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The length-weight relationship and condition factors of coastal small-sized adult and juvenile fish species following dense mucilage in the Sea of Marmara, Türkiye

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Abstract: To understand the ecosystem health of the Sea of Marmara following the dense mucilage event in 2021, growth indicators (length-weight relationships and condition factors) of coastal fish species were investigated. For this purpose, individuals were sampled during experimental fishing trials with beach seine nets between November 2021 and March 2022 from the Sea of Marmara, Türkiye. A total of 32 fish species belonging to 19 families were obtained. A total of 12 juvenile and 20 small-sized adult coastal fish species were identified, and condition factors and length-weight relationships (LWRs) were calculated. The LWR results of this study reveal the first findings as *Gasterosteus aculeatus* for Mediterranean marine waters, as *Umbrina cirrosa* for Turkish waters, and as *Pomatoschistus marmoratus* and *Pomatoschistus minutus* for the Sea of Marmara. The *b* value of 17 species ranged between 2.586 and 3.566, all distributed within the expected range (2.5 and 3.5) for healthy stocks. In addition, the CF values were found slightly lower from the results of the previous studies. These differences may be a result of abnormal environmental conditions which cause mucilage to form and/or address varied life phases (juvenile/adult) of this study and compared previous studies. To better understand, multidisciplinary studies should be conducted that include case history as well as back-calculated predictions, as in this study.

Key words: Growth indicators, early-life, sea-snot, surf-zone, shelter area

1. Introduction

Juveniles share coastal areas with small-sized adult fishes such as members of the families Gobiidae, Atherinidae, Blennidae, Callionymidae, etc. Some fish species migrate seasonally between the coast and deeper areas for feeding or spawning. Thus, coastal areas are quite complex habitats due to competition (Roughgarden et al., 1988). Additionally, coastal areas are influenced by anthropogenic activities such as tourism, harbor embankments, construction, etc. In many less developed or developing countries, wastewaters are discharged into coastal areas without treatment (Turner et al., 1998).

The juvenile phase is one of the most important phases of life due to newly developing physical, physiological, and behavioral functions. In this phase, juveniles may be affected by lots of exogenous factors, such as the presence of prey and predators, pollution of coastal waters, and physico-chemical changes. The necessity of rapid growth to be able to avoid becoming prey to predators is highly dependent upon the nursery functions of the habitat. Coastal areas are vital environments for juvenile fish as they are nursery areas (Bradley et al., 2019; Whitfield, 2020). Prey availability is crucial due to rapid growth.

Under these circumstances, growth is different between juveniles and adults. The ratio between length and weight differs for juveniles due to further growth occurring in length. Therefore, particular length-weight relationship (LWR) calculations for juveniles and adults are recommended (Froese, 2006). Length-weight relationships studies enable estimations of weight when

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it cannot be obtained due to scales not working properly at sea due to turbulence of waves, performing underwater visual census without removing the individual from water, and for individuals who are partly injured, etc. (Morey et al., 2003). LWR data can be useful for estimations of yield from the length frequency distribution (Petrakis and Stergiou, 1995), for conversion from growth in length equations and weight equations (Pauly, 1993), and for comparison of body condition of a given species between varied geographical areas (Goncalves et al., 1997). Although it is recommended that varied LWR data should be obtained for juveniles and adults, this situation is not given much attention. In the Mediterranean, Morato et al. (2001) and Compaire et al. (2021) conducted studies about the LWRs of juveniles. In terms of the study area, some studies were conducted about adult fishes (Bök et al., 2011; Demirel and Dalkara, 2012; Öztekin et al., 2016; Daban et al., 2020; Karadurmuş, 2022). Even if not given separately for juveniles and adults, some LWR data about juvenile individuals were used in some studies (Tarkan et al., 2006; Keskin and Gaygusuz, 2010).

The Sea of Marmara is a semienclosed basin that is located in the northeastern part of the Mediterranean Sea. This unique area connects the Aegean Sea and the Black Sea via the Turkish Strait System (Dardanelles and Bosphorus). This area hosts a huge population, commercial facilities, maritime transportation, fisheries, and tourism activities. Thus, more pollution load is discharged than the environment can cope with. In recent years, as a result of global warming, abnormal changes have been observed in the physico-chemical parameters of water. When all these factors come together, undesirable environmental conditions such as mucilage occur. Tüfekçi et al. (2010) stated that massive mucilage events began to occur in 1992 in the Sea of Marmara, repeated periodically in 2007–2008 (Aktan et al., 2008). The most impactful event was observed in 2020–2021 (Savun-Hekimoğlu and Gazioğlu, 2021). Mucilage has negative effects on many sectors such as tourism, maritime transportation, fishing, etc., while knowledge about the adverse effects on aquatic species is limited. Sessile invertebrate species are known as the most vulnerable group among all living organisms due to being covered with mucilage, such as red gorgonian *Paramuricea clavata* (Topçu and Öztürk, 2021). Ertürk Gürkan et al. (2022) stated that mucilage was consumed as a food source by *Eriphia verrucosa*, and the high bacterial load in mucilage can also cause problems indirectly as it is consumed by other fish and humans. Knowledge about the effect of mucilage on teleost fish is scarce. Dalyan et al. (2021) stated that mucilage caused intensive damage to cryptobenthic fish species composition. Karadurmuş and Sarı (2022) revealed mass deaths of adult teleost fish species in the Sea of Marmara. It was observed that mucilage was most concentrated in coastal areas and this is the habitat most likely to be damaged during the last massive mucilage event in 2021–2022 in the Sea of Marmara. Due to coastal areas being used by juvenile fish as nursery, growth, and protection areas, the health of these areas is extremely important for sustainable management.

Growth indicators (length-weight relationships (LWRs) and condition factor (CF)) are important components to determine present and future population success or well-being of fish against rapidly evolving environmental events.

Thus, the present study aimed to estimate the condition factor and length-weight relationship of juveniles and small-sized adult fishes distributed around surf zones in the Sea of Marmara in the postmucilage period.

2. Materials and methods

Individuals were obtained during experimental fishing trials with beach seine nets between November 2021 and March 2022 in the Sea of Marmara, Türkiye. A total of 12 sampling stations were determined to encompass the whole Sea of Marmara at equal distances (Figure). Beach seine sampling was completed with 2 replications from all 12 stations. The beach seine hauls were conducted on seagrass beds and/or sandy habitats. Specimens were kept in ice-packs and transported to the laboratory, immediately. The species were grouped and identified to the possible lowest taxon according to Whitehead et al. (1986). Then, the total length (TL) of the individuals within the range between 0 and 15 cm was measured with the digital caliper, Mitutoyo CD-15 APX, which has a 150 mm measurement range and 0.01 mm resolution. Measured values were converted to 0.01 cm TL units. The individuals larger than 15 cm were measured with a measuring board to the nearest 0.1 cm TL. All individuals were weighed to the nearest 0.001 g total weight (W) with a precision scale. The individuals were identified and grouped as juveniles and adults according to first oocyte growth and occurrence of spermiogenesis.

LWR parameters were calculated by linear regression expressed by the equation after base 10 transformation:

$$\log W = \log a + b (\times) \log L$$

where W: weight (g), L: TL (cm), log a: intercept, and *b*: the slope of the regression line (Froese, 2006).

The growth type was identified according to the equation:

$$ts = (b-3) / SE(b)$$

where ts is a t-test value, b is a slope, and SE(b) is a standard error of the slope (Sokal and Rohlf, 1987). Growth type was determined according to the t-test value of b.

Condition factor (CF) was estimated according to equation:

$$CF = 100 (W/TL^3)$$

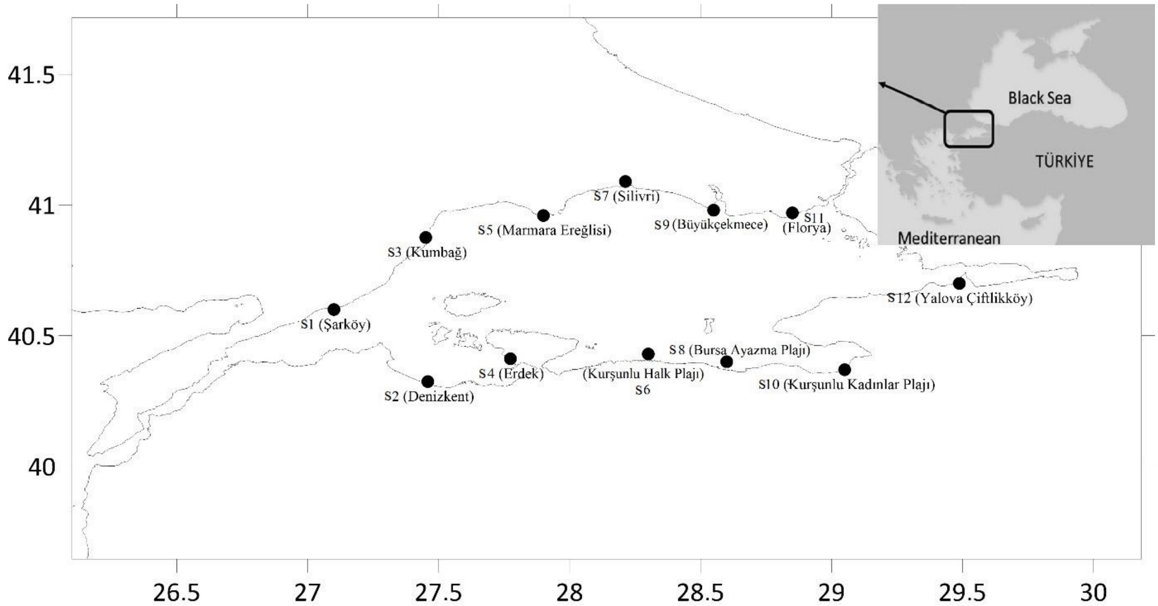

Figure. Study area (the Sea of Marmara, Türkiye) and the sampling stations.

where TL is the total length of fish (cm) and W is the body mass of fish (g) (Froese, 2006). All statistical analyses were evaluated at a 5% significance level ($p < 0.05$).

3. Results

Overall, 32 species belonging to 19 families were identified from beach seine samplings. Of the species, 12 of 32 species were juvenile and the remaining 20 species were small-sized adult fishes distributed in the surf zones. Calculations of the relationships between length and weight were limited to the 16 species with more than 10 specimens in the total sample. Among species, 7 of 16 species with length-weight relationship calculated were juvenile (Table 1). The minimum, maximum, and mean length and weight values of the remaining 16 species are presented in Table 2. Individual numbers ranged from 10 for *Belone belone* to 1729 for *Atherina boyeri*.

The r^2 and b values can be seen in Table 2. The b values for all species ranged between 2.5 (*Gasterosteus aculeatus*) to 3.5 (*Sygnathus abaster*). The mean value of b was 3.017 ± 0.078, and 50% of the b values ranged between 2.95 and 3.20. According to the t-test, growth types were negative allometric ($b < 3$, $p < 0.05$) for 4 species (*Diplodus puntazzo, Lithognathus mormyrus, Liza saliens,* and *Liza aurata*), isometric ($b = 3$, $p > 0.05$) for 6 species (*Umbrina cirrosa, Atherina boyeri, Atherina hepsetus, Gasterosteus aculeatus, Pomatoschistus bathi* and *Pomatoschistus minutus*) and positive allometric ($b > 3$, $p < 0.05$) for 6 species (*Belone belone, Synapturichthys kleinii, Pomatoschistus marmoratus, Sygnathus abaster, Sardina pilchardus* and *Symphodus roissali*).

CF was calculated for 20 small-sized adult and 12 juvenile fish species. The mean CF for 12 juvenile fish species was determined as 0.87. The minimum CF was detected for *Sardina pilchardus* (0.36), whereas the maximum value was found for *Scophthalmus maximus* (1.46). For the remaining 10 juvenile species, only the CF of *Diplodus puntazzo* and *Chelidonichthys lucerna* were higher than 1 (Table 3).

The lowest CF values were calculated for eel-like or elongated fish species such as *Belone belone, Nerophis ophidion, Sygnathus abaster, Sygnathus acus,* and *Sygnathus typhe.* The mean CF of elongated fish species was 0.03. Among them, the highest CF was found for *Belone belone* (0.08), and the lowest CF was detected for *Nerophis ophidion* (0.007). For flatfishes (*Arnoglossus kessleri, Arnoglossus laterna, Arnoglossus thori*), the mean CF was calculated as 0.78. The CF of *A. laterna* (0.91) was slightly higher than the others. The mean CF of the remaining 12 adult fish species (*Lesueurigobius friesii, Uronoscopus scaber, Atherina boyeri, Atherina hepsetus, Callionymus pusillus, Engraulis encrasicolus, Gasterosteus aculeatus, Pomatoschistus bathi, Pomatoschistus marmoratus, Pomatoschistus minutus, Symphodus ocellatus* and *Symphodus roissali*) was calculated as 0.86. Among them, the highest CF was found for *U. scaber* (1.52) and the lowest CF was for *E. encrasicolus* (0.51). *S. ocellatus, S. roissali,* and *G. aculeatus* had CF higher than 1. In total, the CF values for 7 species were higher than 1.

Table 1. Sample size and the length-weight relationship parameters and growth types for 16 fish species from the Sea of Marmara.

Life Phase	Species	n	Total length (TL, cm)			Total weight (g)			Length-weightrelationship parameters				Growth type
			Min	Max	Mean±SE	Min	Max	Mean ± SE	a	b	Se(b)	r^2	
Juvenile	*Diplodus puntazzo*	102	2.45	5.09	3.62 ± 0.5	0.244	1.575	0.603 ± 0.02	0.0178	2.689	0.140	0.81	A -
Juvenile	*Lithognathus mormyrus*	479	2.84	7.49	5.09 ± 0.5	0.244	4.298	1.368 ± 0.03	0.0101	2.948	0.022	0.97	A -
Juvenile	*Liza saliens*	1300	1.27	9.83	3.76 ± 0.2	0.026	8.871	0.497 ± 0.01	0.0078	2.989	0.003	0.97	A -
Juvenile	*Liza aurata*	1674	1.38	12.32	3.72 ± 0.2	0.033	13.345	0.473 ± 0.02	0.0123	2.604	0.031	0.81	A -
Juvenile	*Synapturichthys kleinii*	69	1.72	12.52	7.15 ± 2.7	0.037	18.652	4.214 ± 0.48	0.0064	3.141	0.042	0.99	A +
Juvenile	*Umbrina cirrosa*	23	4.94	13.50	9.84 ± 5.4	1.150	21.514	9.630 ± 1.23	0.0081	3.016	0.057	0.99	I
Juvenile	*Sardina pilchardus*	120	0.98	3.40	2.71 ± 0.2	0.003	0.110	0.075 ± 0.02	0.0023	3.467	0.064	0.90	I
Juvenile	*Atherina boyeri*	44	3.07	4.06	3.74 ± 0.04	0.151	0.399	0.294 ± 0.01	0.0033	3.383	0.056	0.92	I
Adult	*Atherina boyeri*	1664	4.09	15.30	6.91 ± 0.04	0.383	10.672	2.154 ± 0.04	0.0045	3.116	0.017	0.92	A +
Adult	*Atherina hepsetus*	21	13.60	15.40	14.30 ± 0.1	15.391	21.154	17.940 ± 0.32	0.0057	3.062	0.048	0.88	I
Adult	*Gasterosteus aculeatus*	11	5.80	6.93	6.42 ± 1.0	2.379	3.728	2.907 ± 0.14	0.0235	2.586	0.432	0.80	I
Adult	*Belone belone*	10	24.10	29.10	26.79 ± 5.5	9.170	27.850	15.790 ± 1.96	0.0002	3.483	0.252	0.94	A +
Adult	*Pomatoschistus bathi*	516	2.58	8.92	5.53 ± 0.4	0.105	3.335	1.278 ± 0.02	0.0067	3.008	0.014	0.99	I
Adult	*Pomatoschistus marmoratus*	559	2.48	7.99	4.90 ± 0.4	0.078	2.878	0.879 ± 0.02	0.0049	3.269	0.009	0.99	A +
Adult	*Pomatoschistus minutus*	13	4.94	6.39	5.55 ± 1.8	0.861	1.743	1.143 ± 0.12	0.0112	2.702	0.686	0.98	I
Adult	*Syngnathus abaster*	54	8.20	19.70	11.33 ± 2.8	0.104	2.906	0.502 ± 0.06	0.0001	3.566	0.084	0.97	A +
Adult	*Symphodus roissali*	11	4.82	9.68	6.94 ± 0.42	1.110	12.220	4.496 ± 0.98	0.0058	3.355	0.080	0.98	A +

*SE: Standard error; TL: Total length; n: Individual number; a: Regression coefficient; b: Slope; A: Allometric; I: Isometric

Table 2. Total length (TL) and total weight (g) values for 22 species which length-weight relationships were not calculated due to limited sample size.

Life Phase	Species	n	Total length (TL, cm)			Total weight (g)		
			Min	Max	Mean	Min	Max	Mean
Juvenile	*Gaidropsarus mediterraneus*	4	4.03	4.40	4.22 ± 0.8	0.417	0.475	0.445 ± 0.01
Juvenile	*Sarpa salpa*	2	2.23	2.32	2.28 ± 0.3	0.081	0.096	0.089 ± 0.01
Juvenile	*Scophthalmus maximus*	2	7.44	16.6	12.0 ± 3.2	5.375	73.554	39.5 ± 24.1
Juvenile	*Pagellus acerna*	1	2.93	2.93	2.93	0.163	0.163	0.163
Juvenile	*Chelidonichthyes lucerna*	7	6.76	8.79	7.72 ± 2.7	3.620	7.420	4.870 ± 0.73
Adult	*Sygnathus typhe*	2	19.70	26.80	23.25 ± 25.1	2.042	3.321	2.682 ± 0.45
Adult	*Callionymus pusillus*	2	5.12	5.37	5.25 ± 0.9	1.202	1.553	1.368 ± 0.12
Adult	*Engraulis encrasicolus*	2	6.46	7.56	7.01 ± 3.9	1.452	2.117	1.785 ± 0.24
Adult	*Nerophis ophidion*	2	13.90	14.80	14.35 ± 3.2	0.150	0.259	0.205 ± 0.04
Adult	*Arnoglossus kessleri*	1	6.08	6.08	6.08	1.625	1.25	1.625
Adult	*Arnoglossus thori*	1	5.45	5.45	5.45	1.170	1.170	1.170
Adult	*Lesueurigobius friesii*	1	3.62	3.62	3.62	0.329	0.329	0.329
Adult	*Uronoscopus scaber*	1	14.15	14.15	14.15	43.011	43.011	43.011
Adult	*Arnoglossus laterna*	3	5.69	7.34	6.40 ± 3.9	1.640	4.071	2.546 ± 0.63
Adult	*Symphodus ocellatus*	6	7.02	9.94	8.28 ± 4.9	3.420	13.435	7.655 ± 1.62
Adult	*Sygnathus acus*	9	10.4	22.5	14.14 ± 1.5	0.237	6.058	1.484 ± 0.64

4. Discussion

The data of 9 species (*D. puntazzo, L. mormyrus, L. saliens, L. aurata, A. boyeri, B. belone, P. bathi, Syngnathus abaster,* and *S. roissali*) among 14 species with LWR calculated, were previously studied by Keskin and Gaygusuz (2010) in Erdek Bay, the Sea of Marmara. The sampling method and length distributions were similar. Thus, the comparisons should be made with the same life phases. Comparison of the b values and growth type of these species were different between the two studies. The b values in the study by Keskin and Gaygusuz (2010) were mostly higher than this study. This may be related to changing environmental conditions over a long period of time, such as 12 years. Another possible explanation for this difference may be the limited sampling area (Erdek Bay) in the study by Keskin and Gaygusuz (2010). Some authors stated that the b value remains constant over the years or seasons and is more related with species-specific characteristics (Bagenal and Tesch, 1978; Santos et al., 2002). This hypothesis supports the idea that the b value is due to developmental stage differences.

G. aculeatus is known as a mostly freshwater and anadromous fish (McPhail, 1969). In most studies, growth type was determined as a positive allometry in freshwater populations. The b value was calculated as 2.61 by Wilhelms (2013) in the North Sea and calculated as 2.58 in this study. Thus, relatively lower b values may be related to the inability to compete in marine habitats. However, more data from marine habitats should be obtained to support this finding.

The b values related to LWRs of the present study were found between 2.5 and 3.5, and distributed within the range of expected range of healthy stocks reported by Tesch (1971). This study revealed the first LWR data for juvenile *U. cirrosa* and adult *P. minutus* for the Sea of Marmara. Koutrakis and Tsikliras (2003) determined the b value for juvenile *U. cirrosa* as 2.985. Similarly, the b value was calculated as 3.016 in the Sea of Marmara. The b value for *P. marmoratus* was 3.308 (Koutrakis and Tsikliras, 2003) and 3.168 (Altın et al., 2015) in the northern Aegean Sea. Similarly, the b value was calculated as 3.269 in this study. Demirel and Dalkara (2012) calculated the b value as 2.522 and the growth type as negative allometric in the Sea of Marmara. The varied results within the same region may be related to current competitive conditions such as food availability, habitat density, etc. Dermancı (2016) detected the *b* value of *S. ocellatus* as 3.23 in the North Aegean Sea, Türkiye. Although individuals ranged

Table 3. Condition factor (CF) of 32 coastal fish species from the Sea of Marmara.

Life Phase	Sample	Species	CF Min	CF Max	CF Mean
Juvenile	1	*Pagellus acerna*	0.65	0.65	0.65
Juvenile	7	*Chelidonichthys lucerna*	0.87	1.19	1.03 ± 0.04
Juvenile	102	*Diplodus puntazzo*	0.72	2.15	1.22 ± 0.02
Juvenile	4	*Gaidropsarus mediterraneus*	0.50	0.73	0.62 ± 0.08
Juvenile	479	*Lithognathus mormyrus*	0.67	1.57	0.94 ± 0.04
Juvenile	1300	*Liza saliens*	0.17	2.50	0.81 ± 0.03
Juvenile	1674	*Liza aurata*	0.32	2.17	0.86 ± 0.01
Juvenile	2	*Sarpa salpa*	0.73	0.77	0.75 ± 0.01
Juvenile	2	*Scophthalmus maximus*	1.31	1.61	1.46 ± 0.11
Juvenile	69	*Synapturichthys kleinii*	0.55	1.07	0.84 ± 0.01
Juvenile	23	*Umbrina cirrosa*	0.69	0.97	0.84 ± 0.01
Juvenile	120	*Sardina pilchardus*	0.26	0.46	0.36 ± 0.04
Juvenile	44	*Atherina boyeri*	0.47	0.64	0.55 ± 0.01
Adult	1	*Arnoglossus kessleri*	0.72	0.72	0.72
Adult	1	*Lesueurigobius friesii*	0.69	0.69	0.69
Adult	1	*Arnoglossus thori*	0.72	0.72	0.72
Adult	1	*Uronoscopus scaber*	1.52	1.52	1.52
Adult	3	*Arnoglossus laterna*	0.82	1.03	0.91 ± 0.05
Adult	1664	*Atherina boyeri*	0.24	1.56	0.57 ± 0.002
Adult	21	*Atherina hepsetus*	0.53	0.69	0.61 ± 0.01
Adult	10	*Belone belone*	0.07	0.12	0.08 ± 0.01
Adult	2	*Nerophis ophidion*	0.006	0.008	0.007 ± 0.001
Adult	54	*Sygnathus abaster*	0.01	0.05	0.03 ± 0.01
Adult	9	*Sygnathus acus*	0.01	0.05	0.03 ± 0.04
Adult	2	*Sygnathus typhe*	0.02	0.03	0.022 ± 0.003
Adult	2	*Callionymus pusillus*	0.90	0.99	0.94 ± 0.03
Adult	2	*Engraulis encrasicolus*	0.49	0.54	0.51 ± 0.02
Adult	11	*Gasterosteus aculeatus*	0.92	1.19	1.09 ± 0.02
Adult	516	*Pomatoschistus bathi*	0.26	1.91	0.73 ± 0.07
Adult	559	*Pomatoschistus marmoratus*	0.23	1.60	0.68 ± 0.01
Adult	13	*Pomatoschistus minutus*	0.57	0.78	0.66 ± 0.03
Adult	6	*Symphodus ocellatus*	0.96	1.37	1.22 ± 0.06
Adult	11	*Symphodus roissali*	0.96	1.35	1.15 ± 0.04

in length between 1.4 cm and 18.5 cm TL, the respective LWR were not calculated. Thus, the comparison of b values with this study may not be correct, according to Froese's (2006) hypothesis. Among the 32 species in this study, LWR and CF could be calculated separately only for *A. boyeri*. Growth type was found for juveniles to be isometric, whereas it was positive allometric for adults. Also, CF was calculated to be slightly higher for adults compared to juveniles. The results for *A. boyeri* support Froese's (2006) hypothesis that particular LWRs should be applied to juveniles and adults.

According to the author's knowledge, the CF values for 13 juvenile species presented in this study comprise the first data for Turkish waters. CF values are compared with some previous studies that included condition factor data for adults of similar species. Samsun and Sağlam (2021) detected the CF of adult *B. belone* and *U. scaber* from the Black Sea as 0.11 and 1.63, respectively. The findings for adult *B. belone* and *U. scaber* in our study coincide with the findings of Samsun and Sağlam (2021). Uçkun et al. (2004) determined the same CF value for adult *B. belone* from the Aegean Sea. Ergüden et al. (2018) detected higher

CF for adult *A. kessleri* (1.09) in İskenderun Bay, Türkiye. Bostancı and Coşkun (2020) found relatively the same CF value (0.65) for adult *A. hepsetus* in the Sea of Marmara, Türkiye. İlhan and İlhan (2018) found slightly higher CF for adult *A. boyeri* (0.67) in Homa Lagoon, Türkiye. Gürkan and Taşkavak (2011) found slightly higher CF values for adult *N. ophidion* (0.01), adult *S. typhle* (0.03), and adult *S. acus* (0.04) from the Aegean coasts. Şahin et al. (2008) found the CF for adult *E. encrasicolus* as 1.02 in 2004–2005 and 0.49 in 2005–2006 fishing seasons, in the eastern Black Sea, whereas Azgider (2016) found values between 0.60 and 0.72 in the Sea of Marmara. Ustaoğlu (2022) detected the CF of adult *S. roissali* as 1.63 in the southern Black Sea.

Consequently, when compared with the results of previous studies, the growth indicators (b and CF value) were mostly low for many species in this study. Comparisons remain limited as no studies were conducted about the effect of mucilage on adult fish and the early life stages of fish after previous mucilage events. The concrete data of Karadurmuş and Sarı (2022) and Dalyan et al. (2021) revealed adverse effects of mucilage on the health of fish stocks. Similar findings were identified by Karadurmuş (2022) for species sampled from beam trawl nets in the Sea of Marmara. Karadurmuş (2022) stated that low CF values may be a result of abnormal sea water characteristics and mucilage. Dissolved oxygen was measured between 6.5 mg/L and 9.4 mg/L, with a mean of 8.4 mg/L from December 2021 to March 2022 In this study, which was realized under the project of TÜBİTAK 121G097 (Daban et al., 2022) With a decrease in the mucilage density, it was observed that the oxygen values were increased. Thus, another possibility for slightly low CF values may be caused by low oxygen levels. The other possible explanation for low CF in the present study may be related difficulties in accessing food due to the dense mucilage cover on bentos. In addition, bacteria and viruses should play an important negative effect on other living organisms during mucilage both its ectohydrolytic enzymes which play a critical in producing long-lived polysaccharides to form mucilage (Azam et al., 1999) and their direct negative impact on the health of other living things. Thus, to consider the direct effect of mucilage on the condition and growth of fish species, the stomach contents, food possibilities, feeding behaviour and microbial status of fish and sea water should be taken together.

Undoubtedly, these data, which only reveal the condition factor, are insufficient to reveal stock health but may suggest important findings in terms of comparison after larger events that may occur in the future. It is difficult to make a definite judgment as no study was conducted in seas where mucilage was not observed concurrently. Nevertheless, the low condition of coastal species after the mucilage event may be an indication of an unhealthy ecosystem in the Sea of Marmara.

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