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First Record of *Pempheris rhomboidea* (Kossmann & Räuber, 1877) Harvested from Aquaculture Fish Cages

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Abstract

An individual of *Pempheris rhomboidea* species was detected in a cage where sea bream was grown in the Mersin Dana Island region. *P. rhomboidea* is a species of the Pempheridae family distributed in the Indo-Pacific and West Atlantic and is a nocturnal species that inhabit coral reefs and rocky waters. It is known that different wild fish species enter into the aquaculture fish cages where marine fish are grown and grow together with the aquaculture species. There is no previous record of this species obtained from aquaculture cages. The total length and weight of the individual in the cage were 12.6 cm and 23.938 g. Considering the mesh size of the cage, it is estimated that this individual entered the cage in the juvenile period. At the end of the 11-month aquaculture period, it was determined that the individual reached a length close to the maximum length that the species can reach in its natural habitat. It was determined that some morphometric characteristics of the individuals harvested from the cage were similar to individuals caught in nature. The ability of the nocturnal species to grow in aquaculture cages indicates strong adaptability. Other wild species harvested from the cage at the same time were *Oblada melanura*, *Scomber japonicus*, *Liza ramada*, *Diplodus vulgaris*, *Alosa fallax nilotica*, *Siganus rivulatus*, *Trachurus mediterranus*, *Lichia amia*, *Argyrosomus regius*, *Spicara smaris*, *Coryphaena hippurus*. The proportional increase of wild species in aquaculture fish cages may cause economic losses for the companies in the future.

Keywords:
Pempheris rhomboidea, nocturnal, first record, aquaculture cages, morphometry

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Introduction

Marine fish are one of the most basic sources of protein for human nutrition and have been provided by catching since the dawn of human history. However, when meeting the needs of the growing population began to threaten natural resources, aquaculture practices were started to ensure more rational use of natural resources and create alternative resources.

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The rapid development in the aquaculture sector and the increase in the number of fish cages began a period in which the ecological effects of fish cages were examined (Doğdu & Turan, 2021). Production amounts of 109749 tons for sea bream and 148.907 tons for sea bass have been reported in our country (TUIK, 2021). The pressure of excessive and unconscious fishing has brought a significant part of the global fish stocks to the point of collapse. The decreasing population density of a species due to the overfishing not only endangers this species' stocks but also threatens to continue other species' existence related to them. Therefore, the increasing demand for aquaculture consumption and the limited supply capacity in fishing have made the aquaculture sector more important in the last ten years.

Due to the feeding of aquaculture species in fish cages, the feeds dispersed in the natural environment cause some pelagic fish species to gather around the fish cages. In a study carried out in 6 different fish farms in İzmir and Muğla, 39 fish species belonging to 21 families were recorded around the cages and among these, the species with the highest biomass were *Boops boops* with 80.5%, *Atherina boyeri* with 4.14%, *Scomber colias* with 2.82%, and 2.78%. It has been reported that *Sardinella aurita* followed by *Oblada melanura* with a rate of 2.73% (Akyol et al., 2020).

Although there is information that fish species belonging to Sparidae, Carangidae, Mugilidae, Scombridae, Clupeidae, and Pomatomidae families gather around the aquaculture fish cages in the Mediterranean, there is no such record of *P. rhomboidea* belonging to the Pempheridae family. *P. rhomboidea* is a neritic species that inhabit the pelagic zone, coral reefs, and rocky areas of tropical and temperate waters in the Indo-Pacific and Western Atlantic. Their bodies are rhombic, flattened from the sides, and this species is characterized by large eyes and a short nose. They usually come out at night to feed on the reefs where they live collectively. They feed on zooplankton (Mooi & Randall 2014; Randall & Victor, 2015). It is reported that the species is an invasive species that migrate from the Red Sea to the Mediterranean and changes the structure of the ecosystem (Ergüden et al., 2013; Turan et al., 2015; Azzurro et al., 2015; Turan et al., 2018; Galanidi et al., 2019; Turan, 2020). The impacts of lessepsian species on new environment include restructuring established food webs, competition with native organisms for food and space and altering the gene pool when the invading organisms reproduce with native species, altering evolutionary processes and causing dramatic changes in native populations (Yağlıoğlu et al., 2014; Gürlek et al., 2016; Doğdu et al., 2016; Stamouli et al., 2017).

This is the first report of an individual belonging to the species *P. rhomboidea* obtained from aquaculture fish cages.

Materials and Method

The research material consists of an individual belonging to the P. rhomboidea species obtained from a fish cage in the Mersin Dana Island region on 20.09.2021 (Figure 1). Some morphometric characteristics of this individual were measured with a caliper with 0.01 mm precision. A photograph of the individual is presented in Figure 2.

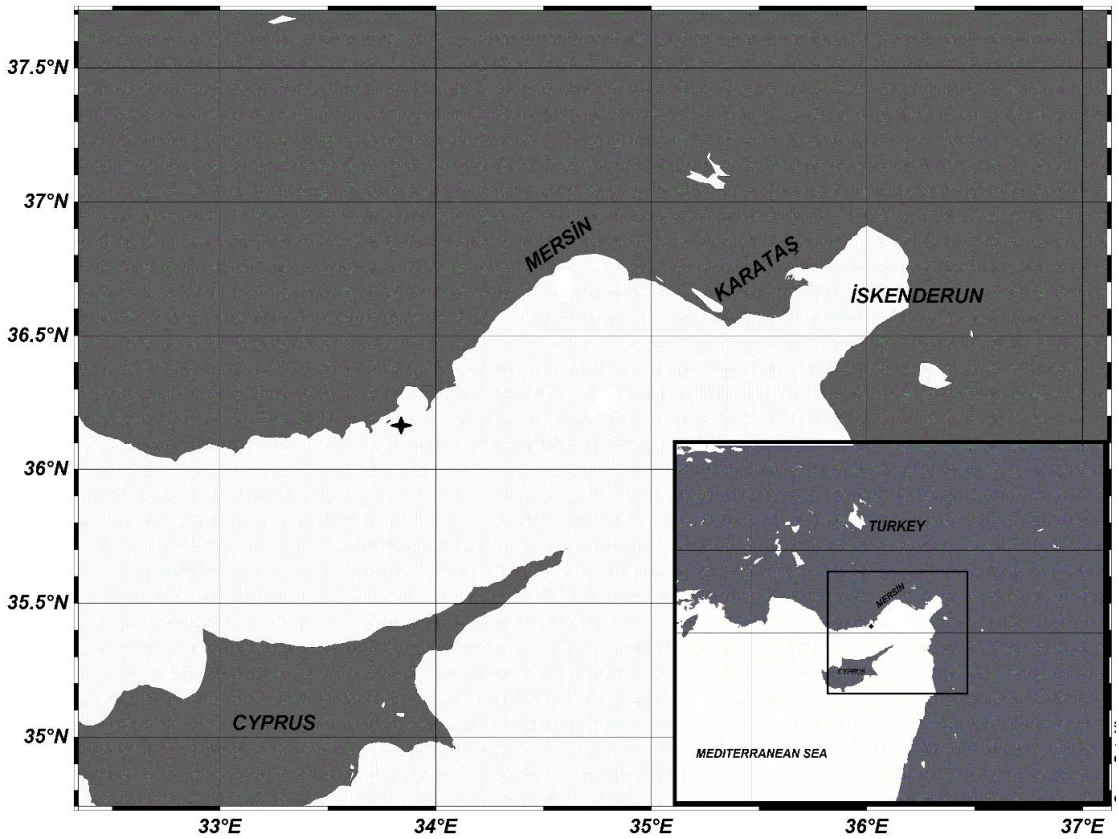

Figure 1. The map showing the point where the individual of the *P. rhomboidea* obtained from the cage is sampled

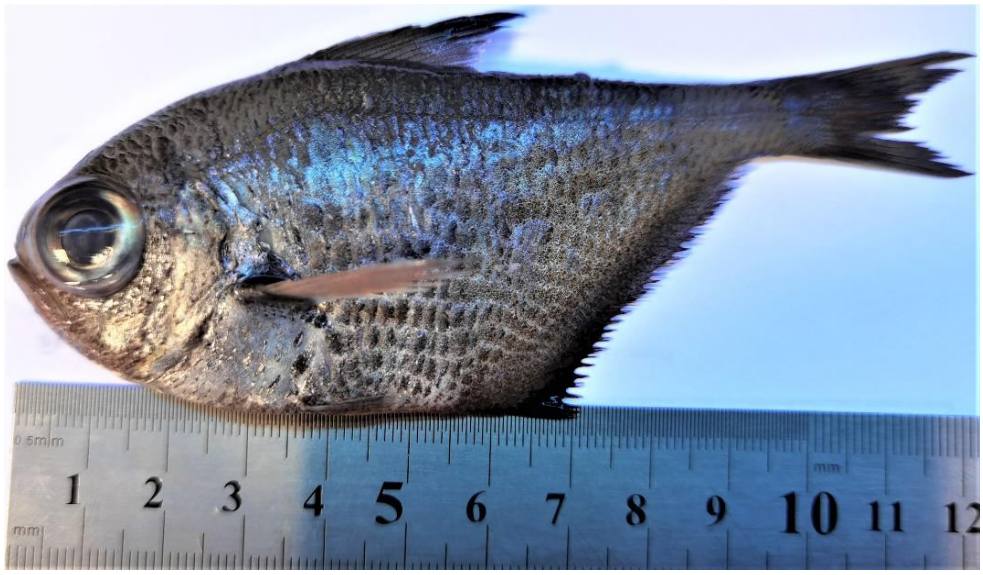

Figure 2. The photo of the individual of *P. rhomboidea*

Results

P. rhomboidea has shaped rhomboid flattened from the sides, and this species is characterized by big eyes and a short nose. Some meristic characters of the species are as follows: Dorsal spines: 6; Dorsal soft rays: 9-10; Anal spines: 3; Anal soft rays: 35-48. There is a blackish spot on the pectoral fin base. They usually go out at night to feed on the reefs they live in bulk. They feed on zooplankton (Mooi & Randall 2014; Randall & Victor, 2015). It is reported that the species is an invasive species that migrated from the Red Sea to the Mediterranean Sea and changed the structure of the ecosystem (Azzurro et al., 2015). On September 20, 2021, a P. rhomboidea individual with a total length of 12.6 cm and a weight of 23.938 g was obtained from a sea bream cage located in the Mersin Dana island region. Other wild species harvested from the cage at the same time were *Oblada melanura*, *Scomber japonicus*, *Liza ramada*, *Diplodus vulgaris*, *Alosa fallax nilotica*, *Siganus rivulatus*, *Trachurus mediterranus*, *Lichia amia*, *Argyrosomus regius*, *Spicara smaris*, *Coryphaena hippurus*.

Some morphometric characteristics of the individual were determined and presented in Table 1.

Table 1. Comparison of some morphometric measurements of P. rhomboidea obtained from sea bream cage and individuals caught from nature

	Present study (n=1)	**% SL**	**Çiftçi et al. (2019) (n=8)**	**% SL**
Standard length (mm)	100.0	100	90.13	100
Total length (mm)	126.0	126	112.62	125
Body depth (mm)	48.9	49	39.2	43
Body width (mm)	14.7	15	11.4	13
Head length (mm)	28.5	29	26.9	30
Eye diameter (ED) (mm)	13.0	13	12.7	14
Interorbital width (mm)	10.1	10	9.3	10
Caudal peduncle length (mm)	14.7	15	13.56	15
Pre-dorsal length (mm)	37.9	38	36.3	40
Pre-anal length (mm)	54.0	54	45	50
Base of Dorsal Fin (mm)	19.1	19	15.4	17
First dorsal spine (mm)	18.9	19	15.9	18
Longest dorsal fin ray (mm)	23.08	23	21.25	24
Longest pectoral fin length (mm)	27.81	28	25.88	29
Base of anal fin (mm)	46.9	47	39.8	44
First anal spine (mm)	1.9	2	1.5	2
Longest anal ray (mm)	14.2	14	13.3	15
Caudal fin length (mm)	22.8	23	20	22
Pelvic spine length (mm)	12.09	12	10.1	11
Pelvic fin length (mm)	15.3	15	14	16

Discussion

It is reported that aquaculture fish cages attract wild species due to the fish pellets fell down the bottom without being consumed by culture species and ensure that they collect on the bottom (Akyol et al., 2020). It is reported that some of these species enter into cages and are harvested together with the aquaculture species.

P. rhomboidea is a nocturnal species that prefers coral reefs and rocky bottoms. They usually come out at night to feed on the reefs where they live collectively. They feed on zooplankton (Mooi & Randall 2014; Randall & Victor, 2015). Although there is information that this species roams around the cage in flocks, no individual that has completed its development in the cage has been encountered before.

The mesh width of the cage where sea bream is grown varies between 2-18 mm depending on the developmental stage. Considering the mesh size, it is thought that the individual of *P. rhomboidea* entered the cage during the juvenile form and completed its development in the cage. The cage was harvested at the end of 11 months and it was observed that the total length (12.6 cm) reached by the individual in this period was close to the maximum length (13.2 cm) that the species reached in its natural habitat. It feeds on zooplankton in nature. It has grown and survived by feeding on pellets in the cage. This situation is interesting in that it shows that a zooplanktivorous fish in nature can survive feed on pellets in fish farms.

Some morphometric characteristics of the individual obtained from the cage were determined and compared with the same morphometric characteristics of individuals sampled from the natural habitat (Table 1).

It has been observed that the individuals caught from nature and the individual obtained from the cage are similar in terms of morphometric characters. The morphometric characteristics of P. rhomboidea caught from nature in the previous study and harvested from the cage in the present study were found similar. It was determined that the percentage ratios of morphometric measurements to the standard length of the individual harvested from the cage were higher than the previous study findings, except for the head length, eye diameter, and predorsal length (Table 1). The eye diameter of deep sea and nocturnal fish species is larger than that of the species living in the light environment. The reason for this can be explained by the fact that fish living in dark environments have larger and more developed eye structures in order to perform their vision function (Partridge et al., 1988). At the same time, in species living in the dark zone, the head is large in proportion to the body length. The reason for this is that the abundance of food in the dark zone is low, and the fish living here need to hunt individuals larger than themselves. In this case, the mouth opening and, accordingly, the head grows in proportion to the body (Ladds et al., 2020).

The study shows that the individual obtained from the cage completes its development in a short time compared to the individuals in its natural habitat and a nocturnal species can adapt to aquaculture conditions. Both cultured fish and wild fish that enter cages from nature grow in a shorter time compared to individuals in nature, as they are fed regularly 3 times a day. In addition, while individuals in nature spend energy to find food, they show faster development performance than those in nature, since they are subjected to more intensely feeding in a limited area in the cage. This is quite surprising given the biological requirements of the species.

Wild species obtained from the cage except for *P. rhomboidea* were *O. melanura, S. japonicus, L. ramada, D. vulgaris, A. fallax nilotica, S. rivulatus, T. mediterranus, L. amia, A. regius, S. smaris, Coryphaena hippurus*. Akyol et al. (2020) reported that among the wild fish species reported from the cage environment, *P. rhomboidea, Siganus luridus, Siganus rivulatus, Stephanolepis diaspros* are non-native species. In this study, *P. rhomboidea* and *S. rivulatus* obtained from the cage are non-native species.

It is known that wild fish species roam in flocks on the bottom of the cages in farms, and some species enter the cage and complete their development in the cage with the target species. It is not yet possible to prevent wild species from entering the cages. The proportional increase in this situation may cause economic losses.

It has been reported that *P. rhomboidea* is an invasive species that migrate from the Red Sea to the Mediterranean and changes the structure of the ecosystem (Azzurro et al., 2015). There is no report of this species from the aquaculture cages to date; only one individual was reported for the first time in this study. In this study, it is shown that *P. rhomboidea* has the ability to adapt to living spaces other than their biological needs and can reach maximum total length in a short period of 11 months.

Author Contributions

N.Ç. and D.A. performed all the experiments and drafted the main manuscript text.

Conflict of Interest

The authors declared that no conflict of interest.

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