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Contents

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The Presence of Pontobdella Muricata (Hirudinea: Piscicolidae), on the New Host Gymnura Altavela (Linnaeus, 1758) in the Eastern Mediterranean, Turkey

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Marine leech,
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Abstract

Two specimens of Pontobdella muricata were observed on the dorsal surface of a female spiny butterfly ray, Gymnura altavela (Linnaeus, 1758), that was recorded in 2018 in the Akcay coast (Iskenderun Bay), Turkey. The spiny butterfly ray, G. altavela, was observed to be the new host for P. muricata in the eastern Mediterranean coast of Turkey. Besides, the present study is given comprehensive documents of the previous records of constitutes of different host records for P. muricata in different geographical areas.

1. Introduction

The marine leech Pontobdella muricata (Linnaeus, 1758) belongs to the Piscicolidae family (Sket and Trontelj 2008). This parasitic species is a predominantly parasite of freshwater or marine fishes and is known to native distribution in the northeastern Atlantic Ocean, the Baltic Sea, the North Sea, and the Mediterranean Sea (Palomares and Pauly 2023).

The marine leech P. muricata in the Mediterranean is most commonly known as parasitic on fish. The marine leech species are found virtually anywhere on the external body parts of cartilaginous and teleost fish (Burreson 1995; Arslan and Öktener 2012). The parasitic marine leech P. muricata several reported from some elasmobranchs and teleost fishes host in the Mediterranean and Adriatic waters (Sağlam et al. 2003; Bottari et al. 2007; Bakopoulos and Ksida, 2014; Başusta et al. 2016; Bolognini et al. 2016; Ben Ahmed et al. 2015).

P. muricata has been recorded from some fish in the marine waters of Turkey (Saglam et al. 2003; Çınar et al. 2014), and it has also been reported from different cartilaginous fish hosts in the Black Sea (Öktener and Utevsky 2010), the Sea of Marmara (Ergüven and Candan 1992), the Aegean Sea (Saglam et al. 2003) and the Mediterranean Sea (Bulguroğlu et al. 2015; Başusta et al. 2016; Yanar et al. 2019). However, up to date, no marine leech specimen of P. muricata was reported on the spiny butterfly ray.

In the present study, two P. muricata specimens were reported from the dorsal surface of a female spiny

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butterfly ray, Gymnura altavela (Linnaeus, 1758). This is the first record of G. altavela as being a host to P. muricata, and it is also the second occurrence of P. muricata in the eastern Mediterranean coast of Turkey (Iskenderun Bay).

2. Method

Two specimens of the marine leech, P. muricata, were observed on February 2018 from the dorsal parts of a female spiny butterfly ray, Gymnura altavela (Linnaeus, 1758), and then it was once recorded by video camera from depths of 9-10 meters from Akçay coast, Iskenderun Bay (Coordinate: 36º 13' N, 35º 50' E) in the eastern Mediterranean coast of Turkey (Fig. 1 and Fig. 2). The sea water temperature was measured as 19 ºC.

After the Scuba survey, these parasites were recovered from the spiny butterfly ray for examination and preserved in 70% ethanol for long-term storage. The two collected marine leech specimens were transferred to the laboratory in the Faculty of Fisheries and Marine Sciences and Technology of the Iskenderun Technical University. They were examined and photographed under an Olympus SZX-7 stereo microscope equipped with a digital camera. Length, width, and diameters of the oral and caudal suckers of the leeches were measured for two leech specimens to the nearest 0.1 mm with a digital caliper. According to Llewellyn (1966) and Sawyer (1986), the marine leeches were identified as P. muricata.

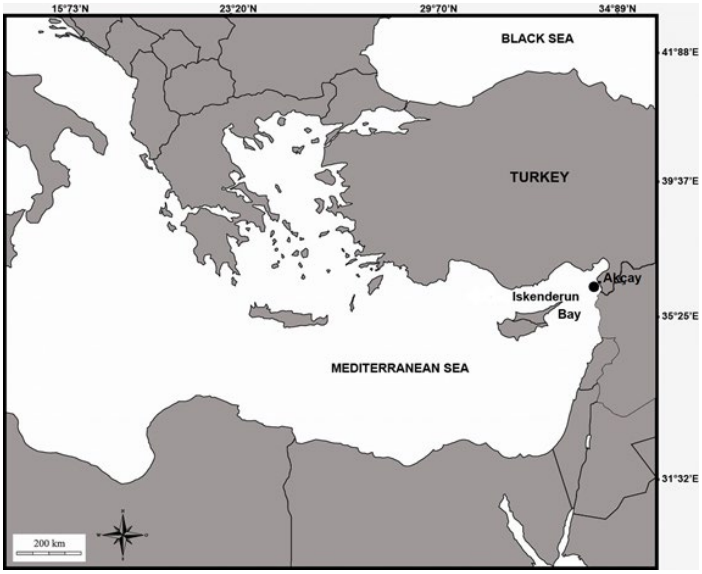

Figure 1. The map showing the capture record (●) of Pontobdella muricata from Akçay (Iskenderun Bay, Turkey)

Figure 2. The marine leechs Pontobdella muricata on the left and right disk of a female Gymnura altavela (Photo: Necdet Uyğur)

3. Results

The parasitic Hirudinea: The length (total length, TL) and width measurements of two specimens of P. muricata were 95.0 mm to 27.4 mm and 33.0 mm to 9.2 mm, respectively (Fig. 3). The diameters of the oral and the caudal sucker of them were 2.5 to 5.2 mm and 0.87 to 1.8 mm, respectively. The skin is rough and covered with small warts. The body is a long, cylindrical, somewhat flattened leech, narrowing at both ends. It has some annulations; the annulation of P. muricata between segments XI and XXVII is similar to the findings of the study by Sawyer (1986). Besides, this species has papillae and tubercles on the trachelosome and urosome and numerous photoreceptive cells on the oral sucker. However, there are no true eyes, and the oral sucker was

wider than the trachelosome. All morphological characteristics of P. muricata are consistent with the descriptions of Sawyer (1986).

Color: The color is olive-green with tiny speckles.

Figure 3. The marine leech Pontobdella muricata (95 mm, TL), OS (oral sucker) and CS (caudal sucker), Scale bar=10 mm

Stingray: The host spiny butterfly ray, G. altavela observed at depths between 9 to 10 m, was 460 mm in total length and 650 mm in disk width in Iskenderun Bay (Akçay coast) (Fig. 4). The spiny butterfly, G. altavela of the disk is very broad, and the tail is short armed with the spine.

Color: The disk is dark brown to grayish, the lower surface of the disc and the pelvic fins are white and brownish, and the tail is whitish. The morphological descriptions of the spiny butterfly ray agree with previous descriptions (Bauchot 1987).

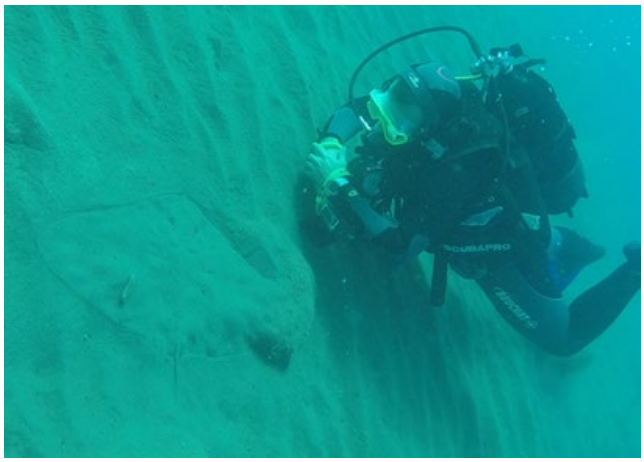

Figure 4. Underwater view of Gymnura altavela (Linnaeus, 1758) from Akçay coast (Photo: Necdet Uyğur)

4. Discussion

The marine leech, P. muricata is found on the seabed at depths down to about 100 m, and they are generally attached to the abdomen, ventral region, fin-bases of large elasmobranches and pectoral and pelvic fins, and gills of fishes where they feed by sucking blood (Rohde 2005; Palomares and Pauly 2023).

To date, marine leeches have been reported on several cartilaginous fishes (in Marbled electric ray Torpedo marmorata, Ray Raja sp., Thornback ray Raja clavata, Brown ray Raja miraletus, Spotted ray Raja montagui, Long-nosed skate Dipturus oxyrinchus and Common stingray Dasyatis pastinaca, Blacktip reef shark Carcharhinus melanopterus and Common eagle ray Myliobatis aquila) (Ergüven and Candan 1992; Sağlam et al. 2003; Öktener and Utevsky 2010; Bakopoulos and Ksidia 2014; Bulguroğlu et al. 2015; Bolognini et al. 2016; Yanar et al. 2019) and some ray-finned fish (in European plaice Pleuronectes platessa, Cape horse mackerel, Trachurus trachurus capensis) (Piasecki 1982; Sawyer 1986; Hayward and Ryland 2000). The previous records for the host list of marine leech P. muricata from different geographical areas are given in Table 1.

The spiny butterfly ray, G. altavela prefers sandy or muddy bottoms of brackish and coastal areas. It is disguised in the sand and feeds on crustaceans, mollusks, and small fish (McEachran and Capapé 1984).

In the Mediterranean, G. altavela is not targeted but is caught as bycatch with multiple fishing gears, including demersal trawl, gillnet, longline, and handline. Besides, coastal development, pollution, and anthropogenic effects through tourism activities are also an important threat to the species in shallow coastal habitats in the Mediterranean Sea. Thus, this species has been assessed as "Endangered, (EN)" under criteria A2d for The IUCN Red List of Threatened Species since 2019 (Dulvy et al. 2021) in the Mediterranean basin.

P. muricata is a hermaphrodite species, and fertilisation is internal. It feeds by sucking blood from fish as a parasite (Burreson 1995; Yamauchi et al. 2008). According to Palomares and Pauly (2023), the parasitic leech species is quiescent during the daytime, holding itself motionless and partially coiled, attached by its posterior sucker; however, it becomes active at night to feed. P. muricata can separate from its host and swim by flattening its body and then a new search for a suitable host fish (Rohde 2005; Palomares and Pauly 2023).

The present study is reported a new host record, G. altavela, for P. muricata in the eastern Mediterranean coast of Turkey. In addition, this study will shed light on scientists working in this field.

Table 1. Historical records host of *P. muricata* from different regions in Adriatic and Mediterranean waters

References	Location/ Country	No. of Infected Host	Year	Gear	Depth (m)	Family	Common Name	Species
Ergüven & Candan (1992)	Marmara Sea/Turkey	1	1992	-	-	Rajidae	Ray	*Raja* spp.
Sağlam et al. (2003)	Aegean Sea/Turkey	1	2000-2001	Bottom Trawl	-	Rajidae	Thornback ray	*Raja clavata* L.
		5				Torpenidae	Marbled electric ray	*Torpedo marmorata* Risso
Öktener & Utevsky (2010)	Black Sea/Turkey	3	2006	Gill net	-	Rajidae	Thornback ray	*Raja clavata* L.
Bakopoulos & Ksidia (2014)	Aegean Sea/Greece	3	2010-2012	Bottom Trawl	-	Rajidae	Thornback ray	*Raja clavata* L.
		2				Dasyatidae	Common stingray	*Dasyatis pastinaca* L.
Ben Ahmed et al. (2015)	Mediterranean Sea/	2	2008-2010	-	-	Rajidae	Ray	*Raja* spp.
Bulguroğlu et al. (2015)	Mediterranean Sea/Turkey	1	2013	Bottom Trawl	70	Rajidae	Thornback ray	*Raja clavata* L.
Başusta et al. (2016)	Mediterranean Sea/Turkey	2	2015	Bottom Trawl	75	Dasyatidae	Common stingray	*Dasyatis pastinaca* L.
Bolognini et al. (2016)	Northern and Central Adriatic Sea	33	2010-2014	Bottom Trawl	-	Rajidae	Thornback ray	*Raja clavata* L.
		21				Dasyatidae	Marbled electric ray	Torpedo marmorata *Risso*
								Myliobatis aquila L.
		3				Myliobatidae	Common eagle ray	
Bottari et al. (2017)	Thyrrhenian Sea/Italy	8	2014	Bottom Trawl	-	Rajidae	Brown ray	*Raja miraletus* L.
		2					Spotted ray	*Raja montagui* Fowler
Yanar et al. (2019)	Mediterranean Sea/Turkey	1	2016	Bottom Trawl	150-300	Rajidae	Long-nosed skate	*Dipturus oxyrinchus* L.
This study	Mediterranean Sea/Turkey	2	2018	Underwater survey	9-10	Gymnuridae	Spiny butterfly ray	*Gymnura altavela* L.

5. Conclusion

Although the marine leeches of Turkey are not well studied, there are limited studies on parasitic annelids and their hosts in Turkey. Our present study is provide a new essential data in this field. Therefore, further research and monitoring studies are required for parasite studies in different zoogeographic areas.

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Author contributions

Deniz Ergüden (DE): Investigation, data analysis, writing, sample design, methodology and final editing. Necdet Uyğur (NU): Data collection, data curation. Deniz Ayas (DA): Validation, supervision and editing.

Conflicts of interest

The authors declare that for this article they have no actual, potential, or perceived conflict of interest.

Statement of Research and Publication Ethics

For this type of study formal consent is not required.

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The Occurrence of Four Syngnathid Species (Osteichthyes: Syngnathiformes) in Mersin Bay (North-Eastern Mediterranean)

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Keywords

Sea horse,
Pipefish,
Syngnathidae ,
Mediterranean Sea,
Turkey.

Research Article

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Abstract

In this study, we report the occurrence of four rare syngnathids; Hippocampus fuscus Rüppell, 1838, Hippocampus guttulatus Cuvier, 1829, Syngnathus acus Linnaeus, 1758 and Syngnathus typhle Linnaeus, 1758 from Mersin Bay (Northeastern Mediterranean Sea coast of Turkey). To date, there is little information about the changes in numbers and habitat status of syngnathid species on the Mediterranean coast of Turkey, and these two sea horse species are currently considered as Near Threatened and Not Evaluated. Also, pipefish species are evaluated as Least Concern for the Mediterranean Regional Red List. Because insufficient information is available to assess their extinction risk, this study is significant for seahorse and pipefish populations in the Mediterranean and determining and evaluating their conservation status. Besides, the present study will be useful in the field of fisheries scientists and make an important contribution to fisheries managers.

1. Introduction

The family Syngnathidae is in the Order Syngnathiformes, and this family is represented by three main genera, Hippocampus Rafinesque, 1810, Nerophis Rafinesque, 1810 and Syngnathus Linnaeus, 1758 in the Mediterranean basin (Froese & Pauly, 2023).

To date, 12 sea horse and pipefish species are known in the Mediterranean Sea (Froese and Pauly, 2023; IUCN, 2023), and all species have been assessed for the IUCN Red List of Threatened Species (IUCN, 2016). However, only two of the 12 species are endemic to the Mediterranean (Abdul Malak et al., 2011), and also only Hippocampus fuscus is a lessepsian species that migrated into the Mediterranean via the Suez Canal (Golani and Fine, 2002; Gokoglu et al., 2004).

In the Turkish Mediterranean waters, 9 syngnathid species have been recorded, most of which live in shallow inshore waters (Fricke et al., 2007; Bilecenoglu et al., 2014). Previously, the boreal Atlantic pipefish Syngnathus rostellatus was reported as a new record for Turkey by Gökoglu et al. (2004). It was removed from the checklist of marine fishes (Bilecenoglu et al., 2014) since there was a misidentification of S. tenuirostris or S. acus (Cinar et al., 2021). Also, this species is commonly found in the Northeast Atlantic (Froese & Pauly, 2023).

Cite this;

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In the present study, the four syngnathid species, namely as; Sea pony Hippocampus fuscus Rüppell, 1838, Long-snouted seahorse Hippocampus guttulatus Cuvier, 1829, Greater pipefish Syngnathus acus Linnaeus, 1758 and Broadnosed pipefish Syngnathus typhle Linaneus, 1758 are reported from the Mediterranean coasts of Turkey by Akyuz (1957) and Aksiray (1987), although they also mentioned within the Turkish marine fishes checklists by Bilecenoğlu et al. (2014), so far these four syngnathid species of specimens have not observed from the Mersin Bay (Northeastern Mediterranean Sea, Turkey).

Although in the Northeastern Mediterranean coast of Turkey, syngnathids are not targeted by fisheries, seahorses and pipefish did get taken incidentally as bycatch. The present report is for the rare sightings of four Syngnathid species from northeastern Mersin Bay.

2. Method

The two seahorse and two pipefish specimens were accidentally caught from the marine area of the Goksu, Mersin Bay (Coordinate: 36° 17' 36.7 "N, 34° 02' 50.3"E) using commercial trawl fisheries at 3-10 m depths in April 2019 (Fig. 1).

Göksu River, which is the sampling area, is a river that flows into the Mediterranean Sea in the south of Silifke district of Mersin province. It is located 30 km south of Silifke.

The samples were brought to the laboratory in a ice box. After, the body measurements of fish samples were measured to the nearest 0.1 cm using calipers. The morphological descriptions and color of the captured sea horse and pipefish specimens are in agreement with those by Lourie et al. (1999), Dawson (1986a,b), and Golani et al. (2006) (Fig. 2, Fig. 3, Fig. 4 and Fig. 5).

The Systematic classification was made according to Nelson (2006). These four specimens were deposited in the Museum of Marine Life, Mersin University.

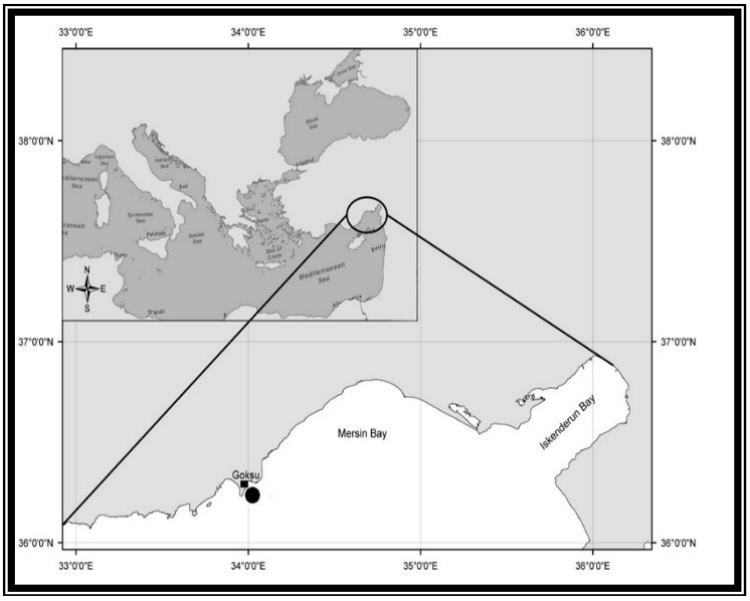

Figure 1. Housing and artificial light source

Figure 2. *Hippocampus fuscus* (female specimen) from Mersin Bay (Northeastern Mediterranean, Turkey)

Figure 3. *Hippocampus guttulatus* (male specimen) from Mersin Bay (Northeastern Mediterranean, Turkey)

Figure 4. Syngnthus acus from Mersin Bay (Northeastern Mediterranean, Turkey)

Figure 5. Syngnthus typhle from Mersin Bay (Northeastern Mediterranean, Turkey)

3. Result

SYSTEMATICS
Class: Actinopterygii
Order: Syngnathiformes
Family: Syngnathidae
Genus: Hippocampus (Cuvier, 1816)
Genus: Syngnathus Linnaeus, 1758

Hippocampus fuscus Rüppell, 1838

Diagnostic features: D, 14; A, 4; P, 14

Description of the Mediterranean specimen: The coronet is lowly raised and slightly curved, and the head is large compared to the body. The body is composed of bony rings arranged in dermal plates without spines. The snout is cylindrical. The prominent spine is above the eyes.

Color: The body is brown or pale yellow to light green with delicate white spots to lemon yellow.

Remarks: The sea pony H. fuscus has a wide distribution in areas along the coast of the Arabian Sea, Red Sea, and Indian Ocean (Lourie et al., 2016) and also entered from the eastern Mediterranean through the Suez Canal (Golani & Fine, 2002; Golani et al., 2021).

Biology and Ecology: This species is found in shallow waters on the edges of algal reefs or seagrass beds between 0-10 m depths (Foster & Vincent, 2004). The maximum length is up to 14.4 cm (Golani and Fine, 2022). The males carry the eggs in a brood pouch found under the tail (Breder & Rosen, 1966).

Threatened status: Not Evaluated (Mediterranean Regional Red List, IUCN, 2023).

Material examined: 1 female specimen, Goksu estuary, Mersin Bay, April 2019. Catalog number: MEUFC-19-11-103-001 (Fig. 2).

Hippocampus guttulatus Cuvier, 1829

Diagnostic features: D, 18; A, 4; P, 15

Description of the Mediterranean specimen: The coronet is small but distinct, with 5 rounded knobs or blunt points. Spines are medium to well-developed with blunt tips. The eye spine is prominent, rounded, and often with a mane of thick skin fronds on the neck and head.

Color: The body is dark green to brown, with prominent white spots on the body and often with a dark ring around them.

Remarks: British Isles and the Netherlands to Morocco, Canary Islands, Madeira, and the Azores, including the Mediterranean. (Dawson, 1990; Lourie et al., 2004; Froese & Pauly, 2023).

Biology and Ecology: Inhabits seagrass or algae in rocky or flat bottom to the depth of 10 m. The maximum length in male specimens is up to 21.5 cm, Standard Length (Curtis & Vincent, 2006). It feeds on zooplankton. Female deposits her eggs on the brood pouch of the male which is found under the tail (Breder & Rosen, 1966). Spawning season from April to October (Golani et al., 2006).

Threatened status: Near Threatened (Mediterranean Regional Red List, IUCN, 2023).

Material examined: 1 male specimen, Goksu estuary, Mersin Bay, April 2019. Catalog number: MEUFC-19-11-103-002 (Fig. 3)

Syngnathus acus Linnaeus, 1758

Diagnostic features: D, 35; P, 12 -Trunk rings: 18; Tail rings: 38.

Description of the Mediterranean specimen: Snout is cylindrical, equal to or less than eye diameter. An elongated lump is found on top of the head behind the eye (Muus & Nielsen, 1999).

Color: The body is light greenish to dark brown with variable markings.

Remarks: Eastern Atlantic from Norway, Faroes, and the British Isles to South Africa and northward to the coast of Zululand in the western Indian Ocean. (Dawson, 1986c; Froese & Pauly, 2023).

Biology and Ecology: Benthic neritic fish species living among rocks, mostly found in vegetation habitat between depth range 0-110 m (Dawson, 1986c). It feeds on small crustaceans (Taşkavak et al., 2010). Spawning season in spring and summer (Golani et al., 2006).

Threatened status: Least Concern (Mediterranean Regional Red List, IUCN, 2023).

Material examined: 1 specimen, Goksu estuary, Mersin Bay, April 2019. Catalog number: MEUFC-19-11-103-003 (Fig. 4).

Syngnathus typhle Linaneus, 1758

Diagnostic features: D, 32; P, 14- Trunk rings: 16; Tail rings: 31.

Description of the Mediterranean specimen: Snout is compressed and taller than the eye diameter, and anterior trunk rings are not fused ventrally (Muus & Nielsen, 1999).

Color: The body is usually harmonized with the surroundings and is brown or beige.

Remarks: Eastern Atlantic from Vardø, Norway, Baltic Sea, and the British Isles to Morocco. Also throughout the Mediterranean, Black Sea, and Sea of Azov (Dawson, 1990; Golani et al., 2006; Froese & Pauly, 2023).

Biology and Ecology: Inhabits seagrass meadows to a depth of 20 m. It feeds on small invertebrates. The male carries the eggs in a brood pouch (Breder and Rosen, 1966). Spawning season from March to October, peaking in the summer months (Golani et al., 2006).

Threatened status: Least Concern (Mediterranean Regional Red List, IUCN, 2023).

Material examined: 1 specimen, Goksu estuary, Mersin Bay, April 2019. Catalog number: MEUFC-19-11-103-004 (Fig. 5).

4. Discussion

The seahorses and pipefishes include more than 300 species in all major oceans and a few species in freshwater systems in the world. Also, 9 species are distributed in the eastern Mediterranean basin (Golani et al., 2006; Bilecenoglu et al., 2014).

The taxonomic information on seahorses and pipefishes is complex and constantly changing, making it difficult to determine the number of species in these fishes (Vincent, 1996; Gürkan et al., 2007). Due to the synonymous confusion, the number of seahorse species stated as close to 133. Scientifically, it is stated valid species as 57 in the literature. Similarly, the number of pipefish species scientifically stated as close to 193 is actually given as 34 valid species (Lourie et al., 2016; Froese & Pauly, 2023).

Two of three seahorses and six pipefish distributed on the Mediterranean Sea coast of Turkey are Endangered (EN), three of them are Near Threatened (NT), three of them are Data Deficient (DD), and one of them is Not Evaluated (NE) have been notified. Fricke et al. (2007) mentioned that is not enough information about these syngnathid species to assess their extinction risk in the region. However, of these nine syngnathid species, two are assessed as Near Threatened, three are Least Concern, three are Data Deficient, and one is Not Evaluated according to the Mediterranean Regional Red List (IUCN, 2023).

The life history characteristics of seahorses, such as male pregnancy, low fertility, and low mobility, have attracted considerable attention regarding biological conservation (Foster & Vincent, 2004). According to the IUCN Red List assessment, the long-nosed seahorse H. guttulatus is Near Threatened in the Mediterranean Sea. This species is also listed in Appendix II: International trade, export is regulated by a licensing system (CITES II since 15 May 2004). However, the alien sea pony H. fuscus is still Not Evaluated category for Mediterranean waters (Pollom, 2017; IUCN, 2023). Seahorses are especially very sensitive to human activities, such as habitat degradation caused by coastal development and destructive fishing gear. Thus, the sea horse populations have been a significant decline in the recent decade in the Turkish Mediterranean waters.

Pipefish and Seahorses in the Mediterranean coast of Turkey are threatened by habitat loss and degradation, tourism coastal development, and bycatch in trawl fisheries. Besides, some syngnathids are also at risk from threats such as pollution, sedimentation, eutrophication, and habitat disturbance through shipping in Mersin Bay (northeastern Mediterranean, Turkey). Therefore, further research study and monitoring are needed in order to determine population sizes, trends in abundance, changes in habitat, and threats for Mediterranean syngnathids in this coastal region.

5. Conclusion

To date, there is very scarce information about the changes in numbers and habitat status of syngnathid species on Turkey's Mediterranean coast. The present report shows that these syngnathid species still exist in the Mersin coasts. Thus, this study is very important for seahorse and pipefish populations in the Mediterranean Sea and determining and evaluating their conservation status. Besides, the present study will be very important and useful to decision-makers and fisheries managers.

Author contributions

DE: Conceptualization, investigation, data curation, writing, sample design and methodology, original draft, writing – review and editing. DA: Supervision, visualization, review and editing, Data collection, validation, image preparation.

Conflicts of interest

The authors declare that for this article they have no actual, potential, or perceived conflict of interest.

Statement of Research and Publication Ethics

No approval of research ethics committee was required to this study.

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A rare occurrence of Gymnothorax unicolor (Delaroche, 1809) in the South Eastern Mediterranean, Türkiye

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Abstract

In the present study, one specimen of Gymnothorax unicolor (Delaroche, 1809) was reported from the Southeastern Mediterranean waters with visual record during an underwater Scuba survey conducted on October 28, 2018, in the Keldağ/Yayladağı. This brown moray specimen was observed at 12 m in depth at night. This species, which was observed during night feeding in its natural environment, was reported for the first time during underwater observation from Iskenderun Bay. This report also constitutes a rare record of brown moray eel for this region.

1. Introduction

The family Muraenidae is represented by four species belonging to three genera in the Mediterranean waters (Fricke et al. 2023). These genera comprise brown moray eel, Gymnothorax unicolor (Delaroche, 1809), moray eel Gymnothorax reticularis Blotch, 1795, Mediterranean moray Muraena helena Linnaeus, 1758 and Fangtooth moray Enchelycore anatina (Lowe, 1838) (Golani et al. 2006; Stern and Goren 2013; Spinelli and Castriota 2017). Of these species, E. anatina and G. reticularis are non-indigenous species, and two moray species were reported for the first time in 1984 (Ben-Tuvia and Golani 1984) and 2013 (Stern and Goren 2013) from the Mediterranean Sea.

The brown moray G. unicolor has also been recorded in the eastern Atlantic, the Azores, Madeira, and Canary Islands, and also throughout the Mediterranean Sea, including the Balearic Islands (Riera et al. 1980; Froese and Pauly 2023). G. unicolor is a benthic fish species and prefers temperate waters (Spinelli and Castriota 2017).

Although Turkish checklists mentioned, the brown moray G. unicolor was reported (Bilecenoglu et al. 2002; Fricke et al. 2007) in the Mediterranean Sea for the Turkish waters. This species is rare in the southeastern Mediterranean (Iskenderun Bay). Besides, this species was first observed in the present study during nocturnal feeding.

Cite this;

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2. Method

Iskenderun Bay has a vast continental shelf, and the depth within this region does not exceed 90 m (Erguden and Turan 2013). On October 28, 2018, an individual of brown moray G. unicolor was observed with a teleost fish species in a rocky crevice in the Iskenderun Bay (Keldag/Yayladağı) at 12 m in depth during the night Scuba dive (Fig. 1). The surface water temperature was 24° C.

The brown moray specimen was photographed, and video recorded using a digital underwater camera during the scuba survey. The morphologic identification for G. unicolor (Fig. 2) was made according to Smith and Böhlke (1990).

3. Results

The following morphological features: The body is moderately compressed. The head and snout are short. The posterior nostril is a simple opening without a tube. The dorsal fin originates on the head just before the branchial anteriormost line-lateral pore (Carpenter and De Angelis 2016).

Color: The body and fins are uniform medium to dark brown, the anterior part of the head darker. The mouth is angle dark, fins margins with light yellowish.

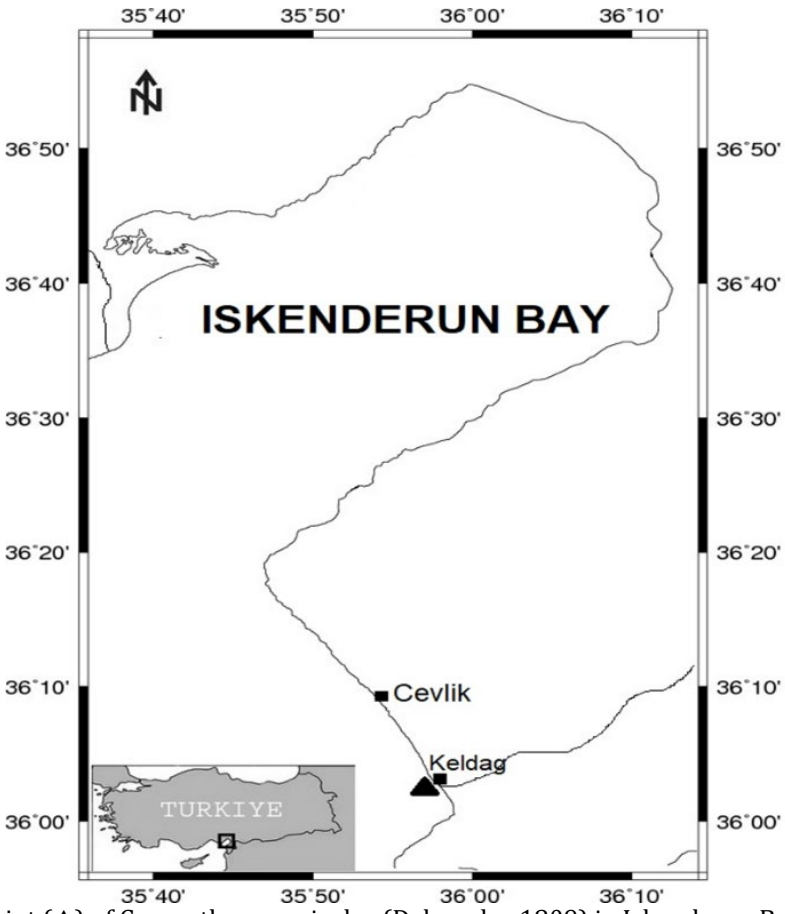

Figure 1. Sampling point (▲) of Gymnothorax unicolor (Delaroche, 1809) in Iskenderun Bay, Türkiye

Figure 2. Underwater images of the recorded brown moray Gymnothorax unicolor (Delaroche, 1809) in İskenderun Bay (Southeastern Mediterranean, Türkiye)

4. Discussion

The brown moray G. unicolor is a solitary nocturnal species. It is commonly found on shelves, on rocky bottoms, gravel, crevices, and small caves at depths of 10-80 m (Bauchot 1986). In this study, a brown moray specimen was found at 12 m depth. This depth range entirely agrees with the literature (Spinelli and Castriota 2017; Spinelli and Vitale 2023).

The typical total length of G. unicolor is 80 cm (Didier et al. 2023). The recorded maximum adult moray length is 110 cm for this species (Bini 1970; Didier et al. 2023) in the Mediterranean Sea. It feeds on small crabs, gastropods, and cephalopods (Bini 1970; Bohlke 1981).

In the Mediterranean Sea, the distribution and population of the brown moray eel is poorly known. The

brown moray G. unicolor individual observed during night feeding during scuba diving showed docile behavior and did not display an aggressive attitude towards the diver. It is seen that the individual who leaves his hole is looking for prey on the sandy-gravel ground at night (Fig. 2).

Although two moray species belonging to the genus Gymnothorax are known in the Mediterranean, G. unicolor differs from its other Mediterranean moray species in having a short snout and high dark head, separated from the brown body (Fischer et al. 1981).

G. unicolor is occasionally caught as a bycatch, and this species lives in coastal habitats where it may be vulnerable to anthropogenic impacts. There are no known major threats for this species in the eastern Mediterranean. This species has been assessed globally as Least Concern (LC) on the IUCN Red List (Tighe, 2015; IUCN 2023). However, it has been evaluated as Data Deficient (DD) on the Mediterranean Red List (Papakonstantinou et al. 2011).

In the present study, we report on the rare occurrence of G. unicolor specimens from the southeastern Mediterranean coast of Türkiye (Keldağ/Yayladağı). Besides, there is not enough information about the biology of this species observed during night feeding. Therefore, this visual record provides a vital filling gap about this species, which has not been adequately studied in the Mediterranean.

5. Conclusion

The brown moray G. unicolor is very rare in the southeastern Mediterranean. Thus, the present study is very important in monitoring, determining, and evaluating the conservation status of this Brown moray, which is Data Deficient "DD" in the Mediterranean Sea.

Author contributions

The article has a single author.

Conflicts of interest

The authors declare that for this article they have no actual, potential, or perceived conflict of interest.

Statement of Research and Publication Ethics

For this type of study formal consent is not required.

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Investigation of Violations in the Black Sea During the 2008-2012 Fishing Season

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Abstract

The infringements for the fisheries catching ban were investigated by using acquired data after controls performed by the Turkish Coast Guard Command in seafood catching activities between the Kocaeli-Kefken and Artvin-Hopa borders from 2008 to 2012. In parallel with the gradual increase of world population, both food needs and interest to supply of the need by sea because of limited terrestrial production increases in the same parallel. From this aspect, the protection and improvement of existing catching areas have great importance for the sustainability of fisheries sources in our country. In the present study it has been aimed to contribute to solution offers and fisheries chapter as a part of the European Union accession project via analyses of the infringements for catching ban made by fisheries within the process, based upon the Communique (no: 2/1) that regulates commercial fisheries catching from 2008 to 2012. It has been seen that the number and types of infringements of different catching boats in the different parts of the Black Sea Region are different from each other, and cross-domain differences have been observed. Within the four-year catching season, it has been taken against a total of 234 trawlers, 116 of the punishments from the Middle Black Sea, and being taken criminal actions against 80 seine boats and 175 from the Eastern Black Sea have been an indicator of local variability in catching activities.

1. Introduction

A rapid increase in the world's population, various climate changes, increases in the average temperature levels around the globe, melting of the glaciers, storms, natural disasters, and changes in the natural vegetation which have all been continuously increasing their impact since the last decades of 20'th century, are creating a variety of problems that affect our living environment and the entire world. In the first place, among these problems is providing the proper nutrition for an individual to maintain his/her life (Baykal & Baykal, 2008). The world's population has exceeded 7 billion by the year 2012 and it is predicted that it will be 9,6 billion in the year 2050 (URL-1: www.un.org). While the natural systems on the earth's surface are not enhancing and remain constant, the human population is ascending. If global climate changes and harming the soil because of improper cultivation are added to this situation, it raises the issue of healthy food security in the world.

For a human body to grow and operate healthy and protect itself from diseases, nourishment has gained

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much more attention within the last couple of years (Mol, 2008). The rapid increase in the world's population made it compulsory to use the limited food resources more efficiently. Today, it is recognized that not only just satiating people is essential, but at the same time, feeding them well-balanced is also crucial. Nowadays, besides being hygienic and economical, food is desired to contain protein, fat, carbohydrates, vitamins, and minerals in a balanced proportion. Aquaculture products are the only foodstuff that fits this request, and fish take the first place (Varlik et al., 2004). Fishing activities must be controlled and adequately conducted to preserve the stocks of aquaculture products and the revenues obtained from those stocks. The existence and size of the seafood stocks are related to food quantity inside the sea and the ecological conditions (Fasham, 1978)

As long as there is sufficient food and suitable habitat, the quantitative reduction because of fishing or natural deaths is compensated by the new individuals, and both the new individuals and the growth of the small ones can equalize the decrease in the total mass. In normal conditions, the stocks' continuance is achieved this way but can be damaged by overfishing or similar outside solid effects. Aquaculture stocks are substantially affected by commercial sea transportation enhancement and coastal pollution. Furthermore, overfishing activities above the sea's capacity are leading to spoilage in the balance and equation within the stocks. This situation shows itself by reducing the average length and age of the individuals in the population, and the decrease in the number of hunted fishes. Unless necessary measures are taken, the fishermen who catch from unbalanced stocks are reducing the size of meshes, making bigger nets, raising the working hours, and using more advanced technical equipment to protect their revenues. As a result, this behavior is boosting the fishing pressure on the population. Because of the accelerating fishing efforts, many small fish have been caught without getting the chance to grow up and reproduce. For this reason, the stock balance spoils much more, and getting products at the optimum level becomes impossible. For efficient management, fish that will be caught must reach specific length, age, and weight levels. With the help of scientific research, the minimum length and mesh size must be determined for each species (Erkoyuncu et al., 1995).

In our country, various limitations about fishing zones, characteristics, and technical properties are being publicly announced every four years. There is not much literature on how the fishermen violate the rules, why they intend to violate them, and which rules are especially violated in the Communique, which comprises four years the presentation of which type of fisherboat had breached what rule is very important. Generally, monthly and annual comparisons during the fishing sessions will be useful. Moreover, creating maps of the Black Sea based on sections and provinces will help identify the areas where regulation violations by commercial fishing boats are concentrated. The research will guide us on the EU's Fishing Chapter, data evaluations, and other public institutions' risk analysis studies.

2. Method

The Black Sea Region is divided into three parts regarding fishing activities: West Black Sea, Central Black Sea, and East Black Sea. The criteria in the General Directorate of State Meteorology reports are used principally. According to those, the West Black Sea section includes the Sakarya, Düzce, Zonguldak, Bartın, and Kastamonu provinces. In contrast, the Central Black Sea section is composed of Sinop, Samsun, and Ordu, and the East Black Sea includes Giresun, Trabzon, Rize, and Artvin provinces in the research. In aggregate, the entire Black Sea Region from the province of Sakarya to the Turkey-Georgia borderline is defined as the research field with approximately 1310 km of coastline.

Within the limitations of Communique on the Commercial Fishing No: 2/1 on the Black Sea,1205 small or big fishing vessels, including trawlers, purse seine, beam trawlers, and other different types that are existed in the entire Black Sea region between 2008-2012 fishing seasons, had been examined in the research study. These vessels or boats are both local and had come from outside the Black Sea for temporarily fishing there. The records and data were obtained from the routine controls of the Turkish Coast Guard Black Sea Regional Command.

Violations are classified in parallel with the official records of the Turkish Coast Guard Black Sea Regional Command, which carries out the duty of control and supervision in the Black Sea most effectively and successfully has every type of marine vehicle, equipment, and personnel for this purpose. Between 2008 and 2012, violation cases are analysed with regard to the introduced systematic, both for each fishing session and for four years of communique 2/1. Firstly, the fishing vehicles are assorted into four categories: trawlers, purse seine, beam trawlers, and coastal fishing. Secondly, the data in these categories are classified according to the year, month, section, and province parameters. Then, the violation cases against the place, time, characteristics, documents, and length prohibitions within Communique 2/1 are analyzed by dividing them into years and sections.

3. Results

In the 2008-2009 fishing session, most of the violations were made by shore fishers, while the least were made by beam trawlers (Table 1, Figure 1).

Table 1. Violations Based on Vessel Types in the 2008-2009 Fishing Session

Vessel Types	2008-2009 Fishing Session	
	N	%
Trawler	64	27
Purse seine	36	15
Beam Trawler	25	11
Coastal Fishing	109	47
Total	234	100

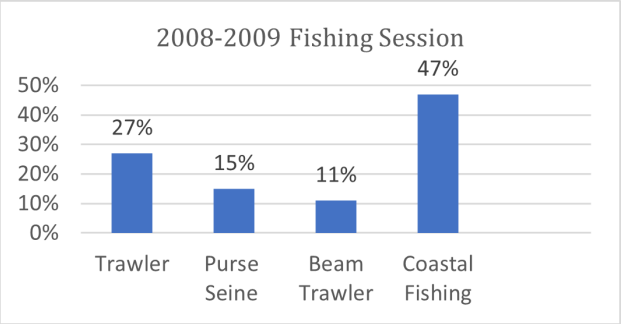

Figure 1. Violations Based on Vessel Types in the 2008-2009 Fishing Session

It can be seen that in the 2009-2010 fishing session, most of the violations were made by shore fishers. Violations by trawlers and beam trawlers are close to each other. The least is purse seine (Table 2, Figure 2).

Table 2. Violations Based on Vessel Types in the 2009-2010 Fishing Session

Vessel Types	2009-2010 Fishing Session	
	N	%
Trawler	55	24
Purse seine	29	13
Beam Trawler	47	21
Coastal Fishing	96	42
Total	227	100

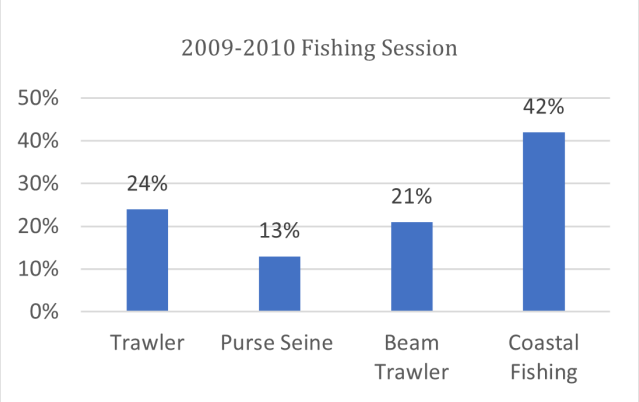

Figure 2. Violations Based on Vessel Types in the 2009-2010 Fishing Session

The results show that in the 2010-2011 fishing session, most of the violations were made by beam trawlers and shore fishers close to each other. Similarly, violations by trawlers and purse seine are near (Table 3, Figure 3).

Table 3. Violations Based on Vessel Types in the 2010-2011 Fishing Session

Vessel Types	2010-2011 Fishing Session	
	N	%
Trawler	61	19
Purse seine	57	18
Beam Trawler	91	29
Coastal Fishing	109	34
Total	318	100

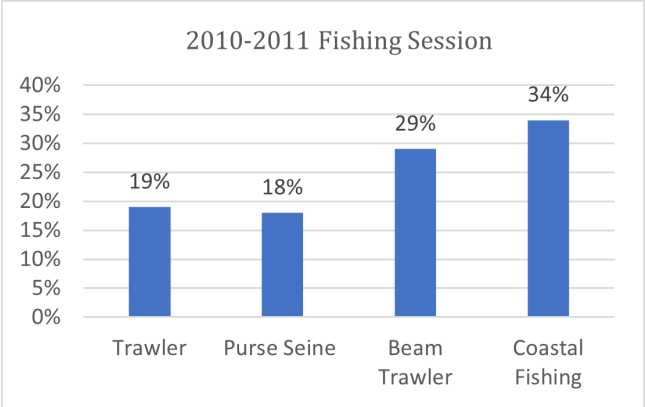

Figure 3. Violations Based on Vessel Types in the 2010-2011 Fishing Session

It is shown that, in the 2011-2012 fishing session, most of the violations were made by shore fishers. Violation cases of trawlers and purse seine are close to each other, and they share the bottom of the table (Table 4, Figure 4).

Table 4. Violations Based on Vessel Types in the 2011-2012 Fishing Session

Vessel Types	2011-2012 Fishing Session	
	N	%
Trawler	58	14
Purse seine	48	11
Beam Trawler	104	24
Coastal Fishing	216	51
Total	426	100

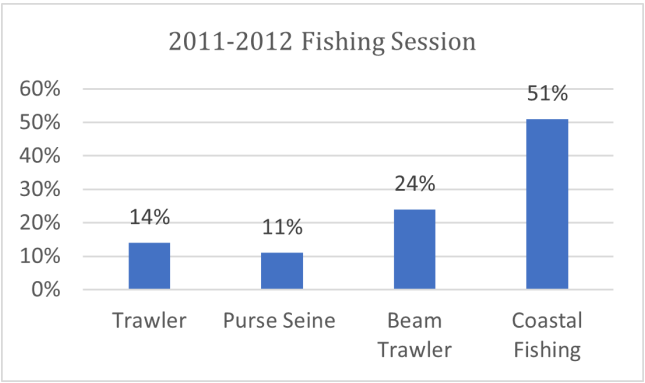

Figure 4. Violations Based on Vessel Types in the 2011-2012 Fishing Session

We can see that the highest percentage in the West Black Sea section is document deficiency, while breach against time limitation is the highest in the Central Black Sea section. In the East Black Sea section, a violation against technical properties is at the top. (Table 5, Figure 5).

Table 5. Violations Against Regions, Time, Technical Properties, Document Length- Species Prohibitions According to the Sections in the 2008-2009 Fishing Session

Regions	Time	Place	Technical Properties	Document	Length- Species Prohibitions
West Blacksea	4	16	0	33	2
Centrel Blacksea	24	32	5	36	4
East Blacksea	13	31	5	27	2
Total	41	79	10	96	8

Table 6. Violations Against Regions, Time, Technical Properties, Document, and Length-Species Prohibitions According to the Sections in the 2009-2010 Fishing Session

Regions	Time	Place	Technical Properties	Document	Length- Species Prohibitions
West Blacksea	7	30	1	18	2
Centrel Blacksea	27	24	21	33	10
East Blacksea	6	9	6	30	3
Total	40	63	28	81	15

Table 7. Violations Against Regions, Time, Technical Properties, Document and Length-Species Prohibitions According to the Sections in the 2010-2011 Fishing Session

Regions	Time	Place	Technical Properties	Document	Length- Species Prohibitions
West Blacksea	13	17	7	23	0
Centrel Blacksea	22	56	18	63	3
East Blacksea	10	19	33	32	2
Total	45	92	58	118	5

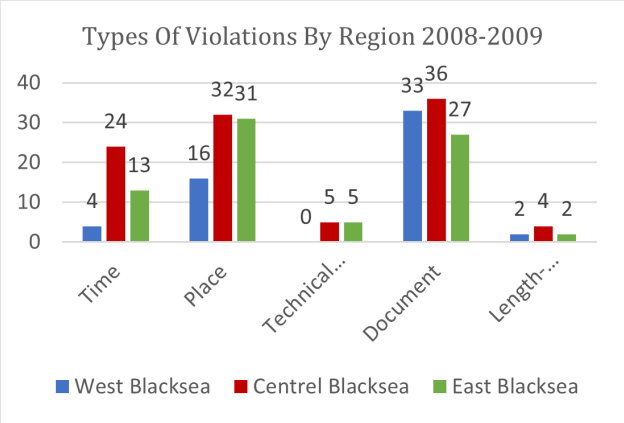

Figure 5. Violations Against Regions, Time, Technical Properties, Document, and Length- Species Prohibitions According to the Sections in the 2008-2009 Fishing Session

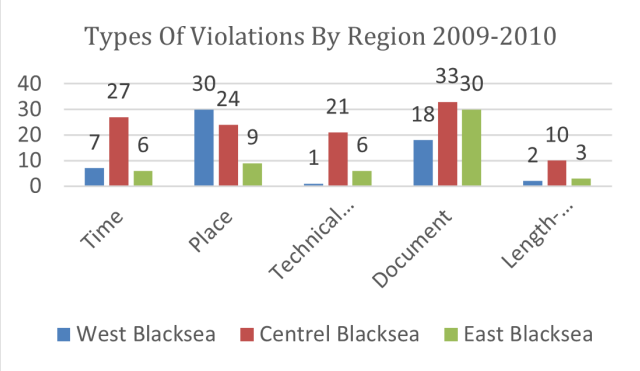

Figure 6. Violations Against Regions, Time, Technical Properties, Document and Length-Species Prohibitions According to the Sections in the 2009-2010 Fishing Session

In the 2009-2010 fishing session, breach against place constraints in the West Black Sea section, violation against technical properties in the Central Black Sea section, and document deficiency in the East Black Sea sector have the highest percentages (Table 6, Figure 6).

In the 2010-2011 fishing session, length and genus violations in the West Black Sea section, breach against place constraints in the Central Black Sea section, and violations against technical constraints in the East Black Sea sector have the highest percentages (Table 7, Figure 7).

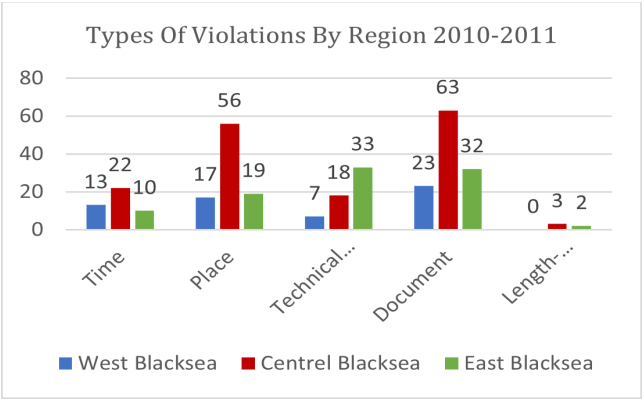

Figure 7. Violations Against Regions, Time, Technical Properties, Document, and Length-Species Prohibitions According to the Sections in the 2010-2011 Fishing Session

In the 2011-2012 fishing session, breach against place constraints in the West Black Sea section, breach against time limitation in the Central Black Sea section, and document deficiency in the East Black Sea sector have the highest percentages (Table 8, Figure 8).

Table 8. Violations Against Regions, Time, Technical Properties, Document, and Length-Species Prohibitions According to the Sections in the 2011-2012 Fishing Session

Regions	Time	Place	Technical Properties	Document	Length- Species Prohibitions
West Blacksea	8	58	15	15	8
Centrel Blacksea	41	17	46	36	10
East Blacksea	16	45	46	53	12
Total	65	120	107	104	30

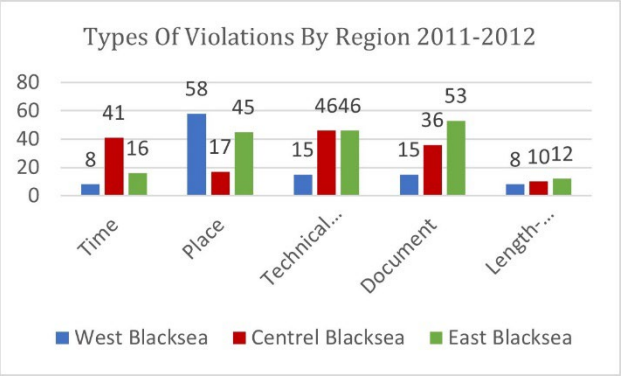

Figure 8. Violations Against Regions, Time, Technical Properties, Document, and Length-Species Prohibitions According to the Sections in the 2011-2012 Fishing Session

4. Discussion

The Black Sea is an area where the leaders of our country's fishing potential, that are anchovy, horse mackerel, bonito, bluefish, or other migrant fishes, are being caught by the purse seine. In contrast, trawlers or other dragging vehicles are hunting deep sea fishes like whiting, red mullet, or turbot. Compared to the other seas, the Black Sea is more advantageous for the small shore fishers, mostly below 12 meters, in terms of available boat yards and other facilities.

Regarding fishing for migrant species, local Black Sea vessels and vessels from other seas (Marmara, Aegean Sea etc.) exist and fish here. Besides, in the areas open to standard trawl fishing, the vessels have been continuously doing bottom trawling since years ago. As we understand, some foreign vessels have come to the Black Sea for a short fishing period in addition to the local fishing vessels. The fishing activities, which have been usually done in various techniques and within different periods, are supervised every month of the session or even in specific periods.

In the four-year fishing period, it is seen that the biggest amount of violations has been done by shore fishers, which is 530 out of 1205. Violations by purse seine and trawlers mostly increased in the 2010-2011 fishing session, while shore fishers and beam trawlers scored the highest in the session 2011-2012. In sectional comparison according to years, in the East Black Sea, breaches reached 172 in 2011-2012. In the violations against the regulations on the fish types' length, species, and weight, the maximum number of 29 was in the 2011-2012 session.

As the communique 2/1 covers a four-year period, it is normal that annual production quantities of the aquaculture products are different. It is assumed that violations are increasing during the abundant or rich sessions in terms of catchable fish quantity. According to the TÜIK records, total aquaculture product amounts vary in the sessions 2008-2012.

Primarily, powering the effectiveness of supervisory institutions' control and inspecting actions, which leads to an increase in the control and inspection counts, will help to lay off the violations more easily. Another point is that the Turkish Coast Guard Command and other public institutions can positively affect fishermen via educational activities like informative meetings, workshops, conferences, etc., which can prevent them from breaking the rules. The annual rise in the fines that fishermen face can be considered another factor preventing them from violating the regulations.

5. Conclusion

Generally, the variety of the violations and the types of vessels who does these violations in the Black Sea are known. The dispersion of the fishes that migrated to the Black Sea varies because of sectorial differentiations. The increase of the violations in the Central Black Sea section arise from the intense fishing activities of the trawlers, bottom trawlers, purse seine and shore fishers because of the weak limitations of the Communique in this sector.

Violation scores vary according to the type of vessel because of economic profitability. The increase in the breach against time limitation during the summer days when it is prohibited can be an example of this situation. This shows us that violations can go up parallel with the economic incomes.

The data that are gained from effective controls shows the direction of the fishing behaviors in the hunting sessions. However, we think that controls in the sea cannot be sufficient for preserving the stocks. In order to preserve the stocks:

-Boarding points must be active and expert aquaculture engineers should be employed,

- Quotas should be given to prevent overfishing for some species; like in the tuna fish, the data must be instantly shared with the regulatory institutions while fishing anchovy or bonito.

- Quotas should be given to fish processing facilities, especially the fish flour factories.

- Hunting areas ought to be created, and fishermen should hunt within these areas under specific constraints like time or quantity. This can help to preserve the stocks and decrease the costs of fishing.

- Official permission has to be given to the fishermen whose only source of income is fishing.

It is believed that these precautions will help to preserve and protect the fish stocks.

Author contributions

Yekta Tanış: Investigation, data analysis, writing, sample design, methodology and final editing. Data collection, data curation. Validation, supervision and editing.

Conflicts of interest

The author declare that for this article they have no actual, potential, or perceived conflict of interest.

Statement of Research and Publication Ethics

For this type of study formal consent is not required.

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