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RESEARCH ARTICLE

Length-weight relationships of *Glaucostegus cemiculus* (Geoffroy Saint-Hilaire, 1817) from the Aegean Sea and northeastern Mediterranean coasts of Turkey

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Abstract

Glaucostegus cemiculus individuals were collected from two different areas, the estuary of the Gediz River, Izmir Bay (Aegean Sea) on the west and Karataş, Iskenderun Bay on the northeastern coasts of the eastern Mediterranean. Total of 383 individuals (190 male, 193 female) were examined. Individuals ranged between 30-148 cm TL and 81-12010 g. The length-weight relationships were estimated for each area, each sex and combined data, and for Izmir Bay, Iskenderun Bay and combine data were all positive allometry and was as $W=0.0021L^{3.13}$, $W=0.0015L^{3.15}$, and $W=0.0018L^{3.12}$, respectively.

Keywords: *Glaucostegus cemiculus*, length-weight relationships, eastern Mediterranean, Izmir Bay, Iskenderun Bay

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Introduction

Blackchin guitarfish, *Glaucostegus cemiculus* (Geoffroy Saint-Hilaire, 1817), inhabits the Mediterranean, from the northwestern Mediterranean off France, the east coast of Tunisia, along the north coast of Africa, and in the eastern Mediterranean from Israel to southeastern Turkey (Golani *et al.* 2006; Akyol and Capape 2014; Newell *et al.* 2017). Although *Rhinobatos* species have a high economic value in other parts of the Mediterranean Sea, it has a lower economic value and is sold as doner or shish kebab in restaurants of northeastern parts of Mediterranean (Karalar 2005; Çek *et al.* 2009; Echwikhi *et al.* 2014). Despite its large distribution range and commercial value in the Mediterranean, there are few studies on the species which are mostly focused around Tunisia (Capape and Zaouali 1994; Enajjar 2009; Enajjar *et al.* 2012;

Echwikhi *et al.* 2014). While these studies provide information for the species age, growth, reproduction and diet in general, but only from a certain area, the lack of information from other parts of Mediterranean Sea increases the need for biological observations on the species. In case of *G. cemiculus*, it has become more crucial troughout the years, since recently large numbers of *G. cemiculus* have started to migrate north as the Mediterranean warms, the species has already been extirpated from some parts of the Mediterranean, around Sicily and the Balearic Islands of Spain, and there are reports of decline in average size of *Rhinobatos* spp. landed in Banc d' Arguin National Park, Mauritania where guitarfish species inhabit and have been under fishing pressure for some time (Newell *et al.* 2017). Even though there is no quantitative historical or current abundance information on *G. cemiculus*, it appears that it is declining in abundance and unfortunately there are no species-specific management measures currently in place for this species in the Mediterranean Sea (Notarbartolo di Sciara *et al.* 2016). Due to this, basic biological data is an essential need especially for endangered cartilaginous species that are lesser known than their famous relatives such as the great white shark.

Length and weight data and estimations on their relationship (LWR) are useful and standard practice for biological and oceanographic modelling studies, as well as crucial for species conservation and management plans (Kohler *et al.* 1996; Schneider *et al.* 2000). In the LWR equation ($W=aL^b$), a is the coefficient of body shape, with values around 0.1 for fishes which are small sized and with a rounded body shape, 0.01 for streamlined-shaped fishes and 0.001 for eel-like shaped fishes. In contrast, b is the coefficient balancing the dimensions of the equation and its value can be smaller, larger or equal to 3.00. In the first two cases results of b indicates (i.e., $b<3.00$ and $b>3.00$) that fish growth is allometric (i.e., when $b<3.00$ the fish grows faster in length than in weight, and when $b>3$ the fish grows faster in weight than in length), whereas when $b=3.00$ growth is isometric (Karachle and Stergiou 2012). These results provide information on the species population dynamics and provide a baseline for further studies.

In this study, for an "Endangered" species as an IUCN status, blackchin guitarfish, *Glaucostegus cemiculus*, LWR was examined from two different areas located far apart from each other along the Turkish coasts of the eastern Mediterranean.

Materials and Methods

Individuals were collected from two different areas, the estuary of the Gediz River, Izmir Bay, the Aegean Sea on the west and from Karataş, Iskenderun Bay on the northeast coasts of the eastern Mediterranean (Figure 1). Samples from Izmir Bay (117 in total) were collected from gillnet fishermen monthly, between July 2015- June 2016. Iskenderun Bay (266 in total) samples were

collected by trawling (individuals smaller than 80 cm) and longline fisheries as scientific surveys (individual larger than 80 cm) seasonally between 2011 and 2013. After brought to the laboratory and species identification, sex determination and morphological measurements were taken before dissection. Sex determinations were made macroscopically from external observations based on the existence of claspers. Length and weights were measured; length measurements were made by using a measuring board with a sensitivity of 1 mm, and weight measurements were made with an electronic scale with a sensitivity of 1 g.

Figure 1. The sampling areas indicated with a star in Iskenderun and Izmir Bay

The length-weight relationship (LWR) was calculated by using power type equation, i.e., $W=a L^b$. In this equation, where (W) is the total weight (g), (L) is the total length (cm), while a and b are constants for each species. The b value for this species was tested at the 0.05 significance level to verify if it was significantly different from 3. The significance of linear regression was assessed by Analysis of Variance (ANOVA).

Results

Total of 383 individuals (190 male, 193 female) were examined. Individuals ranged between 30-148 cm TL and 81-12,010 g. The length-weight relationships were estimated for each area, each sex and combined data and parameters are presented in Table 1 and Figures 2, 3, 4. After the calculation of parameter b results for each area, each sex and combined data were examined, it was observed that growth in Izmir Bay for each sex and overall data showed isometry, in Iskenderun Bay each sex and overall showed positive allometry, and for combined each sex and overall data showed positive allometry.

Table 1. Length-weight relationship parameters for each sex and all individuals

Location	Sex	N	a	b	R^2	SE of b	Upper 95%	Lower 95%
Izmir Bay	Overall	117	0.0021	3.1284	0.9652	0.0550	3.2173	2.9994
	Female	44	0.0022	3.0923	0.9581	0.0752	3.2477	2.9443
	Male	73	0.0021	3.1116	0.9669	0.0770	3.2812	2.9742
Iskenderun Bay	Overall	266	0.0015	3.1496	0.9733	0.0321	3.2128	3.0864
	Female	149	0.0014	3.1708	0.9738	0.0430	3.2196	3.0495
	Male	117	0.0016	3.1346	0.9730	0.0485	3.2668	3.0748
Combined	Overall	383	0.0018	3.1201	0.9653	0.0303	3.1797	3.0606
	Female	193	0.0020	3.0993	0.9670	0.0414	3.1809	3.0176
	Male	190	0.0016	3.1461	0.9637	0.0445	3.2339	3.0583

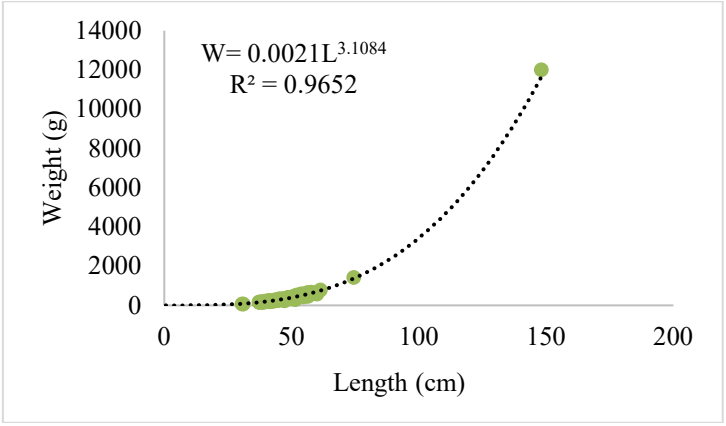

Figure 2. Length-weight relationship of all individuals from Izmir Bay

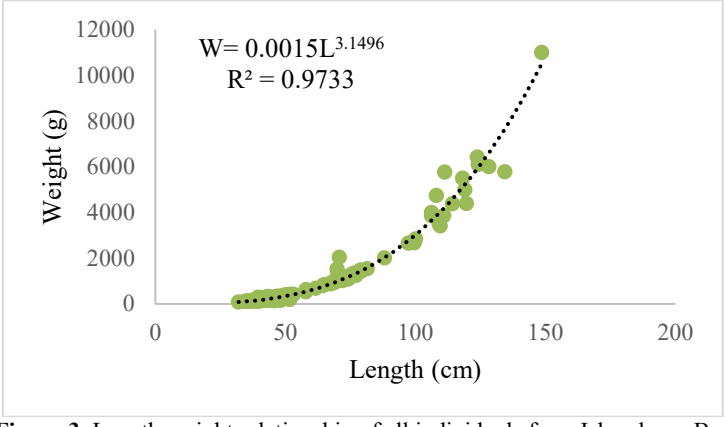

Figure 3. Length-weight relationship of all individuals from Iskenderun Bay

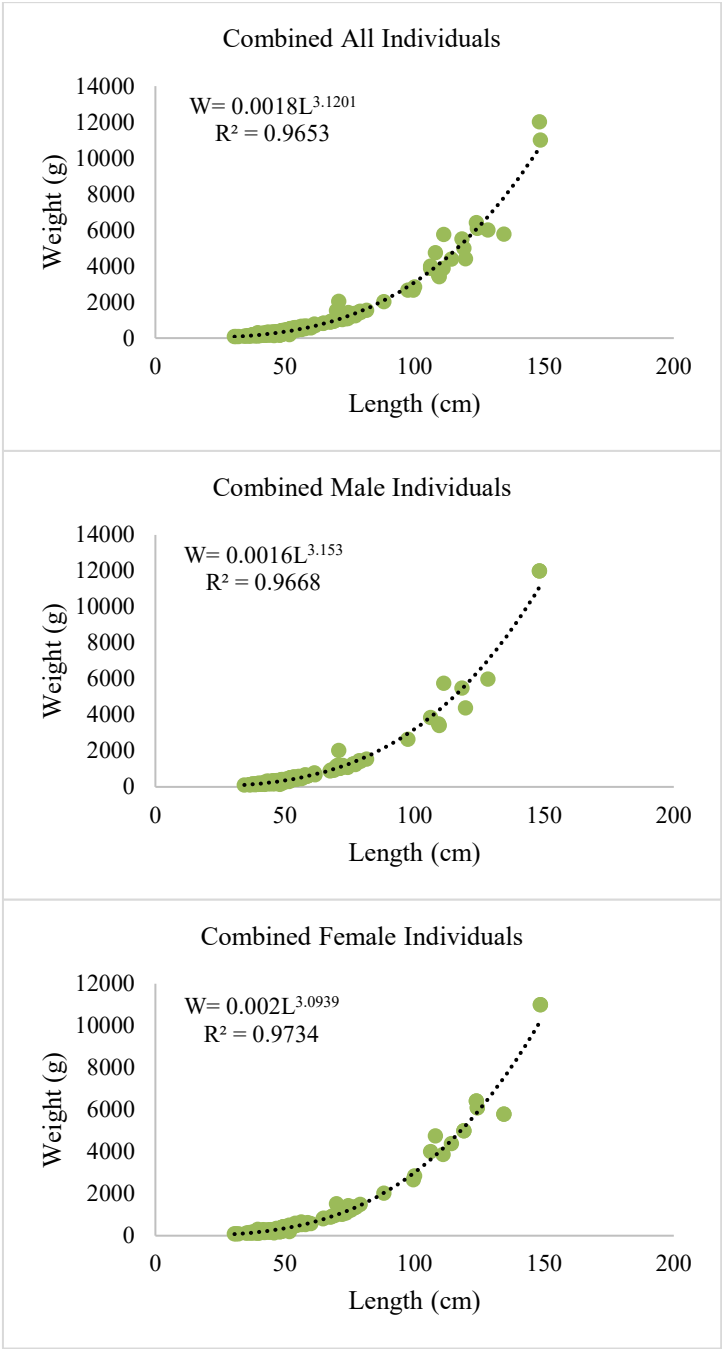

Figure 4. Length-weight relationships for combined each sex and all individuals

Discussion

Even though there are few studies on *Glaucostegus cemiculus* in the eastern Mediterranean Sea, there are more studies on this species in terms of age, growth and reproduction in the western Mediterranean, as well as one from the tropical Atlantic Ocean (Capape and Zaouali, 1994; Seck *et al.* 2004; Enajjar, 2009; Enajjar *et al.* 2012). Only LWR study carried out on the species from the Turkish coasts of the eastern Mediterranean Sea was from Iskenderun Bay by Basusta *et al.* (2012), where LWR was reported for all individuals as $W=0.00265L^{3.02}$ and $R^2=0.86$ (Table 2). Though reported parameter b results of LWR from Iskenderun Bay (Basusta *et al.* 2012) show close similarity with Iskenderun Bay samples and combined dataset in this study, especially when confidence interval of coefficient b is considered, LWR estimation herein represents a more accurate and precise results for the species. In addition, Akyol and Capape (2014) report the occurrence of the species with some morphological measurements from Izmir Bay. Produced parametrization for Izmir Bay samples fits well to this reported measurement. This situation indicates that this parametrization can be used in broader spatial-temporal scale for further modelling studies. However as previously mentioned, LWRs are useful and standard practice and crucial for species conservation and management (Kohler *et al.* 1996, Schneider *et al.* 2000). In this regard, further LWR from different locations, especially between Izmir and Iskenderun Bay, will provide more reliable validation for the model.

Another LWR from the eastern Mediterranean is found in a study from the Lebanese coast (Lteif *et al.* 2016), which reported that species LWR was $W=0.00457L^{2.91}$ (Table 2) and showed (-) allometry. However, due to the lack of provided statistical description in the study, it has not been possible to evaluate if (-) allometry is significantly different from isometry. Detailed statistics of coefficient b may be required to conclude whether the species has any particular allometry as Lteif *et al.* (2016) mentioned, since both Basusta *et al.* (2012) and the present study showed higher b value than that of Lteif *et al*. (2016) but close to 3.00 (from Izmir Bay the lowest b value was below 3.00). When confidence interval is considered for the parameter b, Izmir Bay samples do not show a significant positive allometry, while Iskenderun Bay population showed a significant (+) allometry, in which coefficient b was very close to 3.00. Overall, these positive or negative deviances of coefficient b from three estimations are in narrow range. This may indicate that the species has an isometry tendency and shifts slightly to the negative or positive depending to the environmental factors, such as temperature or food availability, which are known to affect LWR (Froese and Pauly 2000) in their habitats, since b indicates faster growth of weight over length or very opposite.

As a conclusion, it shows the need for further measurements with the simultaneous ecological measurements or importance of coupling LWR with

ecological parameters especially for this species for a more comprehensive output.

Table 2. Length weight relationships reported for *Glaucostegus cemiculus* (both sexes combined)

Location	N	LWR	R^2	Source
Iskenderun Bay	262	$W=0.00265L^{3.02}$	0.86	Başusta *et al.* 2012
Lebanese coast	31	$W=0.00457L^{2.91}$	0.98	Lteif *et al.* 2016
Izmir Bay	117	$W=0.0021L^{3.13}$	0.97	This study
Iskenderun Bay	266	$W=0.0015L^{3.15}$	0.97	This study
Izmir and Iskenderun Bay	383	$W=0.0018L^{3.12}$	0.97	This study

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Türkiye'nin Ege Denizi ve Kuzeydoğu Akdeniz kıyılarından *Glaucostegus cemiculus* (Geoffroy Saint-Hilaire, 1817)'un boy-ağırlık ilişkileri

Öz

Glaucostegus cemiculus bireyleri batıda Gediz Lagünü, İzmir Körfezi (Ege Denizi) ile Türkiye'nin doğu Akdeniz kıyılarında Karataş, İskenderun Körfezi'nden toplanmıştır. Toplamda 383 birey (190 erkek, 193 dişi) incelenmiştir. Bireyler 30-148 cm TL ve 81-12010 g arasında dağılım göstermektedir. Boy-ağırlık ilişkisi her bölge, cinsiyet ve birleştirilmiş veri seti ayrı ayrı yapılmış olup sırasıyla İzmir Körfezi, İskenderun Körfezi ve birleştirilmiş olarak $W=0.0021L^{3.13}$, $W=0.0015L^{3.15}$ ve $W=0.0018L^{3.12}$ bulunmuştur.

References

Akyol, O., Capape, C. (2014) Distribution of blackchin guitarfish *Rhinobatos cemiculus* E. Geoffroy Saint-Hilaire, 1817 (Elasmobranchii: Rhinobatidae) with first records from İzmir Bay (Turkey, northeastern Aegean Sea). *Turkish Journal of Zoology* 38(4): 460-465.

Başusta, A., Başusta, N., Sulikowski, J. A., Driggers, W. B., Demirhan, SA, Cicek, E. (2012) Length-weight relationships for nine species of batoids from the Iskenderun Bay, Turkey. *J.Appl. Ichthyol*. 28: 850-851.

Capapé, C., Zaouali, J. (1994). Distribution and reproductive biology of the blackchin guitarfish, *Rhinobatos cemiculus* (Pisces: Rhinobatidae), in Tunisian waters (central Mediterranean). *Marine and Freshwater Research* 45(4): 551-561.

Çek, S., Basusta, N., Demirhan, S.A., Karalar M. (2009) Biological observations on the common guitarfish *Rhinobatos rhinobatos* from İskenderun Bay (Turkey, Eastern Mediterranean). *Animal Biology* 59: 211-230.

Echwikhi, K., Saidi, B., Bradai, M. N. (2014) Elasmobranchs longline fisheries in the Gulf of Gabes (southern Tunisia). *Journal of the Marine Biological Association of the United Kingdom* 94(1): 203-210.

Enajjar, S., Bradai, M.N., Bouain, A. (2012) Age, growth and sexual maturity of the blackchin guitarfish *Rhinobatos cemiculus* in the Gulf of Gabe`s (southern Tunisia, central Mediterranean). *Cahiers de Biologie Marine* 53: 17–23.

Enajjar, S. (2009) Diversité des Rajiformes et étude écobiologique de *Rhinobatos rhinobatos* et *Glaucostegus cemiculus* (Famille des Rhinobatidae) du Golfe de Gabès (Tunisie). Thesis, university Sfax, Tunisie. 173 pp.

Froese, R., Pauly, D. (2000) Fishbase 2000: Concepts, Designs and Data Sources, World Fish, http://www.fishbase.org/manual/contents.htm. version (10/2017).

Golani, D., Öztürk, B., Başusta, N. (2006) Fishes of the Eastern Mediterranean. Turkish Marine Research Foundation, Istanbul, Turkey. Pub. Number: 24, 259 pp.

Karachle, P.K., Stergiou K.I. (2012) Morphometrics and allometry in fishes. p. 65-86. In: Morphometrics, (ed., Wahl, C.), In Tech. Available from: http://www.intechopen.com/articles/show/title/morphometrics-and-allometry-in-fishes. (01/2018)

Karalar, M. (2005) Reproduction and Feeding of Guitarfish (*Rhinobatos rhinobatos* Linnaeus, 1758) in Iskenderun Bay. MSc Thesis, Science Institute, Mustafa Kemal University, Hatay, Turkey. 29 pp, (In Turkish).

Kohler, N. E., Casey, J. G., Turner, P. A. (1996) Length-Length and Length-Weight Relationships for 13 Shark Species from the Western North Atlantic. *NOAA Technical Memorandum* NMFS-NE-110, 22 pp.

Lteif, M., Mouawad, R., Jemaa, S., Khalaf, G., Lenfant, P., Verdoit-Jarraya, M. (2016) The length-weight relationships of three sharks and five batoids in the Lebanese marine waters, eastern Mediterranean. *The Egyptian Journal of Aquatic Research* 42(4): 475-477.

Newell, B. M., Cantillo, A. Y., Pikula, L., Hale, K. K., Collins, E. V., Caballero, R. (2017) Status Review Report of Two Species of Guitarfish: *Rhinobatos*

rhinobatos and *Rhinobatos cemiculus*. Report to National Marine Fisheries Service, Office of Protected Resources.

Notarbartolo di Sciara, G., Bradai, M.N., Morey, G., Brahim, K., Camara L., Litvinov, F., Dulvy, N. Doumbouya, F., Ducrocq, M., Heenan, A., Sidi, N. (2016) *Glaucostegus cemiculus*. The IUCN Red List of Threatened Species 2016:e.T63132A104009894.http://sci-hub.tw/10.2305/IUCN.UK.2016-3.RLTS.T63132A104009894.en. Downloaded on 15 February 2018.

Schneider, J.C., Laarman, P.W., Gowing, H. (2000) Length-weight relationships In: Manual of Fisheries Survey Methods II: with Periodic Updates, (ed., Schneider, J.C.), Michigan Department of Natural Resources, Fisheries Special Report 25, Ann Arbor, Michigan.

Seck, A.A., Diatta, Y., Diop, M. Guélorget, O. (2004) Observations on the reproductive biology of the blackchin guitarfish, *Rhinobatos cemiculus* E. Geoffroy Saint-Hilaire, 1817 (Chondrichthyes, Rhinobatidae) from the coast of Senegal (Eastern Tropical Atlantic). *Scientia gerundensis* 27: 19-30.