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An updated checklist of poisonous fishes of Turkish Aegean Sea

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ABSTRACT

The current status of marine poisonous fish species ranging in the Aegean Sea coastline in Turkey were introduced. Turkey is a peninsula surrounded by seas with different ecological features on three sides. The total length of shoreline is 8 333 km including the islands. The total number of fish species in Turkish seas is 512, of which 449 live in the Aegean Sea followed by the Mediterranean Sea (441 species), the Marmara Sea (257 species) and the Black Sea (154species). On the Aegean Sea coasts, the richest sea regarding fish diversity, the number of poisonous fish species is also high. This mini-review revealed 51 poisonous fish species belonging to 14 families in the Turkish Aegean Sea. On the Aegean Sea coasts poisonous fish species can be categorized into three groups: (i) Fish that contain venomous spines on the tail or on the operculum (ii) Fish that carry poisonous bite and (iii) Fish having poisonous flesh or liver. Poisoning fish that contain venomous spines on the tail or on the operculum mostly are dangerous because of their poisonous thorns whereas the passive poisonous fish species poison when they are eaten. These toxins can cause morbidity and rarely, mortality in humans. Apart from these, swallowing the blood of species such as European eel *Anguilla anguilla* and European conger *Conger conger* might also cause poisoning. Besides, as there has been an invasion of puffer fish especially on the Turkish Mediterranean and Aegean coasts in recent years, there is a danger in question. Thus, it is very important to particularly draw attention to these fish on the Turkish coasts.

1. Introduction

The coastline of Turkey which is surrounded by the Mediterranean, Aegean, Marmara and Black Seas is about 8 333 km in length, including islands. This extensive marine and coastal fringe supports a rich and important biodiversity. The Mediterranean Sea, the Black Sea, the Aegean Sea and the Marmara Sea have completely different features in terms of geology, geomorphology, oceanography, and ecology. Therefore, each sea has unique flora and fauna. Black Sea and Marmara Sea having the features of an internal sea have flora and fauna composed of boreal, endemic, cosmopolitan and Atlanto-Mediterranean origins whereas North Aegean Sea partially bears a resemblance to these two seas. In the North Aegean and Mediterranean Seas on the other hand tropical and lessepsian species (migrants of the Red Sea) replace subtropical species.

Located between 35°-41° north latitudes and 23°-27° east longitudes and Turkey and Greece, the Aegean Sea is one of the five basins of the East Mediterranean Sea. It is separated from the Mediterranean Sea by Crete, Karpathos and Rhodes Islands on the south. With shores shaped like an indented rectangle, the length of the Aegean Sea is 660 km in the north and south direction. 270 km wide in the north, 150 km wide in the middle and 400 km wide in the south, the acreage of the Aegean Sea is 214.000 km^2.

Since the Aegean Sea has formed more than one threshold by being split by islands on the south border, it has a unique feature in terms of water exchange with the Mediterranean Sea. Also, on the north it is connected to the Marmara Sea and thus the Black Sea by Dardanelles Strait, which is formed as a rather shallow and narrow threshold. Thus, the Aegean Sea has unique sea ecology with its unique features. North side of the Aegean Sea, which forms the junction basin of Black Sea and Mediterranean Sea waters, is under the effect of cold and oligohaline waters of Black Sea and the south side is under the effect of hot and saline Mediterranean Sea waters. Thanks to these differences in the ecological features of the Aegean Sea, middle Aegean Region is qualified as a transition zone.

Marine animals compete and struggle with each other and every species in this struggle have evolved and adapted themselves in order to gain advantage over other species. Also marine animals use toxins which they produce for hunting and self-defense. These toxins can cause morbidity and rarely, mortality in humans[1]. Generally, the fish living in near-coastal, shallow waters, in deep, hiding between rocks and corals or burying themselves in the sand and moving slowly have poison device. Poison device is formed by one or more hard parts of the fish such as apophysis spinals of the bones belonging to the skull or pectoral arch and thorn fin rays and opercular thorns. The location and structure of the poison device differ by species. Poisons are found generally in thorns (body thorns, fins and opercular thorns), muscles, visceral organs (liver, intestines, and stomach *etc*.) and blood[2]. Poison is an important mechanism developed for protection[3].

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Poison ray or thorn is seen in generally slow swimmers or demersal species. In round fish species, this type of adaptation takes place in the tail part and is rarely seen. Also, it is a known fact that there are more poisonous species in tropical regions compared to temperate seas and that their protection mechanisms are more developed[4].

Previous studies reported that some fish ranging in the Turkish seas had poison[3,5]. However studies on envenomations caused by marine animals are inadequate in coast of Turkey. In this mini-review, the poisonous fish species and their poison types in the Aegean Sea in Turkey are present.

2. The rich fish fauna of the Aegean Sea

In terms of oceanography, the Aegean Sea functions as a junction basin of north and south waters, where biologically thermophilic and psycrophile species live together. In the north part of the Aegean Sea dominant are the sub-tropical species whereas tropical and lessepsian species are dominant in the south part. Therefore, 449 fish species live in the biologically rich and diverse Aegean Sea[6]. Besides, together with the opening of the Suez Canal in 1896, some of the fish and invertebrate lessepsian species migrating to the east Mediterranean Sea from the Indian Ocean dwelled in the east

Table 1

Poisonous fish species in the Turkish Aegean Sea.

Familia	Species	Name (English/Turkish)	Origin	Type of poissons
Dasyatidae	*Dasyatis centroura*	Roughtail stingray/Dikenli vatoz	Atlanto-Mediterranean	Neurotoxic-Cardiotoxic
	Dasyatis marmorata	Marbled stingray/Dikenli vatoz	Atlanto-Mediterranean	Neurotoxic-Cardiotoxic
	Dasyatis pastinaca	Common stingray/Dikenli vatoz	Atlanto-Mediterranean	Neurotoxic-Cardiotoxic
	Dasyatis tortonesei	Tortonese's stingray/Dikenli vatoz	Endemic	Neurotoxic-Cardiotoxic
	Himantura uarnak	Honeycomb stingray/Dikenli vatoz	Lessepsian	Neurotoxic-Cardiotoxic
	Pteroplatytrygon violacea	Pelagic stingray/Dikenli vatoz	Cosmopolitan	Neurotoxic-Cardiotoxic
Gymnuridae	*Gymnura altavela*	Spiny butterfly ray/Kazıkkuyruk	Atlanto-Mediterranean	Neurotoxic-Cardiotoxic
Myliobatidae	*Myliobatis aquila*	Common eagle ray/Çuçuna	Atlanto-Mediterranean	Neurotoxic-Cardiotoxic
	Pteromylaeus bovinus	Bull ray/Çuçuna	Atlanto-Mediterranean	Neurotoxic-Cardiotoxic
	Rhinoptera marginata	Lusitanian cownose ray/Çuçuna	Atlanto-Mediterranean	Neurotoxic-Cardiotoxic
	Mobula mobular	Devil fish/Manta-Kulaklı folya	Atlanto-Mediterranean	Neurotoxic-Cardiotoxic
Chimaeridae	*Chimaera monstrosa*	Rabbit fish/Tavşan balığı	Atlanto-Mediterranean	Neurotoxic-Cardiotoxic
Scorpaenidae	*Scorpaena elongata*	Slender rockfish/İskorpit	Atlanto-Mediterranean	Neurotoxic-Cardiotoxic
	Scorpaena loppei	Cadenat's rockfish/İskorpit	Atlanto-Mediterranean	Neurotoxic-Cardiotoxic
	Scorpaena maderensis	Madeira rockfish/İskorpit	Atlanto-Mediterranean	Neurotoxic-Cardiotoxic
	Scorpaena notata	Small red scorpionfish/İskorpit	Atlanto-Mediterranean	Neurotoxic-Cardiotoxic
	Scorpaena porcus	Black scorpionfish/İskorpit	Atlanto-Mediterranean	Neurotoxic-Cardiotoxic
	Scorpaena scrofa	Red scorpionfish/İskorpit	Atlanto-Mediterranean	Neurotoxic-Cardiotoxic
Trachinidae	*Echiichthys vipera*	Lesser weever/Trakonya	Atlanto-Mediterranean	Neurotoxic-Cardiotoxic
	Trachinus araneus	Spotted weever/Trakonya	Atlanto-Mediterranean	Neurotoxic-Cardiotoxic
	Trachinus draco	Greater weever/Trakonya	Atlanto-Mediterranean	Neurotoxic-Cardiotoxic
	Trachinus radiatus	Starry weever/Trakonya	Atlanto-Mediterranean	Neurotoxic-Cardiotoxic
Uranoscopidae	*Uranoscopus scaber*	Stargazer/Tiryaki balığı	Atlanto-Mediterranean	Neurotoxic
Callionymidae	*Callionymus fasciatus*	Banded dragonet/Üzgün balığı	Endemic	Neurotoxic
	Callionymus lyra	Dragonet/Üzgün balığı	Atlanto-Mediterranean	Neurotoxic
	Callionymus maculatus	Spotted dragonet/Üzgün balığı	Atlanto-Mediterranean	Neurotoxic
	Callionymus pusillus	Sailfin dragonet/Üzgün balığı	Endemic	Neurotoxic
	Callionymus risso	Risso's dragonet/Üzgün balığı	Endemic	Neurotoxic
	Synchiropus phaeton	Phaeton dragonet/Üzgün balığı	Atlanto-Mediterranean	Neurotoxic
Siganidae	*Siganus luridus*	Dusky spinefoot/Sokkan	Lessepsian	Neurotoxic
	Siganus rivulatus	Marbled spinefoot /Sokkan	Lessepsian	Neurotoxic
Scombridae	*Auxis rochei*	Bullet tuna/Tulina	Cosmopolitan	Histamine poisoning
	Euthynnus alletteratus	Little tunny/Yazılı orkinoz	Atlanto-Mediterranean	Histamine poisoning
	Katsuwonus pelamis	Skipjack tuna/Yanlışlıkla palamut	Cosmopolitan	Histamine poisoning
	Orcynopsis unicolor	Plain bonito/Ak palamut	Atlanto-Mediterranean	Histamine poisoning
	Sarda sarda	Atlantic bonito/Palamut	Atlanto-Mediterranean	Histamine poisoning
	Scomber japonicus	Chub mackerel/Kolyoz	Cosmopolitan	Histamine poisoning
	Scomber scombrus	Atlantic mackerel/Uskumru	Atlanto-Mediterranean	Histamine poisoning
	Scomberomorus commerson	Spanish mackerel/Ceylan	Lessepsian	Histamine poisoning
	Thunnus alalunga	Albacore/Ton-Orkinoz	Cosmopolitan	Histamine poisoning
	Thunnus thynnus	Atlantic bluefin tuna/Ton-Orkinoz	Atlanto-Mediterranean	Histamine poisoning
Xiphiidae	*Xiphias gladius*	Swordfish/Kılıç balığı	Cosmopolitan	Ciguatoxic
Balistidae	*Balistes capriscus*	Grey triggerfish/Çütre	Atlanto-Mediterranean	Ciguatoxic
Tetraodontidae	*Lagocephalus lagocephalus*	Oceanic puffer/Balon balığı	Atlanto-Mediterranean	Neurotoxic
	Lagocephalus sceleratus	Silver-cheeked toadfish/Balon balığı	Lessepsian	Neurotoxic
	Lagocephalus spadiceus	Half-smooth golden pufferfish/Balon balığı	Lessepsian	Neurotoxic
	Lagocephalus suezensis	Pufferfish/Balon balığı	Lessepsian	Neurotoxic
	Sphoeroides pachygaster	Blunthead puffer/Balon balığı	Lessepsian	Neurotoxic
	Torquigener flavimaculosus	Pufferfish/Balon balığı	Lessepsian	Neurotoxic
Molidae	*Mola mola*	Ocean sunfish/Ay-Pervane balığı	Cosmopolitan	Neurotoxic
	Ranzania laevis	Slender sunfish/Uzun pervane balığı	Cosmopolitan	Neurotoxic

Mediterranean Sea shores of Turkey. Some of these species migrated to north and dwelled in the south and middle Aegean Sea. Therefore, the east Mediterranean and Aegean Sea coasts of Turkey have a rather variable flora and fauna. This dynamic structure still exists and the fauna and flora of the Aegean Sea changes constantly and new species migrating from east Mediterranean Sea have joined in the fauna and flora of the Aegean Sea. Balloon fish which previously distributed only on east Mediterranean coasts of Turkey have recently been found in Izmir Bay and north Aegean Sea coasts.

3. Posonous fish species in the Aegean Sea

This characteristic of the Aegean Sea, which has a rich fauna and flora, applies to the fish fauna as well. The total number of fish species in Turkish seas is 512, 449 of which live in the Aegean Sea followed by the Mediterranean Sea (441 species), the Marmara Sea (257 species) and the Black Sea (154 species)[5]. On the Aegean Sea coasts poisonous fish species can be categorized into three groups like the poisonous fish of the Croatian Adriatic as follows[7]:

1. Fish that contain venomous spines on the tail or on the operculum. The poison can be very strong and can seriously endanger the victim. The sting is dangerous even in the dead fish. Trachinidae are considered aggressive so they can attack divers that approach them.

2. Fish that carry poisonous bite. In this group we include only murray eels. It has not been proved that they carry any poisonous glands in the mouth.

3. Fish having poisonous flesh or liver. The poisonous flesh or some other part of the fish body that is in use for nourishment (usually the liver) can be dangerous. The ingestion of some species of the Scombridae family can cause poisonings during the hot season.

Poisoning fish that contain venomous spines on the tail or on the operculum mostly are dangerous because of their poisonous thorns whereas the passive poisonous fish species poison when they are eaten.

Apart from these, swallowing the blood of species such as European eel *Anguilla anguilla* and European conger *Conger conger* might also cause poisoning. Because raw fish are not consumed in Turkey, this review takes only active and passive poisoning fish into account. In conclusion 51 poisonous fish species belonging to 14 families live on the Aegean Sea coast of Turkey. The updated list and types of poison regarding these species are presented in Table 1. Unfortunately there is no fine record of poisoning from prick or eating these fish. Fish poisoning are generally caused by eating spoiled fish preserved in unhealthy conditions not by eating poisonous fish. Primary symptoms caused by the consumption of stale fish include nausea, stomach ache, diarrhea, vomiting, dizziness and exhaustion[8].

Envenomations and injuries caused by marine animals often occur in coastal regions especially in spring and summer seasons. Many of the marine animals have grown toxins for defending themselves and hunting purposes[9]. Weever fish are the most venomous among the marine animals of the temperate zone[10]. Their habitats are eastern part of Atlantic Ocean, North Sea, Mediterranean and Black Sea[11]. The thorns of sting-fish contain a very strong poison known as dracotoxin[9,10]. Sting-fish injuries and accidents are frequently observed in both our country and in the world. On the other hand, rarely though, there are cases applying to hospitals for pricks of the fish such as scorpion fish or great weever[1,9]. Particularly in Turkey, people may sometimes call a few different species with the same name[3,6]. Pain caused by weever fish envenomations is very severe and reported as close to necrosis[12]. On the other hand, the poisonings caused by pricks may frequently cause swelling and rash in the area of pricks, severe pain, tissue deterioration, fever, change of pulse, difficulty in aspiration, shock and death, although rare.

Besides, as there has been an invasion of puffer fish especially on the Turkish Mediterranean and Aegean coasts in recent years, there is a danger in question. Thus, it is very important to particularly draw attention to these fish on the Turkish coasts. Tetrodotoxin (TTX) is found in species of the order Tetraodonntidae, which includes balloon fish, porcupine fish and puffer fish. These fish contain varying amounts of TTX, with the highest concentrations found within the liver, ovaries, intestines and skin with an increased toxicity at the end of the spring and before the spawning period. There is no specific antitoxin against TTX[13-15].

4. Conclusion

In conclusion, species causing envenomation in the sea and their venoms may regionally differ from each other. Also, responses of the envenomed cases may be different and this situation may change the clinical course of the disease. Therefore, follow-up and controls are essential while treating these cases[1].

Conflict of interest statement

We declare that we have no conflict of interest.

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