İskenderun Koyundan Monofilament Galsama Ağ ile Yakalanan Üç Ticari Balık Türünün Boy-Ağırlık İlişkileri ile Kondisyon İndeksleri, Türkiye

Büreç YEŞİLBDUK

Çukurova Üniversitesi, Fen Edebiyat Fakültesi, Biyoloji Bölümü, 01330, Adana

*https://orcid.org/0000-0002-3627-0024

*Sorumlu yazar: yesilbudak@gmail.com

Araştırma Makalesi

Makale Tarihiçi:
Geliş tarihi: 30 Eylül 2020
Kabul tarihi: 4 Aralık 2020
Online Yayınlanma: 2 Mart 2021

Anahtar Kelimeler:
Balık Büyümesi
Boy-Ağırlık İlişkisi
Geleneksel Balıkçılık
İskenderun Koyu
Kondisyon Faktörü

ÖZET
Bu araştırmada, İskenderun koyunda ekonomik yönden önemli olan üç ticari balık türünün toplam boy ve ağırlık ilişkileri (LWRs) ile Fulton’un kondisyon faktörünün (K) belirlenmesi amaçlanmıştır. Bu amaçla, kirlangıç balığı (Chelidonichthys lucerna, Linnaeus, 1758), dil balığı (Pegusa lascaris, Risso, 1810) ve şipura (Sparus aurata, Linnaeus, 1758) İskenderun koyundan 2016 yılında Eylül aylarında profesyonel bir balıkçının tek tarafından monofilament galsama ağ (göz açığı: 28) ile 10-20 metreden dipten toplanmıştır. Toplamda, 82 balık örneğinin toplam boy ve ağırlıkları 0,01 cm ve 0,01 g hassasiyetle ölçülmüştür. Yakalanan balıkların minimum-maksimum uzunluğu ve ağırlığı C. lucerna için 14,0-24,5 cm ve 31,2-126,6 g, P. lascaris için 18,5-25,55 cm ve 37,7-125,5 g, S. aurata için 14,5-26,6 cm ve 55,8-180,0 g olarak belirlenmiştir.UCH balık türünün toplam boy-ağırlık ilişkisi C. lucerna için W = 0,0837 * TL 0,28, P. lascaris için W = 0,0018 * TL 0,45 ve S. aurata için W = 0,0667 * TL 0,30 olarak bulunmuştur. Fulton’un kondisyon faktörü C. lucerna için 1,05 ± 0,04, P. lascaris için 0,72 ± 0,01 ve S. aurata için 2,00 ± 0,10 olarak tespit edilmiştir. Bu çalışmanın sonuçları, bu alanda ekonomik açıdan önemli balıkların LWR parametrelerine ve K indislerine katkı sağlayabilecek benzer balık stoklarını karşılaştırmak için yararlı olacaktır.

Research Article

Article History:
Received: 30 September 2020
Accepted: 4 December 2020
Published online: 2 March 2021

Keywords:
Fish Growth
Length-Weight Relationship
Artisanal Fisheries
İskenderun Bay
Condition Factor

ABSTRACT
In this study, it was aimed to determine the length and weight relationships (LWRs) and Fulton’s condition factors (K) for three commercial fish species in İskenderun bay. For this purpose, tub gurnard (Chelidonichthys lucerna, Linnaeus, 1758), sand sole (Pegusa lascaris, Risso, 1810), and gilthead seabream (Sparus aurata, Linnaeus, 1758) were collected by a single artisanal fisherman during September-December months in 2016 by means of monofilament gill nets mesh size:28 mm) used at depths 10-20 m in İskenderun bay. Totally, 82 fish samples captured and total lengths and weights of they were measured to the nearest 0,01 cm and to 0,01 g. Minimum-maximum length and weight of caught fishes were determined as 14,0-24,5 cm and 31,2-126,6 g for C. lucerna, 18,5-25,55 cm and 37,7-125,5 g for P. lascaris, 14,5-26,6 cm and 55,8-180,0 g for S. aurata. Total length-weight relationships of three fish species were found as \( W=0,0837*TL^{0,28} \) for C. lucerna, \( W=0,0018*TL^{0,45} \) for P. lascaris, and \( W=0,0667*TL^{0,30} \) for S. aurata. Fulton’s condition factors were detected as 1,05±0,04 for C. lucerna, 0,72±0,01 for P. lascaris, and 2,00±0,10 for S. aurata. Result of this study provides a contribution to parameters of LWRs and K indices of economically important fish in this area and the current study will be useful in order to compare
1. Introduction

Aquaculture is one of the fastest expanding food production sectors in all around the world, by per annual growth rate of 5.8% during the period 2000-2016 [1]. Hundreds of millions of people in the world depend on artisanal fisheries to survive and live, and artisanal fishing is critically important for not only food, but also for jobs, alimentation, food security, and destitution decline [2].

Over the past years, climate change, habitat degradation and wasteful immoderate fishing have created negative effects on fishing population, and these circumstances have also negatively caused yield sea food according to the Food and Agriculture Organization of the United Nations [3]. Further, these environmental disasters and alien fish migration have caused bioecological changes on native fish in coast of East Mediterranean and Aegean Sea. Artisanal fisheries have been widely affected depending on this situation [4]. Iskenderun bay has been known to have proportionally rich fishing resources compared to other fishing areas of eastern Mediterranean since 1940s [5]. It is well known that the length and weight relationships (LWRs) and Fulton’s condition factors (K) are quite useful in determining the fish condition, life history of fish and fish stock [6, 7]. They also provide useful equations to determine whether a somatic growth is isometric or allometric growth [8].

Tub gurnard, sand solea and gilthead seabream are economically important for many countries and there are several studies such as embryonic and larval development [9], reproduction [10, 11], length and weight relationships and growth [12, 10, 13, 14]. There is little current information and explanation for the Iskenderun bay obtained from LWRs, although it is a reliable calculation method for studied biological characteristics of fish populations in aquatic life. Basically, our objective was to contribute to up to date baseline information on LWRs and K analysis, which could be useful for subsequent bioecological and population-based studies on similar studies done in the eastern Mediterranean region.

2. Materials and Methods

This investigation was carried out near domestic area of Iskenderun, the sampling are located within 36°36’32.70”N-36°07’44.14” E in Iskenderun bay in Figure 1.

Figure 1. The study area, Iskenderun Bay

All fishes have been identified in the field by Whitehead et al. [15] and scientific names of samples were checked again according to FishBase [16]. Fishes were collected by monofilament gill nets mesh size 28 mm used at depths 10-20 m from Iskenderun bay in September and December 2016. Total length and wet weight were measured to the nearest 0.01 cm using callipers and 0.01 g using digital balance, respectively. Afterwards, fishes were immediately released at their natural habitats. In this study, sampling was made properly as the 4/1 notification regulates commercial fishery by the Ministry of Agriculture and Forestry of Turkey. The length and weight relationships were determined by using the equation \( W=axL^b \), where \( W \) is total wet weight (g), \( L \) is total length (cm), the value \( a \) is the y-intercept and the value \( b \) is the slope of Ordinary Least Squares regression [17].

The association between length and weight was computed by the determination of coefficient \( r^2 \) [8]. Fulton’s condition factors (K) were calculated by the formula \( K=WxL^2\times100 \) [18]. In order to identify the growth type (isometric or allometric) for all fish species, the value \( b \) of LWRs was tested for the deviation from the value of 3.0 by a \( t \)-test [8] and the \( b \) value of each species was
tested by t-test [19]. Data were evaluated by using Microsoft Office Excel 2010 and statistical packages of IBM SPSS 21 were used.

3. Results and Discussion

A total of 82 specimens belonging to three families were caught from İskenderun port. The number of samples, minimum and maximum values of length and weight of specimens together with LWRs parameters and K indices of Chelidonichthys lucerna, Pegusa lascaris, Sparus aurata were presented in Table 1. Linear regressions were significant (P<0.001), with the coefficient of determination r² values for three fish species. The values 95% confidence limits of b of three fish species were found as 2.001-2.567, 3.294-3.604, 3.106-3.498.

Table 1. Descriptive statistics, estimated length-weight relationships and Fulton’s condition factors of 3 commercial fish species caught by means of monofilament gill nets from İskenderun Bay (Turkey), during September-December 2016.

| Family   | Species     | n  | TL (cm) Min-Max | W (g) Min-Max | LWRs  | K       | GT | X ± Sx |
|----------|-------------|----|-----------------|---------------|-------|---------|----|--------|
| Triglidae | C. lucerna  | 25 | 14.0-24.5       | 31.2-126.6    | 0.0837 | 2.284   | 2.001-2.567 | 0.91 | A-     | 1.05±0.04 |
| Soleidae  | P. lascaris | 30 | 18.5-25.5       | 37.7-125.5    | 0.0018 | 3.449   | 3.294-3.604 | 0.90 | A+     | 0.72±0.01 |
| Sparidae  | S. aurata   | 27 | 14.5-26.6       | 55.8-180.0    | 0.0667 | 3.303   | 3.106-3.498 | 0.95 | A+     | 2.00±0.10 |

n: number of individuals, TL: total length, Min: minimum, Max: maximum, a and b: intercept and slope in aquation \( W = \log(a) + \log(L) \), 95%CI: confidence intervals, r²: coefficient of determination, GT: growth type, A+: positive allometry, A-: negative allometry, I: isometric, K: Fulton’s condition factors, X ± Sx : Mean±SE.

In this study, total lengths of 75% of C. lucerna, 36.6% of P. lascaris, and 100% of S. aurata samples were found to be under the maturity lengths 21.6 cm, 22 cm, and 33 cm, respectively, according to Fishbase data [16]. Minimum-maximum length and weight of caught fishes were determined as 14.0-24.5 cm and 31.2-126.6 g for C. lucerna, 18.5-25.5 cm and 37.7-125.5 g for P. lascaris, 14.5-26.6 cm and 55.8-180.0 g for S. aurata. Total length-weight relationships of three fish species were found as \( W = 0.0837^*L^{2.28} \) for C. lucerna, \( W = 0.0018^*L^{3.45} \) for P. lascaris, and \( W = 0.0667^*L^{3.30} \) for S. aurata. Fulton’s condition factors were detected as 1.05±0.04 for C. lucerna, 0.72±0.01 for P. lascaris, and 2.00±0.10 for S. aurata (see Table 1).

In this study, negative allometric growth was determined for C. lucerna, since its b value was less than 3. In a similar work carried out in the west cost of Portugal, the growth for tub gurnard was determined to be negative allometric (P<0.05) [12, 13].

We determine a positive allometry for the growth of P. lascaris as well as Tsagarakis et al. [22] have measured for sand soles sampled from Black Sea, Sinop (P<0.001). Computations show that S. aurata has a positive allometric growth in this study, whereas gilthead seabream showed negative allometric growth in another study (P<0.05), [13].

4. Conclusion

The value of parameter b was estimated at 2.28 for C. lucerna, 3.45 for P. lascaris and 3.30 for S. aurata. This data is compatible with the fact that the value of b must vary from 2 to 4 via Tesch [20]. Additionally, the value of b, as a characteristic of the species, is generally stable throughout the year [21]. All regressions were highly significant (P<0.001), and the values of coefficient r² ranged from 0.90 (P. lascaris) to 0.95 (S. aurata), and the value of r² for C. lucerna was determined as 0.91. A species with the value of b different from 3 is said to have allometric growth; otherwise, the type of the growth is isometric.
The length-weight relationship in fish is affected by a number of factors including season, habitat, sexual maturity, diet regimen, health, and conservation techniques [20]. The condition factor K was determined as 0.72 for *P. lascaris*, 2.00 for *S. aurata*, and 1.05 for *C. lucerna* (see Table 1), which increases during the reproductive cycle of the most of species, decreasing during the spawning season and increasing after that, and well matched with their reproductive cycle [16].

### Statement of Conflict of Interest

Author has declared no conflict of interest.

---

**Table 2.** Comparative results of summary of population biology data for *Chelidonichthys lucerna, Pegusa lascaris, Sparus aurata* from different times and locations.

| Region                                | n   | TL (cm) Min-Max | W(g) Min-Max | a   | b    | r²     | GT | K    | Authors |
|---------------------------------------|-----|-----------------|--------------|-----|------|--------|----|------|---------|
|                                       |     |                 |              |     |      |        |     |      |         |
| **Chelidonichthys lucerna**           |     |                 |              |     |      |        |     |      |         |
| Turkey (Iskenderun Bay)               | 2   | 22.3-23.7       | 0.0180       | 2.798 | 0.968 | A-     |     |      | [4]     |
| Portugal (Algarve Coast)              | 75  | 14-34.4         | 35-368       | 3.019 | 0.866 | A-     |     |      | [12]    |
| Portugal (Western Coast)              | 169 | 13.4-75.1       | 30.0-2810.0  | 2.668 | 0.931 | A-     |     |      | [13]    |
| Turkey (Iskenderun Bay)               | 342 | 8.0-18.7        | 0.009        | 2.99  | 0.98  | 0.221  |     |      | [10]    |
| Turkey (Marmara Sea)                  | 224 | 14.27-41.5      | 0.009        | 3.019 | 0.898 | A+     |     | 0.060-0.70 | [23]    |
| Portugal (Edremut Bay)                | 262 | 12.70-32.55     | 0.005        | 3.206 | 0.989 | 0.106  |     |      | [24]    |
| Turkey (Aegean Sea)                   | 546 | 12-34.4         | 20.58-439.4  | 3.240 | 0.987 | A+     |     | 0.163 | [25]    |
| Portugal (the Arade Estuary)          | 49  | 6-32.4          | 0.00931      | 3.01  | 0.961 | I      |     |      | [26]    |
| Italy (Adriatic Sea)                  | 6616| 12.2-37.4       | 17-425       | 3.057 | 0.967 | A+     |     | 0.25  | [28]    |
| Turkey (Black Sea-Tabzon)             | 1   | 828             | 6640         |      |      |        |     |      | [27]    |
| United Kingdom (North West Wales)     | 970 |                 |              | 3.10  | 0.966 | A+     |     | 0.25  |         |
| **Pegusa lascaris**                   |     |                 |              |      |      |        |     |      |         |
| Turkey (Iskenderun Bay)               | 1   | 22.4            |              |      |      |        |     |      | [4]     |
| Portugal (Western Coast)              | 22  | 20.3-33.4       | 90.0-420.0   | 3.130 | 0.816 | I      |     |      | [13]    |
| Croatia (Estuarine Systems)           | 15  | 9.8-30.6        | 0.0082       | 3.110 | 0.970 |        |     |      | [29]    |
| Portugal (the Arade Estuary)          | 140 | 3.3-24.2        | 0.00680      | 3.20  | 0.994 | A+     |     |      | [26]    |
| Turkey (Black Sea-Sinop)              | 93  | 10.4-22.2       | 07.01-110.33 | 3.484 | 0.95  |        |     |      | [22]    |
| **Sparus aurata**                     |     |                 |              |      |      |        |     |      |         |
| Turkey (Iskenderun Bay)               | 3   | 17.8-19.9       |              |      |      |        |     |      | [4]     |
| Turkey (South Coast of Iskenderun Bay)| 21  | 16.90-32        | 0.0406       | 2.679 | 0.971 | A-     |     |      | [30]    |
| Portugal (Algarve Coast)              | 210 | 23.5-67         | 175-3910     | 2.872 | 0.957 | A-     |     |      | [12]    |
| Greece (Northern Aegean Estuarine System)| 13 | 5.7-10.9       | 0.0153       | 2.996 | 0.992 |        |     |      | [31]    |
| Algeria Mellah Lagoon                 | 370 | 157-610         | 60-4000      | 3.067 | 0.92  | I      |     | 0.513 | [32]    |
| Portugal (the Arade Estuary)          | 99  | 6.6-37.3        | 0.01311      | 3.04  | 0.996 | A+     |     |      | [26]    |
| Turkey (Central Black Sea)            | 109 | 15.7-21.2       | 62.2-136.8   | 2.70  | 0.86  |        |     |      | [33]    |
| Turkey (Black Sea-Ord)                | 3   | 46.2-61.4       | 1500.6-3080.6|      |      |        |     |      | [34]    |
Author's Contributions

The contribution of the author is 100%.

References

[1] Food and Agriculture Organization of the United Nations. The State of World Fisheries and Aquaculture: Meeting the Sustainable Development. Roma- Italy: 2018.
[2] Food and Agriculture Organization of the United Nations. Voluntary Guidelines for Securing Sustainable Small-Scale Fisheries, in the Context of Food Security and Poverty Eradication. Roma- Italy: 2015.
[3] Food and Agriculture Organization of the United Nations. The state of world fisheries and aquaculture. Roma- Italy: 2014.
[4] Başusta N., Erdem Ü. A study on the pelagic and demersal fishes of İskenderun Bay, Turk J Zool 2000; 24, 1-20.
[5] Kossswing C. Some features of fisheries in Turkey (in Turkish), Hidrobiyol Mecmu 1953; A1(4): 145-153.
[6] Moutopoulos DK., Stergiou KI. Length-weight and length-length relationships of fish species from the Aegean Sea (Greece), J Appl Ichthyol 2002; 18, 200-203.
[7] Mozsár A., Boros G., Sály P., Antal L., Nagy SA. Relationship between Fulton's condition factor and proximate body composition in three freshwater fish species, J Appl Ichthyol 2015; 31(2): 315-320.
[8] Ricker WE. Computation and interpretation of biological statistics of fish populations, Bullet Fish Res Board Can 1975; 1(2): 519-529.
[9] Özyurt CE., Mavruk S., Kiyaga VB., Ersönmez H. Spawning ecology of Pegusa lascaris in İskenderun Bay (northeastern Mediterranean Sea), Fresenius Environ Bullet 2018; 27(10): 6500-6505.
[10] İşmen A., İşmen P., Başusta N. Age, growth and reproduction of tub gurnard (Chelidonichthys lucerna L. 1758) in the Bay of İskenderun in the Eastern Mediterranean, Turk J Vet Anim Sci 2004; 28(2): 289-295.
[11] Çiçek E., Avşar D., Özyurt CE., Yeldan H., Manasirli M. Age, growth, reproduction and mortality of tub gurnard (Chelidonichthys lucernus (Linnaeus, 1758)) Inhabiting in Babadillimani Bight (northeastern Mediterranean coast of Turkey), J Biol Sci 2008; 8(1): 155-160.
[12] Santos MN., Gaspar MB., Vasconcelos P., Monteiro CC. Weight-length relationships for 50 selected fish species of the Algarve Coast (Southern Portugal), Fish Res 2002; 59 (1-2): 289-295.
[13] Mendes B., Fonseca P., Campos A. Weight-length relationships for 46 fish species of the Portuguese west coast, J Appl Ichthyol 2004; 20(5): 355-361.
[14] Bolognini L., Domenichetti F., Grati F., Polidori P., Scarcella G. Weight-length relationship for 20 selected fish species in Adriatic Sea, Turk J Fish Aquat Sci 2013; 13, 555-560.
[15] Whitehead PJP., Bauchot ML., Hureau JC., Nielsen J., Tortonese E. Fishes of the northeastern Atlantic and the Mediterranean. Paris: Unesco; 1986.
[16] Froese R., Pauly D. FishBase. World wide web electronic publication 2019. http://www.fish-base.org. Accesses July 1, 2020.
[17] Le Cren ED. The length-weight relationship and seasonal cycle in gonad weight and condition in the Perch (Perca fluviatilis), J Anim Ecol 1951; 20, 201-219.
[18] Anderson R., Neumann R. Length, weight and associated structural Indices. In: Fisheries techniques. Maryland: Amer Fish Soc Bethesda; 1996.
[19] Sokal RR., Rohlf FJ. Introduction to biostatistics. NY: Freeman; 1987.
[20] Tesch FW. Age and growth in: methods for assessment of fish production in fresh waters. Oxford: WE Ricker (Ed) Blackwell Sci Pub; 1971.
[21] Mayrat A. Allometrie et taxinomie, Rév Stat Appl 1970; 18, 47-58.
[22] Tsagarakis K., Başusta A., Başusta N., Biandolino F., Bostanci D., Buz K., Djodjo Z., Dulcie J., Dul J., Gökoğlu M., Gücü AC., Machias A., Maravelias CD., Özvarol Y., Polat N., Prato E., Vasilakopoulos P., Yedier S. New fisheries-related data from the Mediterranean Sea (October 2015), Med Mar Sci 2015; 16(3): 703-713.
[23] Eryılmaz L., Meriç N. Some biological characteristics of the tub gurnard, Chelidonichthys lucerna (Linnaeus, 1758) in the Sea of Marmara, Turk J Vet Anim Sci 2005; 29, 367-374.

[24] Uçkun D. Investigation of the age and growth characteristic of the species belonging to the family triglidae in Edremit Bay, Ege Univ J Fish Aquat Sci 2005; 22(3-4): 363-369.

[25] İlhan D., Toğulga M. Age, growth and reproduction of tub gurnard Chelidonichthys lucernus Linnaeus, 1758 (Osteichthyes: Triglidae) from İzmir Bay, Aegean Sea, Eastern Mediterranean, Acta Adriatica 2007; 48(2): 173.

[26] Veiga P., Machado D., Almeida C., Bentes L., Monteiro P., Oliveira F., Ruano M., Gonçalves JMS. Weight–length relationships for 54 species of the Arade estuary, southern Portugal, Journal of Applied Ichthyology 2009; 25(4): 493-496.

[27] Hasımoğlu A., Ak O., Kasapoğlu N., Atlgan E. New maximum length report of (Chelidonichthys lucerna L. 1758) in Black Sea. Turkey, J Black Sea/Med Environ 2016; 22(2): 149-154.

[28] McCarthy ID., Marriott AL. Age, growth and maturity of tub gurnard (Chelidonichthys lucerna Linnaeus 1758; Triglidae) in the inshore coastal waters of Northwest Wales, UK, Journal of Applied Ichthyology 2018; 34(3): 581-589.

[29] Dulčić J., Glamuzina B. Length–weight relationships for selected fish species from three eastern Adriatic estuarine systems (Croatia), Journal of Applied Ichthyology 2006; 22(4): 254-256.

[30] Can MF., Baştuta N., Çekiç M. Weight-length relationships for selected fish species of the small- scale fisheries off the south coast of İskenderun Bay, Turk J Vet Anim Sci 2002; 26, 1181-1183.

[31] Kautrakis ET., Tsikliras AC. Length-weight relationships of fishes from three northern Aegean estuarine systems, J Apply Ichthyol 2003; 19(4): 258-260.

[32] Chaoui L., Kara MH., Faure E., Quignard JP. Growth and reproduction of the gilthead seabream Sparus aurata in Mellah lagoon (north-eastern Algeria), Sci Mar 2006; 70(3): 545-552.

[33] Samsun O., Akyol O., Ceyhan T., Erdem Y. Length weight relationships for 11 fish species from the Central Black Sea, Turkey, Ege J Fish Aquat Sci 2017; 34(4): 455-458.

[34] Aydın M. Maximum length and age report of Sparus aurata (Linnaeus, 1758) in Balck Sea, J Appl Ichthyol 2018; 34, 964-966.