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Research Article

Impacts, awareness and management of lionfish envenomation in coasts of Turkey

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ABSTRACT

The study was carried out in the Mediterranean region of Turkey between 2018 and 2021. It was aimed to reveal lionfish awareness studies and lionfish venoming cases in Turkey in this study. The awareness studies were determined by institutional studies. Personal interviews, first aid agency notifications and literature were investigated to find lionfish venoming cases. Four awareness studies and seven lionfish venoming cases were detected. Pain, swelling, and redness were often the first symptoms in the venoming cases. The first application was immersion in hot water in three of the seven cases. No deaths were recorded in the cases. In Turkey, the awareness studies should continue with the derbies or tournaments and government-supported removal efforts must be made to reduce the population and stocks of invasive lionfish.

Introduction

Lionfish are venomous fish belonging to the Scorpaenidae family and have venomous spines like the rest of the Scorpaenidae it belongs to. This family consists of stonefish (Synanceia), scorpionfish (Scorpaena), and lionfish (Pterois) in order of venom potency. The name “lionfish” is given for the members of the genera Pterois, Parapterois, and Dendrochirus. Within this family is the lionfish-Pterois genus, principally *Pterois volitans* (Linnaeus, 1758) and devil firefish *Pterois miles* (Bennett, 1828) (Actinopterygii: Scorpaeniformes: Scorpaenidae). Lionfish are of great importance due to their invasive properties such as the wide ecophysiological tolerance, high fecundity and rapid growth, predatory defenses and general feeding habits (Aktaş and Mirasoğlu, 2017; Bilecenoğlu 2017; Uysal and Turan, 2020; Savva et al. 2020; Cavas and Bilgin, 2021; Tanrıverdi et al. 2021).

Currently, two species of lionfish *P. volitans* and *P. miles* are documented from the Mediterranean Sea (Al Mabruk and Rizgalla, 2019). The movement of lionfish into the Mediterranean Sea is considered to have most likely occurred via the Suez Canal, although their release from aquaria cannot be excluded (Al Mabruk and Rizgalla, 2019).The devil firefish *P. miles* was recorded for the first time from the Mediterranean Sea at Haifa Bay in 1991 and later the devil firefish *P. miles* were reported from Lebanon coast and Cyprus coast and then sighted in Turkey, Rhodes in Greece (Golani and Sonin, 1992; Bariche et al., 2013; Turan et al., 2014; Crocetta et al., 2015; Özgül, 2020). The invasion of the species has spread from the southern coast of Turkey towards the Aegean Sea (Özgül, 2020; Turan and Öztürk, 2015; Yağlıoğlu and Ayas, 2016; Turan et al. 2017; Bilge et al. 2017; Yapıcı, 2018). It is also reported in Cyprus, Greece, Lebanon, Tunisia, Italy, Libya, and Croatia (Al Mabruk and Rizgalla, 2019; Jimenez et al., 2016; Dailianis et al., 2016; Azzurro et al., 2017; Dragičević et al., 2021). While *P. volitans* has been only recorded in the Turkish waters (Figure 1) (Gürlek et al., 2016; Gökoğlu et al., 2017; Ayas et al., 2018; Yilmaz and Demirhan, 2020; Dağhan and Demirhan, 2020).

Lionfish inhabit warm marine waters at depths from 1 to 300 feet on hard bottom, mud bottoms, mangroves, seagrasses, coral reefs, and artificial reefs (Turan et al. 2017; Gürlek et al., 2016). It was reported that lionfish could be found at depths ranging from about 1 to 600 meters in Belizean waters (Searle et al., 2012). *P. miles* and *P. volitans* were usually observed in rocky habitats in the Mediterranean and Aegean Sea of Turkey (Gürlek

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et al., 2016; Turan et al. 2017; Özgül, 2020). It has been reported that devil firefish disperse from shallow waters of less than 3 meters to depths of 100-110 meters on the Mediterranean coast of Turkey (Yağlıoğlu and Ayas, 2016; Taşkavak et al., 2021; NTV, 2022).

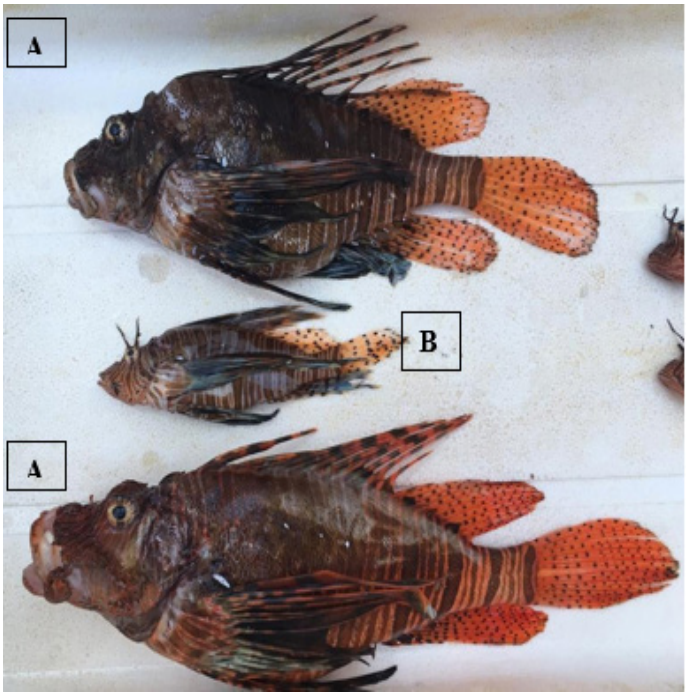

Figure 1. *Pterois miles* (A) and *Pterois volitans* (B) from Antalya Bay in Turkey

The lionfish severely impacts the invaded ecosystems and the native biota, but also affects ecosystem services and human health. The invasiveness of this species can be explained by its various ecological traits such as early maturation, high growth rates, general diet, high reproductive rate, long-range larval dispersion, and defensive structures (Dimitriadis et al., 2020). Of the two species of lionfish documented from the Mediterranean Sea, the devil firefish *P. miles* appears to be the more successful with a wider recorded distribution (Al Mabruk and Rizgalla, 2019; Turan et al., 2014; Crocetta et al., 2015; Turan and Öztürk, 2015; Jimenez et al., 2016; Dailianis et al., 2016; Azzurro et al., 2017). The spreading success of the devil firefish *P. miles* is facilitated, it is believed, by having a few predators e.g. the blue-spotted cornetfish *Fistularia commersonii* and the groupers (*Epinephelus striatus, Myceteroperca tigris, Ephinephelus marginatus* and *Ephinephelus costae*) (Bernadsky and Goulet, 1991; Mumby et al., 2011; Bariche et al., 2013; Turan et al., 2017; Al Mabruk and Rizgalla, 2019).

Lionfish envenomation can occur in their native habitats. However, they do not pose a significant problem since the lionfish population is ecologically limited in these areas and local people are familiar with the species. Even though the risk of local scorpion fish envenomation is more severe in the Mediterranean Sea and Turkish coasts, lionfish is a potential threat for divers due to its noteworthy appearance and for fishermen due to its novelty in the area. Up to date, most of the reported cases of lionfish venoming are aquarium related (Haddad et al., 2015; Aldred et al., 1996, Tam et al., 2007; Schaper et al., 2009; Badillo et al., 2012; Lucerna et al., 2017; Schult et al., 2017). However, the number of cases is remarkable in several studies reported from marine sources (Thomas and Tharakaram, 2016; Resiere et al., 2016; Ayaz et al., 2020). This study, it was aimed to reveal lionfish awareness studies and lionfish venoming cases in Turkey.

Materials and Methods

This study, it was aimed to reveal lionfish awareness studies and lionfish venoming cases in Turkey in this study. The study was carried out in the Mediterranean region of Turkey between 2018 and 2021. The awareness studies were determined by institutional studies. Personal interviews, first aid agency notifications and literature were investigated to find lionfish venoming cases.

The awareness studies

In this study, the awareness studies were determined by institutional studies; Gazipaşa Municipality, Antalya Province, and Gazipaşa District Agriculture and Forestry Regional Directorates, Gazipaşa Fishermen's Cooperative, Directorate Mediterranean Fisheries Research, Production and Training Institute, Antalya Metropolitan Municipality, and the Command of Coast Guard.

The lionfish venoming cases

Firstly, the conversations held with the victims venomed by lionfish were evaluated. Two victims called us and got information about what to do after venoming. The victims' signs of venoming were recorded. Secondly, three victims called the first aid agency after the venoming. The information about the cases was collected. Thirdly, the venoming cases reported in the literature were investigated. Fourthly, a lionfish stick penetrated the finger of R.T. from the authors during laboratory work. R.T. from the authors' signs of venoming were recorded. In addition, the consent of the victims whose photographs were used in the study was got.

Results

The awareness studies

As part of awareness activities, the lionfish competition with speargun was firstly organized by Gazipaşa Municipality, District Agriculture and Forestry Regional Directorate, and Fishermen's Cooperative in 2018. After that, the lionfish meat tasting event was held in Antalya/Demre district in 2019 by the Directorate Mediterranean Fisheries Research, Production, and Training Institute. In the same year, with the cooperation of the Command of Coast Guard and the Directorate Mediterranean Fisheries Research, Production and Training Institute, the fishermen in Antalya were informed about lionfish venom, first aid, and its fishing. The brochures about lionfish were distributed. The fishermen were very satisfied with the

training provided. No awareness activities were detected in 2020. In 2021, the awareness effort was carried out by Antalya Metropolitan Municipality with the participation of the Directorate Mediterranean Fisheries Research, Production and Training Institute, the Province Agriculture and Forestry Regional Directorate, and the Command of Coast Guard in Konyaaltı District. The lionfish caught in the competition were cooked and tasted. The taste of lionfish was appreciated. There are no government-supported awareness studies or removal efforts to combat lionfish in Turkey.

The lionfish venoming cases

The seven lionfish venoming cases were detected in the period 2019-2021 in Turkey. The venoming cases occurred with commercial and amateur fishermen and swimmers. Pain, swelling, and redness were often the first symptoms to appear. It was determined that only three of the 7 cases were immersed in hot water. No fatality was in coasts of Turkey (Table 1).

Table 1. Lionfish venoming cases in coasts of Mediterranean, Turkey

Case	Location	Year	How the Case Occurred	Venoming Case (Person number)	Venoming Symptoms	Treatment	Referans
1	Erdemli/ Mersin	2019	While the fisherman was collecting trammel nets, the spines penetrated to fisherman's hand palm.	1	Bleeding at the site of the sting, burning sensation, intense pain, the pain spread throughout his body, swelling, contractions in your arms after 3 days and slight paresthesia in your arm even after 20 days	Sainkillers and serum were given in hospital.	Ayaz et al., 2020
2	Antalya	2019	During laboratory work, a lionfish stick penetrated the author's finger.	1	Burning sensation, pain, redness and swelling.	The hot water immersion was applied for about 1 hour.	The statement of the author of the study
3	Antalya	2019	Lionfish was fallen on the foot of an amateur fisherman	1	Swelling, pain, and tissue death (Figure 2).	The victim put ice first. After receiving information, the victim applied hot water immersion. Victim then went to the hospital. Doctors encountered this type of poisoning case for the first time. Serum was given in hospital. The pain didn't subside. After victim went to the hospital many times.	Personal interview
4	Kemer/ Antalya	2019	The victim was stung by a lionfish.	1	Getting stick	Serum was given in hospital.	Coast Guard emergency aid request
5	Kemer/ Antalya	2020	The spines was penetrated the finger when the amateur fisherman hold to cut the spines of lionfish.	1	Intense pain and swelling.	The hot water immersion was applied. The victim was taken to the hospital because of the pain.	Coast Guard emergency aid request
6	Fethiye/ Muğla	2021	The person who went into the sea stepped on a lion fish.	1	Getting stick	The victim was taken to the hospital.	Coast Guard emergency aid request
7	Kemer/ Antalya	2021	While the victim catched the lionfish with a spear in Kemer/Antalya, its stick penetrated in the finger.	1	Bleeding at the site of the sting, redness, pain, swelling, and tissue death (Figure 3).	When the victim landed, he contacted us. First, victim applied the hot water immersion. He then went to the hospital. Painkillers and antihistamines were given.	Personal interview

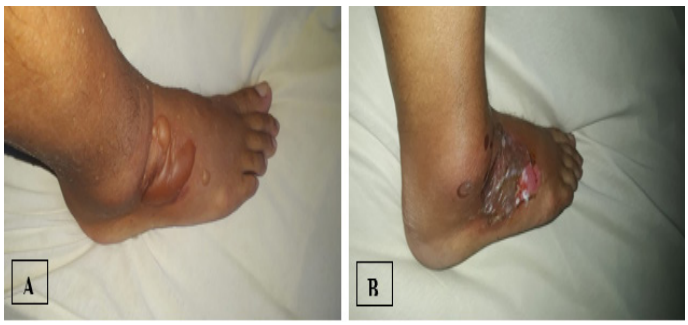

Figure 2. 3rd case: The lionfish that the amateur fisherman caught with a speargun was fallen on the foot in Antalya. A – The swelling stage after venoming, B – The tissue death stage after venoming

Figure 3. 7th case: While the victim caught the lionfish with a spear in Kemer/Antalya, its stick penetrated the finger. A – The Bleeding and redness stage after venoming, B – The The swelling stage after venoming after venoming, C – The The tissue death stage after venoming after venoming.

Discussion

Local-scale efforts were made in an attempt to minimize lionfish's negative impacts on native species and habitats and human health through organized and sustained removal efforts (e.g., recreational lionfish fishing derbies and tournaments used with a spear, speargun, and hook stick) in the Bahamas, Bermuda, Florida Keys, Mexico, San Pedro, Ambergris Caye and Placencia/Belize (Searle et al., 2012; Gleason and Gullick, 2014; ILCAHCANSTF, 2015; Hardison et al., 2018; Harris et al., 2019). It was reported that local removal efforts have to continued and supported (Gleason and Gullick, 2014; ILCAHCANSTF, 2015; Harris et al., 2019; Morris, 2012). The four awareness studies were identified in Turkey. Invasive lionfish is spreading their population in the Mediterranean at an alarming rate (Huseyinoğlu et al., 2021). The population control may require proactive, targeted human removals (Ulman et al., 2021). The catching pressure can be created (Dağhan and Demirhan, 2020).

The awareness studies and removal efforts should be supported in Turkey. On the other hand, there were government-supported removal efforts aimed at reducing the population and stocks of invasive pufferfishes in Turkey (Tanrıverdi, 2021). Considering the distribution, early maturity, high growth rates, high reproductive rate, and generalist diet of lionfish in Turkish seas, the government-supported removal efforts to combat invasive lionfish should be planned and implemented.

Lionfish envenomation can be seen in divers, fisherman and swimmers in the seas of world-wide (Thomas and Tharakaram, 2016; Resiere et al., 2016; Sümen and Öztürk 2020). In the French West, Indies victims included divers (47%), fishermen (32%), swimmers (21%), and even cooks (3%) (Resiere et al., 2016). The case was reported by a swimmer in Egypt (Thomas and Tharakaram, 2016). The case occurred while cleaning a freshly caught lionfish in Belize (Norton and Norton 2021). The venoming cases occurred with fishermen and swimmers in Turkey. When the cases in the world were examined, pain, edema, and swelling were usually symptoms seen firstly after a lionfish sting (Haddad et al., 2015; Aldred et al., 1996, Tam et al., 2007; Badillo et al., 2012; Lucerna et al., 2017; Schult et al., 2017, Thomas and Tharakaram, 2016; Resiere et al., 2016; Norton and Norton 2021). In the cases in Turkey, the first symptoms were pain and swelling. No fatality was reported in the world. Similarly, it was not in Turkey. The first application was immersion in hot water in the World (Haddad et al., 2015; Aldred et al., 1996, Tam et al., 2007; Schaper et al., 2009; Badillo et al., 2012; Lucerna et al., 2017; Schult et al., 2017, Thomas and Tharakaram, 2016; Resiere et al., 2016; Norton and Norton 2021). In Turkey, the first application was immersion in hot water in three of the seven lionfish venoming cases. This result may indicate low public and health worker's awareness and the necessity of continuing awareness studies in Turkey. Kleitou et al. (2019) reported limited awareness of lionfish in Cyprus. In Turkey, the cases of lionfish venoming were determined in the sea. The highest number of venoming cases in the world also occurred in the sea (Thomas and Tharakaram, 2016; Resiere et al., 2016; Norton and Norton 2021). However, it was seen that the aquarium cases were as much as the sea cases (Haddad et al., 2015; Aldred et al., 1996, Tam et al., 2007; Schaper et al., 2009; Badillo et al., 2012; Lucerna et al., 2017; Schult et al., 2017).

Lionfish are safely consumed when the lionfish's spines are removed (Cavas and Bilgin, 2021). In order to popularize the consumption of lionfish in Turkey, it was offered for sale at the Antalya Metropolitan Municipality's fish store and restaurant (Liberty, 2022). Many businesses in Antalya, Ankara, Istanbul, Muğla, and Bodrum began to enter their menus (Anadolu Agency, 2022). Incentives and studies should continue in order to popularize the consumption of lionfish in Turkey. Hardison et al. (2018) reported that lionfish were harvested recreationally and commercially throughout most of the invaded regions and were served in restaurants.

The spread of lionfish continues in the Mediterranean and Aegean Sea of Turkey (Turan et al., 2014; Turan and Öztürk, 2015; Gürlek et al., 2016; Turan et al. 2017; Özgül, 2020). Today, its spread area has reached as far as İzmir in Turkey. Their presence on the coastline, which is popular with fishermen and tourists, threatens human health. The development of lionfish fisheries has the potential to provide territorial control and

reduce ecological impacts. It can also represent an unexploited economic opportunity for fishing communities (Hardison et al., 2018; Ulman et al., 2020). In Turkey, lionfish fisheries should be developed. Since commercial fishing with harpoons or underwater rifles is prohibited in Turkey (Anonymous, 1995), fishing gear studies have to carried out to catch lionfish found in rocky areas. Private licensed commercial fishing infrastructure can be developed to combat lionfish as reported by Dağhan and Demirhan (2020).

Invasive species are globally on the rise due to human-induced environmental change and are often a source of harm to their new ecosystems. The continuous monitoring of invasive species is crucial to creating effective management strategies and mitigating their negative impact on native ecosystems. Citizen science and social media are important for monitoring invasive species (Al Mabruk and Rizgalla, 2019; Phillips and Kotrschal, 2021).

Conclusion

The single most important rule in approaching and handling lionfish and preventing from lionfish in the Mediterranean and Turkey where lionfish are less recognized by swimmers, people, and divers, amateur, and commercial fishermen are to create awareness. The awareness studies should continue to be focused on so that the public can recognize to tell the first application when sticks penetrated, catch, and consume lionfish during the derbies or tournaments in Turkey. In order to reduce the lionfish population and stocks, government-supported removal efforts must be made. The fishery and consumption of lionfish should be improved.

COMPLIANCE WITH ETHICAL STANDARDS

Authors' Contributions

Study concept and design (RT); data acquisition (RT, MG); data analysis (RT); drafting of the manuscript (RT, MG); critical revision of the manuscript (all authors); approval of the final manuscript (all authors).

Conflict of Interest

We declare that we have no conflict of interest.

Ethical Approval

For this type of study, formal consent is not required.

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