Atlantic counterparts owing to the faster K [3,7,11]. A broader comparison of published VBGF estimates is provided in Table 2.

Table 2. Von Bertalanffy growth parameters for *Pagellus erythrinus* from the present study and selected Mediterranean and Atlantic populations.

Population/Reference	L_∞ (cm)	K (Year ⁻¹)	t_0 (Years)	ϕ'
Southern Adriatic—present study	30.0 (fixed)	0.2296	−1.566	2.315
Central Adriatic—Zupanović and Rijavec [4]	37.7	0.201	−0.093	2.455
S. Adriatic/Boka Kotorska—Rijavec (1975, cited in [4])	30.0	0.245	n/a	2.343
Montenegrin shelf—Joksimović et al. [19]	32.76	0.202	−1.970	2.336
Central Aegean—Theocharis et al. [25]	39.53	0.160	−1.53	2.394
Cretan shelf—Somarakis and Machias [3]	27.8	0.317	−0.739	2.382
Central Aegean—Metin et al. [10]	30.67	0.165	−0.857	2.191

The growth performance index $\phi' = 2.315$ is comparable to the values compiled for *P. erythrinus* across the Mediterranean [25], in line with the expectation that ϕ' remains relatively stable within a species despite the population-level variations in L_∞ and K . Within the Adriatic, the central basin value ($\phi' = 2.455$, derived from [4]) is slightly higher than values estimated for the southern Adriatic, both from the present study (2.315) and from that of Rijavec (1975, cited in [4]; 2.343), though this difference should be interpreted cautiously given the methodological and temporal distance between studies such as those of Zupanović and Rijavec [4], with aged fish from scales collected in the late 1950s, and the parameter uncertainty across ageing structures and methods is well documented [26,27]. Noticeable variability in K across populations from 0.080 year^{-1} in the southern Tyrrhenian [2] to 0.317 year^{-1} on the Cretan shelf [3] likely reflects local differences in temperature regime and food availability, consistent with the west-to-east decline in primary productivity across the Mediterranean basin [12].

The similar mean lengths at ages 5 and 6 (24.24 vs. 24.05 cm) reflect the very small sample sizes at these classes ($n = 5$ and $n = 2$, respectively) and should not be interpreted as evidence of growth stagnation. The VBGF was fitted to mean length-at-age data rather than individual observations, as the strong age-class imbalance prevented stable nonlinear convergence [3].

The estimated maximum lifespan of 11.5 years is consistent with the growth coefficient for this population. The faster-growing individuals generally reach their asymptotic length sooner and exhibit shorter maximum lifespans [38]. Reported maximum ages vary considerably across the species' range, from 8 years in the Edremit Bay, northern Aegean [39], 9 years in the Central Aegean [25] and 10 years off the Canary Islands [7] to 21 years

in southern Portugal [11]. This pattern is consistent with slower, longer-lived growth trajectories in more productive, cooler waters to the west [12].

Mortality parameters, including total mortality (Z), natural mortality (M), and fishing mortality (F), were not estimated in the present study. The dataset used in this study is limited to a single winter sampling period and exhibits a strongly uneven age structure, with low representation of both younger and older individuals, thereby violating the key assumptions required for reliable catch curve analysis. Consequently, any mortality estimates derived from these data would likely be biased and were therefore not considered appropriate for inclusion.

5. Conclusions

The sampled population of *P. erythrinus* from the Elafiti archipelago area of the southern Adriatic shows growth and condition characteristics broadly consistent with eastern Mediterranean stocks and distinct from the more productive Atlantic populations. Its growth trajectory aligns most closely with populations from the Cretan shelf and the central Aegean, reflecting the oligotrophic character of the southern Adriatic basin. The age structure, dominated by classes 2–4, reflects the combined effects of gear selectivity, ontogenetic habitat segregation, and natural mortality; interpretation in terms of fishing pressure is not possible from this dataset alone, as mortality parameters were not estimated. The parameters reported here represent a winter biological baseline for the Elafiti archipelago area of the southern Adriatic and should be interpreted as locally representative rather than basin-wide. They can nonetheless serve as reference parameters for future monitoring and comparative studies across the southern Adriatic, and to support management of this commercially exploited stock within the framework established for Mediterranean demersal fisheries [40]. It must be emphasised that all results reflect winter sampling conditions, with lower energy reserves and seasonal physiological state typical of that period; multi-seasonal data will be required before these parameters can be treated as annual averages. Future work should prioritise multi-seasonal sampling to resolve temporal variations in condition and growth, alongside sex-specific analyses of condition, maturity stage, and gonadosomatic indices.

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