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Four Important Poisonous Fishes in the Black Sea Coasts: Length-Weight Relationships (LWRs) and Some Biological Features

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ABSTRACT: In this study it was demonstrated that length-weight relationships (LWRs) and some biological characteristic of four venomous fishes, common stingray (*Dasyatis pastinaca*), greater weever (*Trachinus draco*), scorpion fish (*Scorpaena porcus*) and stargazer (*Uranoscopus scaber*) from Black Sea coasts. The present study was carried out between 01 January 2015 and 30 September 2016 in Sinop peninsula coasts of the southern Black Sea. The fish samples were captured trammel nets (32 mm, 36 mm 40 mm and 48 mm mesh size) in 0-15-30-45 meters depth ranges. The average length of common stingray, greater weever, scorpion fish and stargazer were established 48.2±4.98 cm 17.88±0.25 cm, 11.49±0.07 cm and 13.25±0.47 cm respectively. LWR of the venomous fishes were determined $W=0.0028L^{3.2187}$ (n=12, $R^2=0.97$), $W=0.0287L^{2.5776}$ (n= 181, $R^2=0.93$), $W=0.0245L^{2.9050}$ (n=808, $R^2=0.98$) and $W=0.0181L^{2.9398}$ (n=779, $R^2=0.98$), respectively. Positive allometric growth for common stingray and negative allometric growth for greater weever, scorpion fish and stargazer were obtained (t-test, $p < 0.05$).

Keywords *– Venomous fishes, Length-weight relationships, Biological characteristics, Black Sea*

1. Introduction

Venomous fish generate a potent toxin detrimental to people which they transfer by prick, sting or stab. Venomous fish are found in almost all aquatic ecosystems, but usually in tropical waters around the world. The most important venomous fish in the Black Sea coasts are greater weever (*Trachinus draco*), scorpion fish (*Scorpaena porcus*), common stingray (*Dasyatis pastinaca*) and stargazer (*Uranoscopus scaber*) (Fig 1).

The common stingray is spread North-eastern Atlantic Ocean, the Mediterranean Sea and the African coast southwards to Senegal. A coastal species, which enters coastal lagoons, shallow gulf and deltas (Séret, 2003). Found over sandy and muddy bottoms, sometimes near rocky reefs (Michael, 1993). Feeds on bottom fishes, crustaceans and mollusks. Harmful to shellfish banks; dangerous to bathers and fishers due to its poisonous spine. Barbed poison spine is a modified denticle that can be 35cm long, shed occasionally and replaced (Muus, and Nielsen, 1999). IUCN Red List status of common stingray is vulnerable in Mediterranean Sea (Serena et al., 2015).

The greater weever is distribution Eastern Atlantic: Norway to Morocco, Madeira and Canary Islands, including the Mediterranean and the Black Sea (Roux, 1990a). On sandy, muddy or gravelly bottoms, from a few meters to about 150 m. Rest on the bottom, often buried with eyes and tip of first dorsal fin exposed (Frimodt, 1995). At night they swim around freely, even pelagically. Feed on small invertebrates and fishes; chiefly nocturnal (Tortonese, 1986).

There are dark markings along the scales; the anterior dorsal fin is black and contains venomous spines.

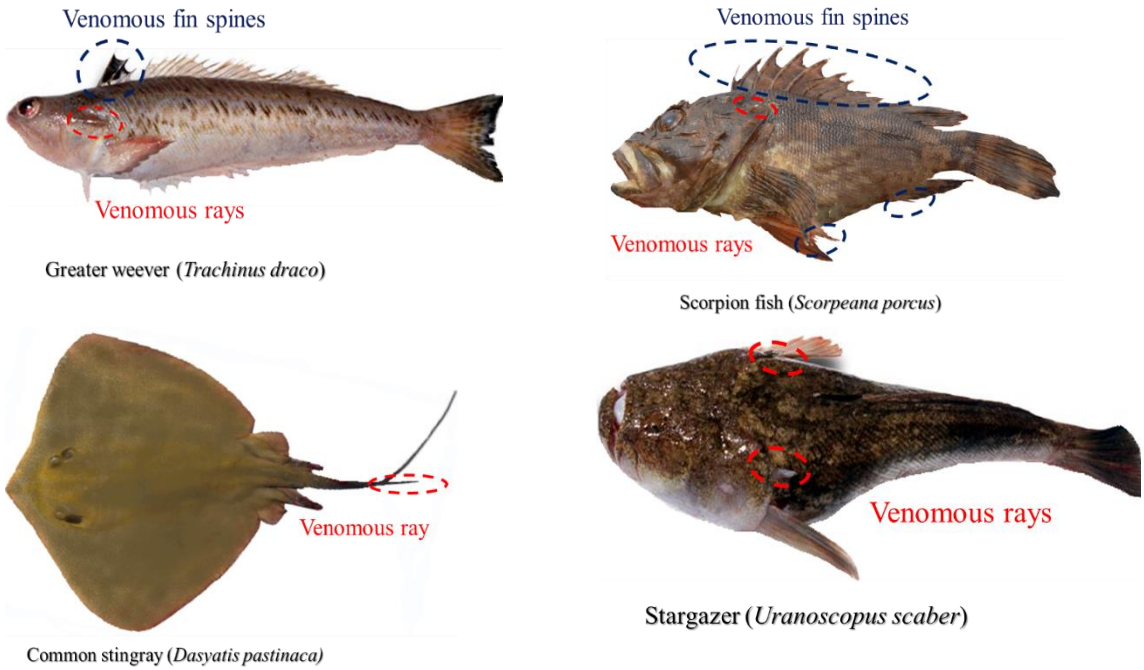

Fig. 1. Venomous fishes from the Black Sea coasts (red line: venomous rays, blue line: venomous spines)

The scorpion fish mostly appear Eastern Atlantic: British Isles to the Azores, and the Canary Islands, including Morocco, the Mediterranean Sea and the Black Sea. Usually occurs in rocky areas of bays and along shore, especially in caves and crevices. An excellent food fish. Venomous spines in the dorsal, anal, and pelvic fins (Eschmeyer, et al., 1983).

The stargazer fish occur from Eastern Atlantic to Mediterranean Sea and Black Sea. The shoulder spines can inflict, painful stings. Usually found buried in the sand or mud. Equipped with an acoustic apparatus that generates both acoustic and electric pulses. Oviparous, eggs, larvae and juveniles are pelagic (Roux, 1990b).

Although these fish are discarded into the sea in commercial fishing, they are an important part of the Black Sea ecosystem. Black Sea ecosystem significant changes have been observed in recent years (Bat et al., 2007). Due to climate change, new species of Indian and Atlantic Oceans origin enter the Mediterranean and Black Sea. Some of these species consist of poisonous fishes and organisms, such as oceanic puffer, red lionfish and compass jellyfish (Oral, 2010; Aydın et al., 2017; İşinibilir et al., 2017; Hüseyinoğlu and Öztürk, 2018).

Scientific studies are usually on economical fishes (pelagic and demersal) in Black Sea such as anchovy, bluefish, horse mackerel, pontic shad, sprat, whiting, red mulled, turbot (Samsun et al., 2004; Kalaycı et al., 2007; Özdemir et al, 2009; Sağlam and Sağlam, 2012; Özdemir and Duyar, 2013; Mazlum and Bilgin, 2014; Özdemir et al., 2015; Samsun et al., 2017; Çalık and Sağlam, 2017; Özdemir et al., 2018; Kasapoğlu, 2018; Özdemir and Erdem, 2018; Yıldız and Karakulak, 2019). There are less studies on bycatch and discard fishes of Black Sea fisheries (Kalaycı and Yeşilçiçek, 2014; Özdemir et al., 2016; Kasapoğlu and Düzgüneş, 2017; Yeşilçiçek et al., 2017). Besides, there is a few studies on some venomous species (as

bycatch and discard) of the Black Sea (Başçınar ve Sağlam, 2008; Aydın et al., 2015; Yıldız and Karakulak, 2016).

In this study, some biology characteristics and length-weight relationships (LWRs) of the most important poisonous fishes, which bycatch or discard fishes of small-scale and large-scale fisheries of the Black Sea, were determined.

2. Material and Methods

Sinop region is important fisheries central for the Black Sea in Turkey. Especially, fishermen are use gillnets and trammel nets in the coastal fisheries. Target fish species of the fishing gears are red mullet, whiting, turbot, horse mackerel and bluefish in the area. The most important bycatch species of these fishing gears are scorpion fish, weever, stargazer, gobidae fishes and crabs species respectively. So, the study was carried out in Sinop coasts of the southern Black Sea between 01 January 2015 and 30 September 2016 (Fig. 2).

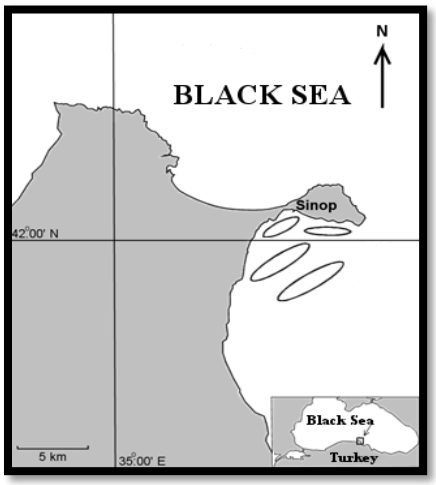

Fig. 2. The sampling points of the study

A total of 16 trammel gillnets (32 mm, 36 mm, 40 mm and 48 mm mesh size) were used in the sea experiments. The nets were set 15-30-45 m depth ranges. All samples were taken to the laboratory and were measured to the nearest 0.1 cm (total length), weighted (wet weight) to the nearest 0.01 g.
Length-weight relationships of venomous fishes were estimated by fitting an exponential curve: $W = aL^b$ to the data (Ricker, 1973; Pauly, 1984).

Parameters a and b of the exponential curve were estimated by linear regression analysis over log-transformed data Log W = Log a + b Log L

Where W is the total weight (g) L is the total length (cm), a is the intercept and b is the slope, using the least-squares method. The association-degree between variables of W and L was calculated by the determination coefficient (R^2). Additionally, 95% confidence limits of the parameter *b* were estimated. The Student's *t test* was used for comparison of the slopes (Zar, 1996).

$$t = \frac{Sd_{logL}}{Sd_{logW}} \frac{|b-3|}{\sqrt{1-r^2}} \sqrt{n-2}$$

Where Sd_{logTL} is the standard deviation of the log TL values, Sd_{logW} is the standard deviation of the log W values, n is the number of specimens used in the computation. The value of b is different from b = 3 if calculated t value is greater than the tabled t values for n-2 degrees of freedom (Pauly, 1984).

When the parameter '*b*' is statistically equal to 3, the growth is called isometric, but the growth is positive allometric when the '*b*' value is more than 3 and negative allometric when the '*b*' value is less than 3 (Dutta et al., 2012). Differences were considered statistically significant when $P < 0.05$.

3. Results and Discussion

A total 76.8 kg venomous fish were captured in the experiments. Stargazer has most of total catch with 31.782 kg. The total catch of scorpion fish, common stingray and greater weever were established 26.617 kg, 12.815 kg and 5.586 kg respectively. Mean length of venomous fishes were determined 13.25±0.47 cm, 11.49±0.07 cm, 49.78±4.69 cm and 17.88±0.25 cm respectively. Mean weight of species were found 40.79±1.03 g, 32.94±0.83 g and 42.65±1.63 g respectively. Maximum and minimum of total length and weight of the venomous fishes shows in Table 1.

Table 1. Total length, weight and catch of venomous fishes from southern Black Sea coasts

Venomous fishes	Total Length (cm)			Wet Weight (g)			Total Catch (kg)
	Max.	Min.	Mean	Max.	Min.	Mean	
Greater weever	28.6	10.1	17.88±0.25	147.3	11.5	42.65±1.63	5.586
Common stingray	75.2	27.2	49.78±4.69	2788.6	83.9	1068±263	12.815
Scorpion fish	22.5	7.5	11.49±0.07	207.2	9.7	32.94±0.83	26.617
Stargazer	23.4	6.3	13.25±0.47	218.3	4.1	40.79±1.03	31.782

LWR of the venomous fishes were calculated $W=0.0287L^{2.5776}$ (n= 181, $R^2=0.93$), $W=0.0245L^{2.9050}$ (n=808, $R^2=0.98$), $W=0.0181L^{2.9398}$ (n=779, $R^2=0.98$) and $W=0.0028L^{3.2187}$ (n=12, $R^2=0.97$), respectively (Fig. 3).

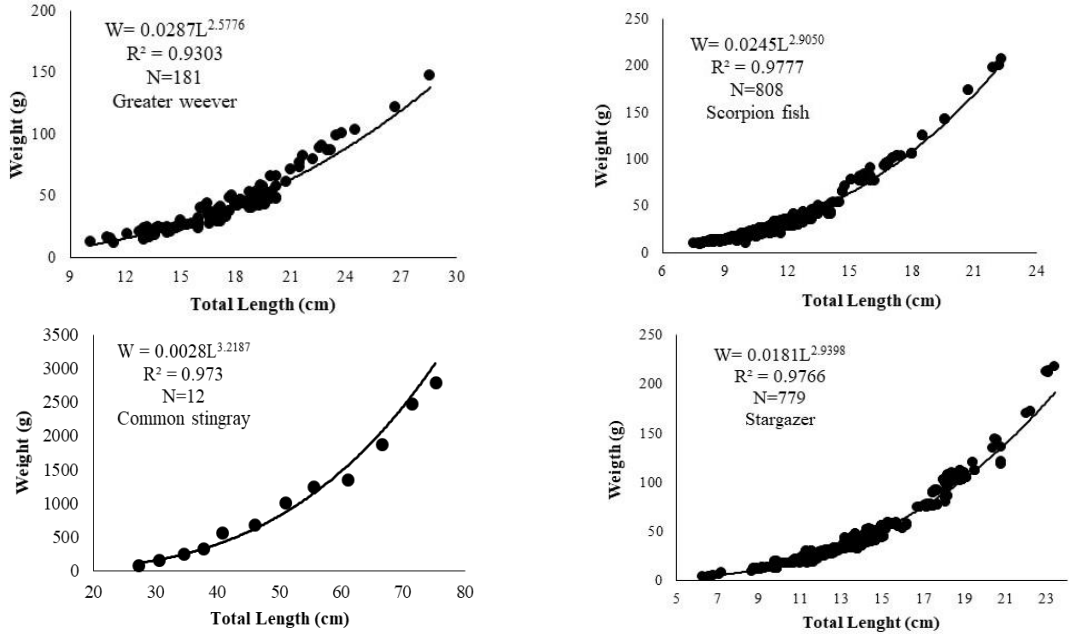

Fig. 3. LWR graphics of venomous fish from Black Sea coasts

"b" values of greater weever, scorpion fish, stargazer and common stingray were fixed 2.5776 (b<3), 2.9050 (b<3), 2.9390 (b<3) and 3.2187 (b>3) respectively. a value of fishes was determined 0.0287, 0.0245, 0.0181 and 0.0028 respectively. Positive allometric growth for common stingray and negative allometric growth for other species were obtained (t-test, p< 0.05). LWRs parameters of fishes were showed in Table 2.

Table 2. LWRs parameters of venomous fishes

LWR Parameters	**Venomous Fishes**			
	Greater weever	**Scorpion fish**	**Stargazer**	**Common stingray**
a	0.0287	0.0245	0.0181	0.0028
95% Confident of a	0.0203-0.0404	0.0224-0.0267	0.0167-0.0196	0.0007-0.0083
b	2.5776	2.9050	2.9398	3.2187
Standard error of b	0.0609	0.0187	0.0159	0.1409
95% Confident of b	2.4071-2.6481	2.8683-2.9417	2.9085-2.9711	2.9842-3.5123
N	181	808	779	12
R^2	0.9303	0.9777	0.9766	0.9730
P-value	0.05<	0.05<	0.05<	0.05<
Growth	-Allometric	-Allometric	-Allometric	+Allometric

4. Conclusion

Target fishes are red mullet, whiting bluefish, and horse mackerel in in the Black Sea coastal fisheries. However other fishes have been bycatch and discard of small scale fisheries (gillnets, trammel nets and hand-lining fishing) such as crab species, goby species, scorpion fish, stargazer, great weever, sharks, thornback rays and common stingray.

Table 3 gives the length–weight relationships for 4 important venomous species estimated in this study and those previously obtained for other seas, Mediterranean Sea, Marmara Sea, Aegean Sea and Black Sea.

There are seven studies for greater weever, eighth studies for scorpion fish, seven studies for stargazer and thirteen studies for common stingray previously in the Mediterranean, Aegean Sea, Marmara Sea and Black Sea (Table 3).

For greater weever, there were no significantly different b-values in the four of these studies with the differences ranging between 2.578 and 2.934; three of seven studies had significantly different b-values, with the differences ranging from 3.059 to 3.433.
Six of eight studies had significantly different b-values, with the differences ranging from 3.045 to 3.343; two of these studies there were no significantly different b-values, with the differences ranging between 2.594 and 2.987 for scorpion fish.

For stargazer, there were no significantly different b-values in the two of these studies with the differences ranging between 2.829 and 2.850; four of six studies had significantly different b-values, with the differences ranging from 3.039 to 3.226.

Nine of thirteen studies had significantly different b-values, with the differences ranging from 3.143 to 3.609; four of these studies there were no significantly different b-values, with the differences ranging between 2.122 and 2.992 for common stingray.

Table 3. Venomous fishes LWRs parameters from previously studies

Species	Sex	N	a	b	Region	Author(s)
Greater weaver	**F+M**	22	0.0213	2.934	Mediterranean	Dulčić & Kraljevic, 1996
	F+M	54	0.0033	3.090	Mediterranean	Sangun et al., 2007
	F+M	32	0.0243	2.578	Aegean Sea	Karakulak et al., 2006
	F+M	338	0.0040	3.433	Black Sea	Ak et al., 2009
	F+M	21	0.0054	3.059	Mediterranean	Giacalone et al., 2010
	F+M	59	0.0033	3.228	Aegean Sea	Bilge et al., 2014
	F+M	67	0.0114	2.806	Aegean Sea	Moutopoulos et al., 2013
	F+M	***181***	***0.0287***	***2.5776***	***Black Sea***	***This Study, 2020***
Scorpion fish	**F+M**	633	0.0540	2.594	Black Sea	Koca, 2002
	F+M	262	0.0166	3.101	Black Sea	Başçınar & Sağlam 2005
	F+M	470	0.0124	3.190	Black Sea	Demirhan & Can, 2007
	F+M	351	0.0090	3.272	Black Sea	Ak et al., 2009
	F+M	45	0.0158	3.088	Marmara Sea	Keskin & Gaygusuz, 2010
	F+M	15	0.0067	3.343	Marmara Sea	Bök et al., 2011
	F+M	221	0.0209	2.987	Aegean Sea	Akalın et al., 2011
	F+M	63	0.0170	3.045	Aegean Sea	Bilge et al., 2014
	F+M	561	0.0290	2.831	Black Sea	Aydın et al., 2015
	F+M	***808***	***0.0245***	***2.905***	***Black Sea***	***This Study, 2020***
Stargazer	**F+M**	116	0.0148	3.039	Black Sea	Başçınar & Sağlam 2005
	F+M	62	0.0156	2.998	Aegean Sea	Karakulak et al., 2006
	F+M	630	0.0080	3.226	Black Sea	Ak et al., 2009
	F+M	66	0.0293	2.829	Mediterranean	Giacalone et al., 2010
	F+M	82	0.0190	3.154	Marmara Sea	Bök et al., 2011
	F+M	155	0.0252	2.854	Black Sea	Kasapoğlu, 2016
	F+M	108	0.0087	3.217	Aegean Sea	Bilge et al., 2014
	F+M	***779***	***0.0181***	***2.9398***	***Black Sea***	***This Study, 2020***
Common Stingray	**F+M**	-	0.0251	3.310	Mediterranean	Torres, 1991
	F+M	256	0.0014	3.310	Mediterranean	İşmen, 2003
	F+M	8	0.0092	2.933	Aegean Sera	Filiz & Mater, 2002
	F+M	44	0.0498	2.992	Mediterranean	Morey et al., 2003
	F+M	29	0.0149	2.810	Aegean Sea	Filiz & Bilge, 2004
	F+M	92	0.0021	3.397	Mediterranean	Pallaoro et al., 2005
	F+M	12	0.1168	2.122	Aegean Sea	Karakulak et al., 2006
	F+M	334	0.0020	3.242	Mediterranean	Yeldan & Avşar, 2007
	F	189	0.0025	3.286	Mediterranean	
	M	145	0.0014	3.338	Mediterranean	
	F+M	346	0.0033	3.143	Mediterranean	Yeldan et al., 2009
	F	52	0.0008	3.507	Agean Sea	Yığın & İşmen, 2012
	M	32	0.0005	3.609	Agean Sea	
	F+M	***12***	***0.0028***	***3.2187***	***Black Sea***	***This Study, 2020***

The differences in b-values may be attributed to one or more factors: the effects of seasonal and different sea areas, habitat, food availability, degree of stomach fullness, gonad maturity, changes in sea temperature and salinity, gender, reproduction status and phases, sampling amount, differences in the number of specimens examined as well as in the observed size ranges of the fishes captured (Tesch, 1971; Morey et al., 2003; Karakulak et al., 2006; Moutopoulos et al., 2013;).

In conclusion, studies on the fisheries biology and population dynamic of this species are generally inadequate, but in considering the Black Sea coasts, studies are particularly rare. Thus, the bioecological features of four important poisonous of the Black Sea given in this

study provide some LWRs and basic biological characteristics knowledge related to the species and may support in next time studies. Population dynamics and biology studies on the venomous species should continue for the scientific support to solutions and the measures to be taken of many problems in the marine and ocean ecosystems of the world.

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