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Growth Parameters of the Silverstripe Blaasop, *Lagocephalus sceleratus* (Gmelin, 1789) from the Mediterranean Coast of Turkey

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Research Article

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Abstract

Some biological aspects of silverstripe blaasop from the Turkish coast were studied in terms of morphometry age and growth. Samples were collected between December 2011 and May 2013, comprising of 100 inviduals of *Lagocephalus sceleratus* (Gmelin,1789) from Antalya Bay. The age of each specimen was estimated based on vertebra analysis, and the age of *L. sceleratus* ranged between one and five years. Length weight relationships were calculated as $W= 0.0102TL^{3.0118}$ and Von Bertalanffy growth function $L_t=79.48\ (1-e^{-0.18537(t+0.61791)})$. The results were discussed with data available from different studies.

Key words: Age, growth, silverstripe blaasop, Turkey

Türkiye'nin Akdeniz Kıyılarından Gümüş Bantlı Balon Balığı *Lagocephalus sceleratus* (Gmelin, 1789)'un Büyüme Parametreleri

Özet

Türkiye'nin Akdeniz kıyılarından, gümüş bantlı balon balığının bazı biyolojik özellikleri, yaş ve büyüme açısından incelenmiştir. Aralık 2011-Mayıs 2013 tarihleri arasında Antalya Körfezi'nden *Lagocephalus sceleratus* (Gmelin, 1789) türüne ait toplamda 100 birey toplanmıştır. Her bir bireyin yaşı, omurga analizine dayanarak okunmuştur ve bu çalışmada *L. sceleratus*'un yaş aralığı I-V yıl olarak belirlenmiştir. Boy-ağırlık ilişkisi $W = 0.0102\ TL^{3.0118}$ ve Von Bertalanffy büyüme fonksiyonu $Lt = 79.48\ (1\text{-}e^{(-0.18537\ (t\ +\ 0.61791))})$ olarak hesaplanmıştır ve sonuçlar farklı çalışmalardan elde edilen verilerle karşılaştırılmıştır.

Anahtar Kelimeler: Yaş, büyüme, gümüş bantlı balon balığı, Türkiye

INTRODUCTION

The silverstripe blaasop, *Lagocephalus sceleratus* (Gmelin, 1789) belongs to the family Tetraodontidae; with the native range in the Indo-West Pasific Ocean (Smith and Heemstra 1986; Aydın, 2011). It inhabits tropical waters at depths ranging from 18 to 100 m, preferably on reefs (May 1986; Türker-Çakır et al., 2009). It contains Tetrodotoxin (TTX) which can cause death by muscular paralysis, respiratory depression and circulatory failure (Field, 1998; Akyol et al., 2005).

L. sceleratus is a Lessepsian immigrant and was first recorded in the Gökova coast of Turkey from the Eastern basin of the Mediterranean Sea on 17 February 2003 (Akyol et al., 2005). Additional some records followed from Mediterranean coast of Israel, (Golani and Levy, 2005) in the marine of Rhodes Island (SE Aegean Sea, Greek) on 21 September 2005 (Corsini et al., 2006); a single specimen from Kemer-Antalya coast (Antalya Bay, eastern Mediterranean Sea) on 18 September 2004 and another specimen was speared from Hekim Island- İzmir Bay (Aegean Sea) on 21 April 2006 (Bilecenoğlu et al., 2006); a specimen was caugt in July 2005 in Heraklion Bay and another specimen was caught in December 2005 in Georgipoupolis Bay (Cretan Sea) (Kasapidis et al., 2007); a single specimen in Edremit Bay (Aegean Sea) in July 2008 (Türker-Çakır et al., 2009); four specimens were caught in February 2009 in İskenderun Bay (Torcu-Koç et al., 2011); two specimens were caught from Mersin

coast (Mersin Bay, north-eastern Mediterranean Sea) on 10 November 2010 and other two specimens Konacık Harbour (İskenderun Bay northeastern Mediterranean Sea) on 29 November 2010 (Yağlıoğlu et al., 2011); in the southern gulf of Gabes, Central Mediterranean on December 2010 (Jribi and Bradai, 2012); five inviduals were caught in Ain Al Ghazala, Libya in September 2010 (Milazzo et al., 2012). *L. sceleratus* has established new territories of the Eastern Mediterranean Sea.

Length-weight relationships are important because they: allow the conversion of growth-in-length equations to growth-in-weight, for use in stock assesment models; allow the estimation of biomass from length observations; allow an estimate of the condition of fish; and are useful for between-region comparisons of life histories of a certain species (Wootton, 1991; Pauly, 1993; Petrakis and Stergio, 1995; Gonçalves et al., 1996; Moutopoulos and Stergio, 2002). Relationships between different types of lengths are also very important for comparative growth studies (Moutopoulos and Stergio, 2002).

The population structure of *L. sceleratus* should be monitored regularly in distribution areas due to the rapidly adapted new environment. The aims of this study were to investigate (i) the relationships between different morphometric parameters and the population structures, (ii) growth and age determination of the vertebrae. The results are discussed with respect to observations from the same and different areas.

MATERIALS and METHODS

Specimens of silverstripe blaasop *L. sceleratus* were collected from commercial catches and fishing line at the Antalya Bay between December 2011 and May 2013. In this study, a total of 100 *L. sceleratus* was examined. The sex (female and male) was determined by macroscopic observation of the gonads. Total body weight was recorded with an electronic balance at the nearest 0.1 g. Length-weight relationships (LWRs) were calculated for male, female and combined sex by the exponential regression equation: $W=a\ TL^b$ (Ricker, 1975); where W is the total body weight in g, TL is the total length in cm, a and b the parameters to be established. The 95% confidence interval (95% CI), CI of *b* was computed using the equation: $s(b)*t_{(n-2)}$ where s(*b*) is standart error of *b* (Sparre and Venema, 1998). The age of this species were determinedby vertebrae. The trunk vertebrae was carefully removed and placed in boiling water for 5 minutes, cleaned from tissues. The mechanically uncleaned backbones were left in 5-25 % sodium hydrocloride for about 1day and rinsed distilled water (Karataş, 2005). Age was determined by counting the apaque rings on the vertebral centrum.

The von Bertalanffy growth equation $L_t= L_\infty\ (1\text{-}e^{-k(t+to)})$ was used to describe the growth of silvestripe blaasop. The von Bertalanffy growth equation $L_t= L_\infty\ (1\text{-}e^{-k(t+to)})$ where t is age, L_t is the length at time t. Asymptotic length (L_∞), growth cofficient (k) and theoritical age (t_o) were calculated using the Ford-Walford method (Avşar, 2005; Aydın, 2011). The growth performance index (Φ) was calculated. $\Phi = 2 \log_{10} L\infty + \log_{10} K$ (Pauly and Munro, 1984) where L_∞ and k were parameters of the von Bertalanffy growth equation. Additionally, the stomach content of silvestripe blaasop was examined by macroscopic.

RESULTS

Total length range, weight range, parameters of LWR and 95% CI of *b* are presented for of male, female and all fish in Table 1. Graphic of LWRs is given in Figure 1, Male exhibitied negative allometric growth ($b<3$), female and all sampled fish exhibitied positive allometric growth ($b>3$) in Table 1.

Table 1. Parameters of length-weight relationships for *L. sceleratus*, male, female and all sampled fish (M: Male; F: Female; LR: Length Range; N: Number of inviduals; WR: Weight Range; *a* and *b*, Intercept and Slope of Length–Weight Relationships; r^2, Coefficient of Determination; SE(*b*): Standart Error of *b*; 95% CI: Confidence Interval)

Sex	N	LR (cm)	WR (g)	*a*	*b*	r^2	SE(*b*)	95% CI of *b*
M	52	19.0-57.4	58.60-1981.00	0.0108	2.9914	0.9903	0.0299	0.0593
F	48	13.2-57.6	28.20-2042.80	0.0096	3.0337	0.9921	0.0272	0.0539
All	100	13.2-57.6	28.20-2042.80	0.0102	3.0118	0.991	0.0289	0.0574

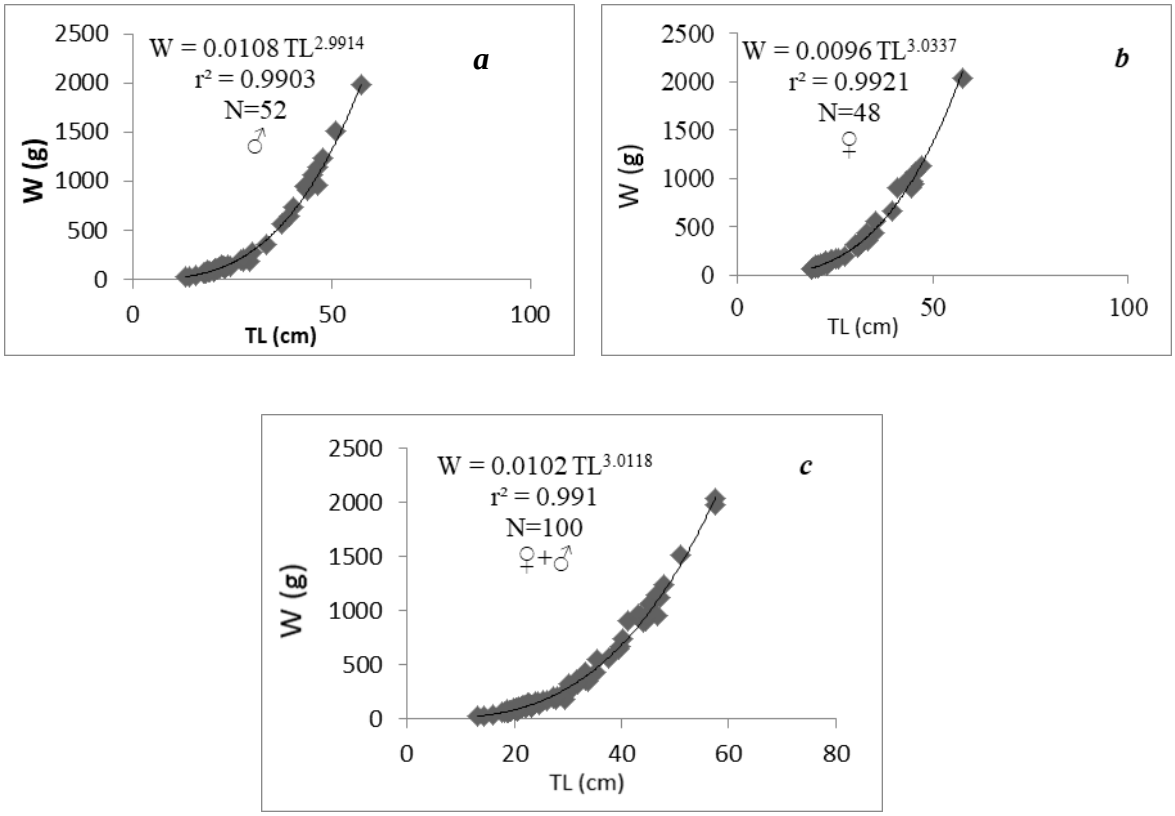

Figure 1. The total length- weight relationships of the a) male, b) female and c) sex combined of *L. sceleratus* in Antalya Bay

The age distribution of samples ranged from I to V years based on the results of vertebra reading. The age group I was dominant (49%), followed by age groups II (32%), IV (11%), III (4%) and V (4%).

The growth was described by the von Bertalanffy model based on the back-calculated length at age data (Figure 2). Estimates of L_{∞}, k, and t_0 obtained from Ford-Walford were respectively 79.48; 0.18537 and -0.61791. The values of the growth performance index (Φ) calculated as 3.069 in this study (L_{∞}=79.48) and were given along with the values of other authors in Table 2.

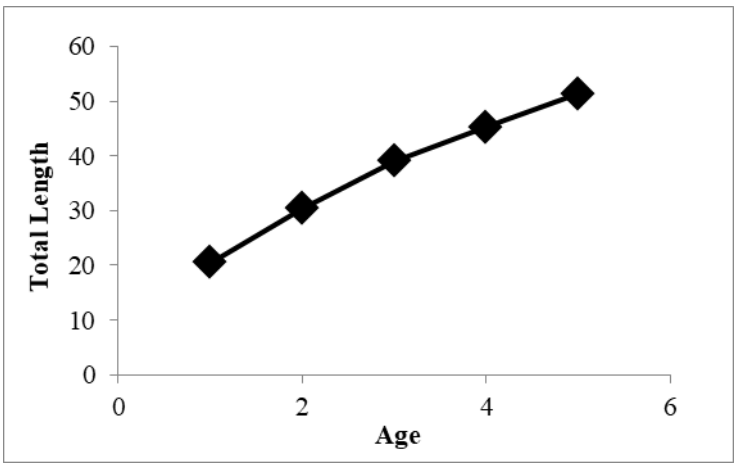

Figure 2. The von Bertalanffy growth curve for *L. sceleratus* in Antalya Bay (Mediterranean Coast of Turkey)

Table 2. Values of L_∞ (cm), k (years)$^{-1}$, t_0 (years)$^{-1}$ and Φ of other studies for *L. sceleratus* (L∞ : Theasymptotic Length,; k: Growth Coefficient; t_0: theoretical age; Φ: The Growth Performance Index)

L_∞ (cm)	k	t_0	Φ	References
81.1	0.26	-	3.23	Sabrah et al., 2006
82	0.5	-	-	Michailidis, 2010
126.6	0.0994	-0.4336	3.197	Aydın, 2011
106.34	0.17	0.0228	3.289	Farrag et al., 2015
109.72	0.12	-0.4544	-	Ersönmez et al., 2017
79.48	**0.18537**	**-0.61791**	**3.069**	**This study**

The population *L. sceleratus* is carnivorous which was seen to feed on shrimps, fishes, crabs, squids, cuttlefish, a remnant of fishnet, fishing hook and piece of stone in this study.

DISCUSSION

L. sceleratus has come under the scientific spotlight since first being noted in the Mediterranean in the early 2000s due to (i) the rapid invasion (ii) ecological as well as socio-economic (fisheries) impacts (iii) and threat it poses to human health due to its toxicity. The maximum observed length and weight (57.6 cm) is well below the maximum values of 110 cm reported in Japan (Masuda et al., 1984), 78.5 cm in the Suez Canal (Sabrah et al., 2006); 78.4 cm in Iskenderun Bay (Başusta et al. 2013); 77 cm in Cyprus (Michailidis, 2010); 71.5 cm in New Caledonia (Letourneur et al., 1998); 65 cm in Antalya Bay (Aydın, 2011). Additionally, the maximum weight of fish observed in the present study (2042.80 g) is also lower than that of 7000 g reported (Smith and Heemstra, 1986); 5100 g (Sabrah et al., 2006); 4750 g (Başusta et al., 2013); 5600 g (Michailidis, 2010), 3465 g (Aydın, 2011).

Length-weight relationships are important in fisheries biology because they allow estimation of the average weight of the fish at a given length, by establishing a mathematical relationship between weight and length (Kalogirou, 2013). Additionally, this mode of growth for males was nearly the same other recorded while the type of growth in all fishes and females was different other recorded in Table3. This difference may due to variations in habitats, biological, environmental conditions, seasonality, sex or even the used of narrow length range.

This findings are lower than compared with previously studies in Table 3. The difference between previously and present studies may be from differences numbers of invidual in age groups.

The population *L. sceleratus* is carnivorous which was seen to feed on shrimps, fishes, crabs, squids and cuttlefish. Our results are consistent with Sabrah et al. (2006) and Aydın (2011). Additionally there are remnant of fishnet, fishing hook and piece of stone in this study.

Studying growth patterns and other life cycle characteristics of invasive species are important to understand and possibly respond to the newly invaded environment. In addition, long term approaches and continuous studies are required for invasives to monitor their spatial distribution and population status. Finally over the last ten years silvestre blaasop have rapidly spread and reproduced in southern coasts of Turkiye (the Eastern Mediterranean Sea). The results of this research showed, growth and feeding of lessepsian species *L. sceleratus*. Previously other studies with this data will be used as first step for further ecological and biological studies of *L. sceleratus.*

Table 3. Length range, weight range and parameters of length-weight relationships of *L. sceleratus* as reported

Length range (cm)	Weight range (g)	*a*	*b*	r^2	Sex	N	Samples Date	Area	References
18.5-78.5	82.9-5100	0.0160	2.9044	0.9883	M	77	October 2002, June 2003	Gulf of Suez	Sabrah et al., 2006
19.1-69.5	115-4445	0.0209	2.8418	0.9803	F	99	October 2002, June 2003	Gulf of Suez	Sabrah et al., 2006
18.5-78.5	82.9-5100	0.0187	2.8676	0.9835	All	176	October 2002, June 2003	Gulf of Suez	Sabrah et al., 2006
-	-	0.0111	3.0037	-	M	-	2009-2010	Coastal of Cyprus	Michailidis, 2010
-	-	0.0105	3.0255	-	F	-	2009-2010	Coastal of Cyprus	Michailidis, 2010
6.0-77.0	3.0-5600	0.0106	3.018	-	All	6656		Coastal of Cyprus	Michailidis, 2010
12.5-65.0	22.8-3463	0.012	2.974	0.994	M	336	December 2008-January 2010	Antalya Bay	Aydın, 2011
13.5-63	29-3465	0.011	2.984	0.994	F	320	December 2008-January 2010	Antalya Bay	Aydın, 2011
12.5-65.0	22.8-3465	0.012	2.979	0.995	All	656	December 2008-January 2010	Antalya Bay	Aydın, 2011
8.9-78.4	7.59-4750	0.0381	2.6446	0.9392	M	49	September 2011-March 2012	Iskenderun Bay	Başusta et al., 2013
15.4-52.3	37.04-1324	0.0138	2.915	0.9730	F	28	September 2011-March 2012	Iskenderun Bay	Başusta et al., 2013
5.3-63.1	-	0.0164	2.8932	-	All	290	2008-2009	Rhodes Islands	Kalogirou, 2013
-	-	0.012	2.957	0.984	M	408	January 2012-December 2012	Coast of Egyptian	Farrag et al., 2015
-	-	0.013	2.933	0.997	F	371	January 2012-December 2012	Coast of Egyptian	Farrag et al., 2015
5-83	2.1-5400	0.013	2.938	0.996	F	795	January 2012-December 2012	Coast of Egyptian	Farrag et al., 2015
12.5-68	14.6-3678	-	2.9814	-	All	997	2008-2011	Antalya Bay	Aydın et al., 2017
16.7-63.8	64.36-2968.42	0.0164	2.9272	0.974	All	125	2014	Coast of Muğla	Bilge et al., 2017
-	-	-	2.9993	-	M	235	March 2017- August 2017	Finike Bay	Ersönmez et al., 2017
-	-	-	2.9919	-	F	165	March 2017- August 2017	Finike Bay	Ersönmez et al., 2017
5.4-62.5	2.0-3700	0.0172	2.8921	-	All	69	October 2014-February 2015	Antalya Bay	Mutlu et al., 2017
19.0-57.4	**58.60-1981.00**	**0.0108**	**2.9914**	**0.9903**	**M**	**52**	**December 2011-May 2013**	**Antalya Bay**	**This Study**
13.2-57.6	**28.20-2042.80**	**0.0096**	**3.0337**	**0.9921**	**F**	**48**	**December 2011-May 2013**	**Antalya Bay**	**This Study**
13.2-57.6	**28.20-2042.80**	**0.0102**	**3.0118**	**0.991**	**All**	**100**	**December 2011-May 2013**	**Antalya Bay**	**This Study**

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