Acta Biologica Turcica, 35(3), J5:1-5, 2022 Received 13 Apr. 2022; Accepted 09 Oct. 2022; Published Online 21 Oct. 2022

ACTA BIOLOGICA TURCICA

E-ISSN: 2458-7893, http://www.actabiologicaturcica.com

Review article

A review of population parameters of silverstripe blaasop, *Lagocephalus sceleratus* (Gmelin, 1789) in Mediterranean Sea

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Abstract: This paper presents length-weight relationships and gathered from literature pertaining to silverstripe blaasop, *Lagocephalus sceleratus*, throughout Mediterranean Sea. The first publication on this species was over 16 years ago, and a number of new studies have been going on. This review which consists of additional records is important to track the populations of *L. sceleratus.*

Keywords: Silverstripe Blaasop, *Lagocephalus sceleratus*, Mediterranean Sea.

Citing: Torcu-Koç, H., & Erdoğan, Z. (2022). A review of population parameters of silverstripe blaasop, *Lagocephalus sceleratus* (Gmelin, 1789) in Mediterranean Sea. *Acta Biologica Turcica,* 35(3), J5:1-5.

Introduction

Invasive species from the Suez Canal, also named "Lessepsian species", often have an ecological and financial impact on marine life, fisheries, human well-being and health in the Mediterranean Sea. Among these, *Lagocephalus sceleratus* (Gmelin, 1789) has rapidly colonised the eastern Mediterranean basin and is currently moving westwards.

Lagocephalus sceleratus (Tetraodontidae) is a lessepsian migrant which has rapidly reproduced in the Red Sea, Indo-West Pacific Ocean, and the Mediterranean, posing a risk to the ecosystem and spreads because of global heating (Smith and Heemstra, 1986; Akyol et al., 2005, Streftaris and Zenetos 2006, Mavruk et al. 2017), primarily at depths ranging from 18 to 100 m (Randall, 1995), feeding with crustaceans and mollusks (Aydın, 2011) . This fish is known to carry tetrodotoxin that can be fatal to man (Sabrah et al., 2006; Bentur et al., 2008; Katikou et al., 2009; Arakawa et al., 2010). This species attacks fish caught in nets and lines and tears gears, causing serious problems to the artisanal fisheries. For these reasons, *L. lagocephalus* is considered among the worst invasive species in the Mediterranean Sea (Streftaris and Zenetos 2006). *Lagocephalus sceleratus* is was identified from Jaffa along the Israel Coast, Gökova Bay, İzmir, Antalya and İskenderun Bays, the waters of Libya, Crete, Rhodos, and Adriatic Sea (Golani and Levy, 2005; Akyol et al., 2005; Bilecenoğlu et al., 2006; Corsini et al., 2006; Kasapidis et al., 2007; Torcu Koç et al., 2011; Jribi and Bradai, 2012; Milazzo et al., 2012; Sprem et al., 2014). A record from the Edremit Bay confirmed the distribution of the species northward along the coasts of eastern Mediterranean of Turkey (Türker-Çakır et al., 2009). Some investigations on biological aspects of this alien species are focused in Suez Gulf, Cyprus, Antalya Bay, İskenderun Bay, Finike Bay, Mersin Bay, Muğla by Sabrah et al.(2006), Michailidis (2010), Tüzün (2012), Başusta et al. (2013), Ersönmez et al. (2017), Türker and Zengin (2020), Torcu Koç et al. (2020), Mutlu et al. (2021), Ulman et al. (2021), respectively.

The aim of this paper is to gather data from the relevant studies on *L. sceleratus* by in order to provide better knowledge about population structures of the species.

Material and Methods

All length–weight relationships, von Bertelanfyy growth parameters, ages, sex ratios presented here gathered from literature published during 2006–2021 in Mediterranean Sea.

Results and Discussion

Overall, 24 length–weight relationships (Table 1) were gathered from the literature, referring to *L. sceleratus* from Mediterranean waters. The value of the slope b in the plot of log W against log L ranged from 2.64 in İskenderun Bay to 3.64 Mersin Bay. Various factors may be responsible for the differences in parameters of the length-weight relationships among seasons and years, such as temperature, salinity, food (quantity, quality and size), sex, time of year and stage of maturity (Bagenal and Tesch, 1978; Nikolsky, 1980; Pauly, 1984).

Table1. Parameters of the length-weight relationships (a, b) of *Lagocephalus sceleratus* in some relevant literature (- indicates absence of data, F: Female, M: Male C: Combined,).

N	Sex	a	b	Lmin-max(cm)	Lenght	R^2	Locality	Authors
176		0.0104	2.8676	18.5-72.5	TL	0.98	Egypt	Sabrah et al.(2006)
-	-	-	-	11.2-18.3	-	-	-	Simon et al. (2009)
6656	-	0.0116	3.018	6.0-77.0	TL	-	Cyprus	Michailidis (2010)
-	-	0.0197	2.966			0.9978	Ioanian Sea	Corsini Foka, et al. (2010)
4	-	-	-	33.8-61.1	TL	-	İskenderun Bay	Koç et al. (2011)
656	-	0.012	2.979	12.5-65.0	TL	0.995	Antalya Bay	Aydın (2011)
997	C	-	2.98	12.5-68.0	TL	-	Antalya Bay	Aydın et al. (2017)
-	-	0.0277	2.8462		TL	0.9849	Antalya Bay	Tüzün (2012)
-	C	0. 0225	2. 820	5-56. 5	-	0.991	Israel Coast	Edelist et al. (2012)
28	F	0.0138	2.915	15.4-52.3	TL	0.973	İskenderun Bay	Başusta et al. (2013)
49	M	0.0381	2.6446	8.9-68.4	TL	0.9392	İskenderun Bay	Başusta et al. (2013)
-	-	0.0164	2.89	-		0.99	Rhodose Island	Kalogirou (2013)
132	C	0.143	2.99	20.5-73.5	-	0.975	Lebanon Coast	Boustany et al. (2015)
795	C	0.013	2.938	5.0-83.0	-	0.996	Egyptian Coasts	Farrag et al. (2015)
-	-	0.0013	2.959	-	-	-	Suez Gulf	El.Ganainy et al. (2017)
-	-	0.042	2.65	-	-	-	Egyptian Gulg of Mediterranean	El.Ganainy et al. (2017)
125	C	0.0164	2.92	16.7-63.8	TL	0.97	Coast of Muğla	Bilge et al. (2017)
165	F	-	2.9919	-	-	-	Finike Bay	Ersönmez et al. (2017)
235	M	-	2.9913	-	-		Finike Bay	Ersönmez et al. (2017)
69	C	0.0172	2.8921	5.4-62.5	TL	-	Antalya Bay	Mutlu et al. (2017)
100	-	0.0102	3.0118	13.2-57.6	TL	0.99	Antalya Bay	Zengin and Türker (2020)
98	F	0.0110	3.064	14.9-67.5	FL	0.988	Mersin Bay	Torcu Koç et al.(2020)
110	M	0.016	2.956	20.4-67.6	FL	0.967		
	C	0.01538	2.93	5.4-62.5	TL	-	Antalya Bay	Mutlu et al. 2021
270	F	-	-	13.0-77.2	TL	-	Muğla	Ulman et al. (2021)
456	M							
287	J							

It is evaluated that ages are differed from 1-10 from the studies which are carried out in Mediterranean Sea as seen in Table 2. Age determination in fish is a basic step in understanding fish biology, population dynamics, and fisheries management (De Vries and Frie, 1996). In the studies, the sex ratios varied from 0.69:1 to 1.3: 1 (F : M) in different localities and not significantly different from 1 : 1 (X^2 test). Although the sex ratio in most of the species was close to 1, this may vary from species to species, differing from one population to another of the same species, and may vary year after year within the same population. At early life stages the ratio of males is higher, but at later stages the female ratio is higher (Nikolsky, 1980). The estimated von Bertalanffy growth equations have shown different values (Table 2). Temperature, and the water system in which the fish live (Wootton, 1992), food availability cause a shift towards larger maximum size (Bagenal and Tesch., 1978).

Due to different ecological and climate conditions, the starting and finishing time of reproduction may include different months (Nikolsky, 1980) (Table 3).

Due to a nearly complete lacks of population control and predator in its habitat, the silverstripe blaasop has shown a rapid distribution with a successful colonisation from the

eastern Mediterranean Sea reaching towards the northern parts of the Aegean Sea. *L. sceleratus* shows highly negative impacts due to its high toxicity, economic losses to fishery, and supresses native marine biodiversity.

Table 2. Sex ratio (F:M), age composition, L_∞, K, t_0 of *Lagocephalus sceleratus* in some relevant literature (-indicates absence of data).

Age	Sex Ratio (F:M)	L_∞	K	t_0	Φ	Locality	Authors
1-10	1.3:1	81.1	0.26	-0.17	3.099	Egypt	Sabrah et al.(2006)
-	-	-	-	11.2-18.3	-	-	Simon et al. (2009)
1-6	-	82.0	0.5	-0.606	3.527	Cyprus	Michailidis (2010)
	-	0.0197	2.966	-	-	Ioanian Sea	Corsini Foka, et al. (2010)
1-6	-	126.1	0.099	-1.435	3.197	Antalya Bay	Aydın (2011)
1-6	-	48.2	0.52	-0.27	3.082	Antalya Bay	Tüzün (2012)
-	-	0. 0225	2. 820	5-56. 5	-	Israel Coast	Edelist et al. (2012)
1-10	1:1.1	46.36	0.133	-1.76	2.426	İskenderun Bay	Başusta et al. (2013)
	-	0.0164	2.89	-	-	Rhodose Island	Kalogirou (2013)
-	-	0.143	2.99	20.5-73.5	-	Lebanon Coast	Boustany et al. (2015)
1-7	-	106.3	0.17	-0.0228	3.289	Egyptian Coasts	Farrag et al. (2015)
-	-	103.71	0.132	-	-	Suez Gulf	El.Ganainy et al. (201/)
-	-	89.03	0.2718	-	-	Egyptian Mediterranean	El.Ganainy et al. (201/)
1-8	-	114.52	0.11	-0.664	-	Mersin Bay	Başusta et al. (2017)
-		-	-	-	-	Coast of Muğla	Bilge et al. (2017)
-	-	109.7	0.22	-0.4544	-	Finike Bay	Ersönmez et al. (2017)
	-	0.0172	2.8921	5.4-62.5		Antalya Bay	Mutlu et al. (2017)
1-5	-	79.5	0.18537	-0.611791	3.069	Antalya Bay	Zengin and Türker (2020)
1-6	0.89:1	118.71	0.115	-0.178	3.209	Mersin Bay	Torcu Koç et al.(2020)
-	0.69:1	88.7	0.32	-	-	Muğla	Ulman et al. (2021)

Table 3. Spawning periods of *Lagocephalus sceleratus* in some relevant literature (-indicates absence of data).

J	F	M	A	M	J	J	A	S	O	N	D	Locality	Reference
			■	■	■							Gulf of Suez	Sabrah et al. (2006)
		■	■	■	■							Finike and Antalya Bays	Yıldırım (2011)
			■	■	■	■						Antalya Bay	Aydın (2011)
				■	■	■						SE. Mediterranean Sea	Rousou et al. (2014)
		■	■									Mersin Bay	Torcu et al., 2020
				■	■							Muğla	Ulman et al. (2021)

Despite being aware of aware of this highly toxic fish, tetrodotoxin poisoning is quite common in Japan and South-East Asia (secondary to consuming of meals prepared from puffer fish or "fugu" fish) (Kheifets et al., 2012). In addition, some people unwittingly consume its flesh and inner organs containing tetrodotoxin (liver, gonads, intestines, and skin), leading to hospital and death (Milazzo et al., 2012). Therefore, the consumption of pufferfishes have been baned by Republic of Türkiye Ministry of Agriculture and Forestry. But the government recently applied a pilot project collecting *L. sceleratus* tails from the Turkish Mediterranean coasts. 5066 of tails were collected for a reward price of 5 Turkish liras each, for supporting with positive economic benefit to some fishers with the notification (2020/37) (www.tarımorman.gov.tr). Besides, the skin of *L.* sceleratus have been gained value, processing as of a various of accessories (e.g. handbag, purse and belt).

Consequently, the potential effects on fisheries and human health need to enhance our knowledge about the future geographical distributions of this pufferfish in Mediterranean Basin.

Ethical Approval

The authors don't declare ethical approval.

Conflicts of Interest

The authors declare that they have no conflict of interest.

Funding Statement

The research had not received specific funding.

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