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RESEARCH ARTICLE **ARAŞTIRMA MAKALESİ**

The comparison of population density of *Holothuria tubulosa* (Gmelin, 1790) and *Holothuria polii* (Delle Chiaje, 1823) between exploited and non-exploited areas in the Aegean Sea coast of Türkiye

Türkiye'nin Ege Denizi kıyılarında *Holothuria tubulosa* (Gmelin, 1790) ve *Holothuria polii* (Delle Chiaje, 1823) popülasyon yoğunluğunun av yapılan ve yapılmayan alanlar arasındaki karşılaştırılması

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Abstract: Increasing demand from the Asian market first led to the collapse of economically valuable sea cucumber stocks in the Indo-Pacific, and then demand shifted to lower value Mediterranean species. The effect of this change in sea cucumber stocks in Türkiye started to be seen after the 2010s. To address it, we carried out a study to compare the population density of the most caught *Holothuria tubulosa* and *Holothuria polii* species between exploited and non-exploited areas in the Aegean Sea coast of Türkiye. The study was carried out between September 2018 and March 2020 at 4 stations, two of which are in Çandarlı Bay, where sea cucumber fishing is free, and two in İzmir Bay, where it is prohibited. Samplings between 0-20 m depths were carried out with underwater transect line technique, and at depths deeper than 20 m, with beam trawling operations. A total of 6 sea cucumber species were identified, including *Holothuria mammata, Holothuria sanctori*, *Parastichopus regalis* and *Holothuria forskali* species, apart from the target species *H. tubulosa* and *H. polii*. Only one *P. regalis* individual was recorded in the samplings in waters deeper than 20 m. The mean densities of *H. tubulosa* and *H. polii* were found to be higher in İzmir Bay stations than in Çandarlı Bay ($p<0.05$). The results of this study clearly reveal that the population density of sea cucumber in sampling areas has decreased tens of times compared to the last 5 years.

Keywords: *Holothuria* sp., biometry, overexploitation, fisheries management, Aegean Sea

Öz: Asya pazarının artan talebi, ilk olarak İndo-Pasifik'teki ekonomik açıdan değerli deniz patlıcanı stoklarının çökmesine sebep olmuştur ve daha sonra talep daha düşük değere sahip Akdeniz türlerine yönelmiştir. Türkiye'deki deniz patlıcanı stoklarında bu değişimin etkisi 2010'lu yıllardan sonra görünmeye başlamıştır. Bunu ele almak için, Türkiye'nin Ege Denizi kıyılarında en çok avlanan *Holothuria tubulosa* ve *Holothuria polii* türlerinin popülasyon yoğunluğunu, avcılığın serbest ve yasak olduğu alanlarda karşılaştırmak için bir çalışma yaptık. Çalışma, ikisi deniz patlıcanı avcılığının serbest olduğu Çandarlı Körfezi'nde, ikisi ise yasak olduğu İzmir Körfezi'nde olmak üzere 4 istasyonda gerçekleştirilmiştir. 0-20 m derinlikler arasındaki örneklemeler sualtı çizgisel hat tekniği ile 20 m'den derindekiler ise algarna operasyonları ile gerçekleştirilmiştir. Hedef tür *H. tubulosa* ve *H. polii* dışında *Holothuria mammata, Holothuria sanctori, Parastichopus regalis* ve *Holothuria forskali* türleri olmak üzere toplam 6 deniz patlıcanı türü tespit edilmiştir. 20 m'den daha derin sularda yapılan örneklemelerde sadece bir *P. regalis* bireyi kaydedilmiştir. *H. tubulosa* ve *H. polii*'nin ortalama yoğunlukları İzmir Körfezi istasyonlarında Çandarlı Körfezi'ne göre daha yüksek bulundu ($p<0,05$). Bu çalışmanın sonuçları, deniz patlıcanı popülasyon yoğunluğunun son 5 yılda onlarca kat azaldığını açıkça ortaya koymaktadır.

Anahtar kelimeler: *Holothuria* sp., biyometri, aşırı avcılık, balıkçılık yönetimi, Ege Denizi

INTRODUCTION

The proportion of fish stocks that are within biologically sustainable levels decreased from 90 percent in 1974 to 65.8 percent in 2017, with 59.6 percent classified as being maximally sustainably fished stocks and 6.2 percent underfished stocks (FAO, 2020). As a result of this overfishing, landings from global fisheries have shifted in the last 45 years from large piscivorous fishes toward smaller invertebrates and planktivorous fishes, especially in the Northern Hemisphere (Pauly et al., 1998). Sea cucumber species are among the invertebrates adversely affected by this change.

Sea cucumbers are deposit feeders critical to maintaining the balance of benthic microenvironments, the foundation of a highly productive and healthy marine ecosystem, including coral reefs (Uthicke, 2001; Lök et al., 2005). Sea cucumber over fishing has serious impacts on sediment health, water quality, nutrient recycling, seawater chemistry and energy transfers across the food chains in numerous marine systems globally (Conand, 2018).

Throughout the world, 66 species of sea cucumbers are commonly exploited (Purcell et al., 2010) and of particular importance in the Indo-Pacific (Choo, 2008). The global analysis of sea cucumber fisheries by Purcell et al. (2013) revealed that overexploitation and depletion of sea cucumber stocks, particularly in the Indo-Pacific, is alarmingly high. A number of species are threatened and there is evidence of local extinctions in some tropical regions (Uthicke and Conand, 2005).

Fishing of sea cucumber species has been an important source of income for small-scale fisheries in Türkiye since 1996 (González-Wangüemert et al., 2014; Lök et al., 2017; Dereli and Aydın, 2021). Sea cucumber products are exported to Asian countries, especially China (Aydın, 2008). While sea cucumber export was 247 tons in 2014, it increased to 1169 tons in 2019 (TÜİK, 2020). However, basic scientific studies such as population density, reproductive biology and habitat preferences of sea cucumber species on the Turkish coast are very limited.

The aim of this study is to compare of population densities of *H. tubulosa* and *H. polii*, which have economic value and are the most collected species between exploited (Çandarlı Bay) and non-exploited (İzmir Bay) areas.

MATERIAL AND METHODS

Study area: The study was carried out between September 2018 and March 2020 in the Çandarlı and İzmir Bays in the Aegean Sea. Heavy industry and heavy maritime traffic affect the marine ecosystem negatively in both bays where the population is dense. There are important areas where all kinds of fishing activities (large and small-scale fishing, recreational fishing and aquaculture) are carried out in both Çandarlı and İzmir Bay (Tokaç, 2017). As a result, Çandarlı and İzmir Bays are exposed to similar anthropogenic effects (DGEIAPI, 2017).

According to the regulation published by the Ministry of Agriculture and Forestry, General Directorate of Fisheries and Aquaculture, sea cucumber fishing is free in Çandarlı Bay (Anonymous, 2020). In the same regulation, sea cucumber fishing is prohibited in the south of Izmir Bay.

Sampling: Sampling was carried out seasonally between September 2018 and March 2020. Sea cucumber samples were collected from a total of 4 stations, two from Çandarlı Bay, where fishing is free, and two from İzmir Bay, where fishing is prohibited (Figure 1).

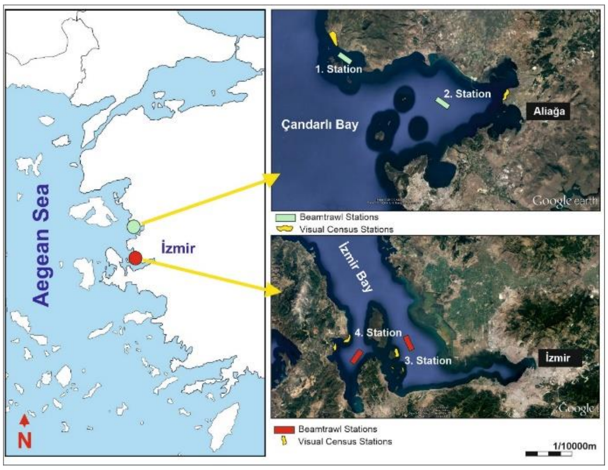

Figure 1. Study area and sampling stations

Sea cucumbers show a wide distribution depth. Thus, samplings were carried out at different bathymetries and with different methods. In this framework, depths of 0-20 meters were sampled with the diving method, and places deeper than 20 meters were sampled with beam trawl.

Samplings made with the line transect were carried out between 0-10 m and 10-20 m depth contours for each station. The transect line is marked with two buoys and a 100 m submersible rope (Figure 2).

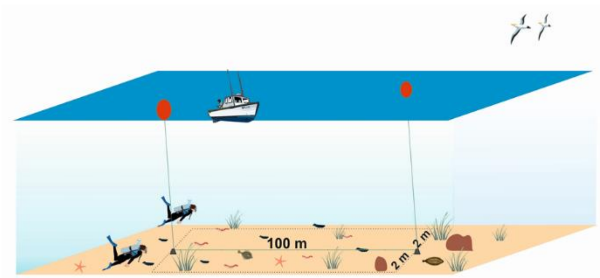

Figure 2. Transect line and dimensions used in underwater

In all four stations, the samplings in the 0-10 m transect were carried out with 6 replications and the samplings at the 10-20 m transect were carried out with 3 replications. In the preliminary studies carried out in the selected sampling areas, it was determined that sea cucumber individuals were found in the first 10 m, while they were very rarely distributed at deeper depths. When diving depth/time limits are added to this situation, the number of replications deeper than 10 meters was determined as 3. Each transect has a length of 100 m, a width of 4 m and an area of 400 m². Thus, at the end of the sampling at each station, 6 x 400 m² = 2400 m² for 0-10 m depth contour and 3 x 400 m² = 1200m² for 10-20 m depth contour, and a total of 3600 m² area was scanned.

Sea cucumber individuals sampled by the diver were placed in the net and transferred to the drums on the research vessel. The samples placed in the drums were taken out of the sea water and taken into a plastic container of known tare, and their weights (with a precision of 0.1 g) were taken. It was then transferred to plastic cuvette containing sea water. The individuals, who were kept in the cuvette for 10-15 minutes, were measured with a 1mm precision tape measure after the contractions stopped and they calmed down (maximum relaxation length value). After measuring the lenght and weight of the individuals, they were released back to the sea

Beam trawl operations were carried out to determine the population density of target species in areas deeper than 20 m. The inside width of the beam trawl frame used in the sampling is 2 m, its height is 55 cm and the cod-end length is 8 m. Polyethylene multi-monofilament (0.20 mm x 14) net with 44 mm mesh size was used in the cod-end (Figure 3).

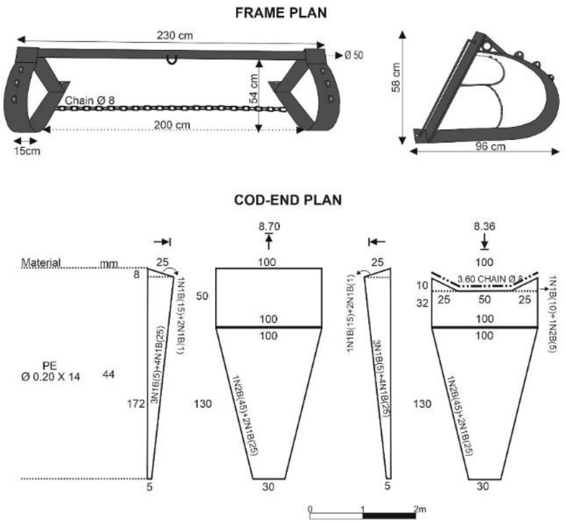

Figure 3. Technical plan of beam trawl cod-end

Beam trawl samplings were carried out at two different bathymetries. Beam trawl operations in Çandarlı Bay were carried out on the shores of Şakran for the 20-40 m depth and on the Denizköy coasts for the 40-60 m. Beam trawl operations in Izmir Bay were carried out on the shores of Gülbahçe for the 20-40 m and on the eastern shores of Hekim Island for the 40-60 m. Beam trawl towing time in one sampling was determined as 30 minutes and was carried out in 3 replicates at each station.

Data analysis: Length and weight frequency distributions were calculated to show the ranges of sizes each species and to identify the most abundant classes.

SPSS 15.0 statistical package program was used to analyse the data. Prior to the analysis, the conformity of the data to the normal distribution was examined using the Shapiro-Wilk test of normality and the homogeneity of variance was tested by Levene test. In statistical tests, the significance level was preferred as $p<0.05$ (Zar, 1999). It has been tested whether the sea cucumber population density differs between stations where fisheries are prohibited and free. In addition, the variation of sea cucumber density according to the seasons was also tested. Kruskal-Wallis one-way analysis of variance and Mann Whitney-U test from non-parametric tests were used in statistical evaluations.

RESULTS

In the study, a total of 216 successful dives were made in underwater visual census samplings carried out at four stations. 144 of these dives were made at 0-10 m depth contour, and 72 were made at 10-20 m depth contour. Diving time for a hundred-meter line varied between 20 minutes and 70 minutes, depending on the habitat type and the frequency of encounters with sea cucumber species. The scanned area in each dive sampling is 400 m². As a result, a total of 86 400m² of area, 57 600 m² at the 0-10 m depth contour and 28 800 m² at the 10-20 m depth contour, was scanned and sampled.

The length-frequency and weight-frequency distributions of all *H. tubulosa* and *H. polii* species collected in visual census samples from Çandarlı Bay and İzmir Bay stations are presented in Figures 4 and 5.

In the sampling studies carried out in Çandarlı Bay, a total of 79 *H. tubulosa* and 81 *H. polii* individuals were collected and measured. *H. tubulosa* showed the most frequent size-class in the range of 22-25 cm in length and 264-324 g in weight. For *H. polii*, these values were in the range of 8.7-10.7 cm in length and 51-81gr in weight. The average length was calculated as 19.8 cm and the average weight as 224.5 g for *H. tubulosa.* These values were found to be 10.4 cm and 82.5 g for *H. polii*. The median values of *H. tubulosa* and *H. polii* in length distribution were found to be 20.6cm and 14.5cm, respectively. Both species showed multimodal size frequency distribution in Çandarlı Bay.

In the sampling studies carried out in İzmir Bay, a total of 442 *H. tubulosa* and 1144 *H. polii* individuals were collected and measured. The most frequent size classes of *H. tubulosa* was between 21.6-23.6 cm in length and 163-213 g in weight. For *H. polii*, it was between 13.4-15.4 cm in length and 61-111 g in weight. The average length was calculated as 19.4 cm, and the average weight was 199 g for *H. tubulosa*. These values were found to be 13.2 cm and 102.3 g for *H. polii*. The median values of *H. tubulosa* and *H. polii* in length distribution were found to be 22.3 cm and 14.7 cm, respectively. *H. tubulosa* and *H. polii* showed unimodal length frequency distribution in Izmir Bay.

When the median values of the length and weigth classes of *H. tubulosa* and *H. polii* species sampled from İzmir and Çandarlı Bays were compared, the difference was not found significant ($p>0.05$).

At the end of seasonal sampling, the data of each station was analysed and population densities were calculated. Population densities of *H. tubulosa* in Table 1 and of *H. polii* in Table 2 are presented together with standard deviations.

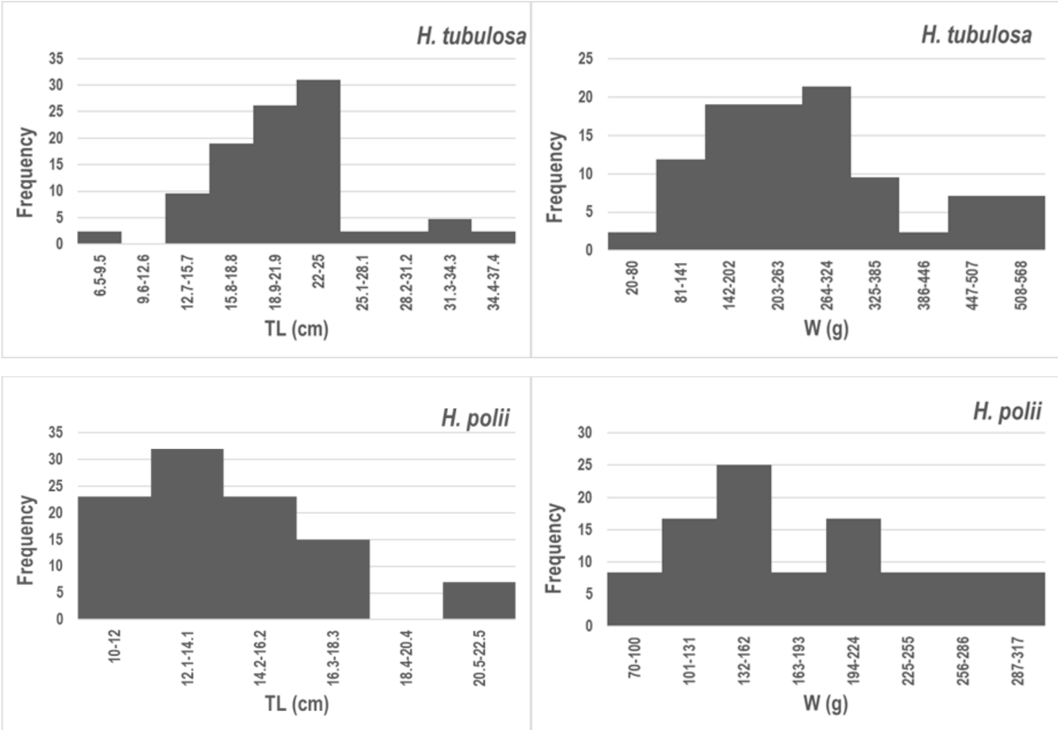

Figure 4. Length-frequency and weight-frequency distributions of *H. tubulosa* and *H. polii* species in Çandarlı Bay

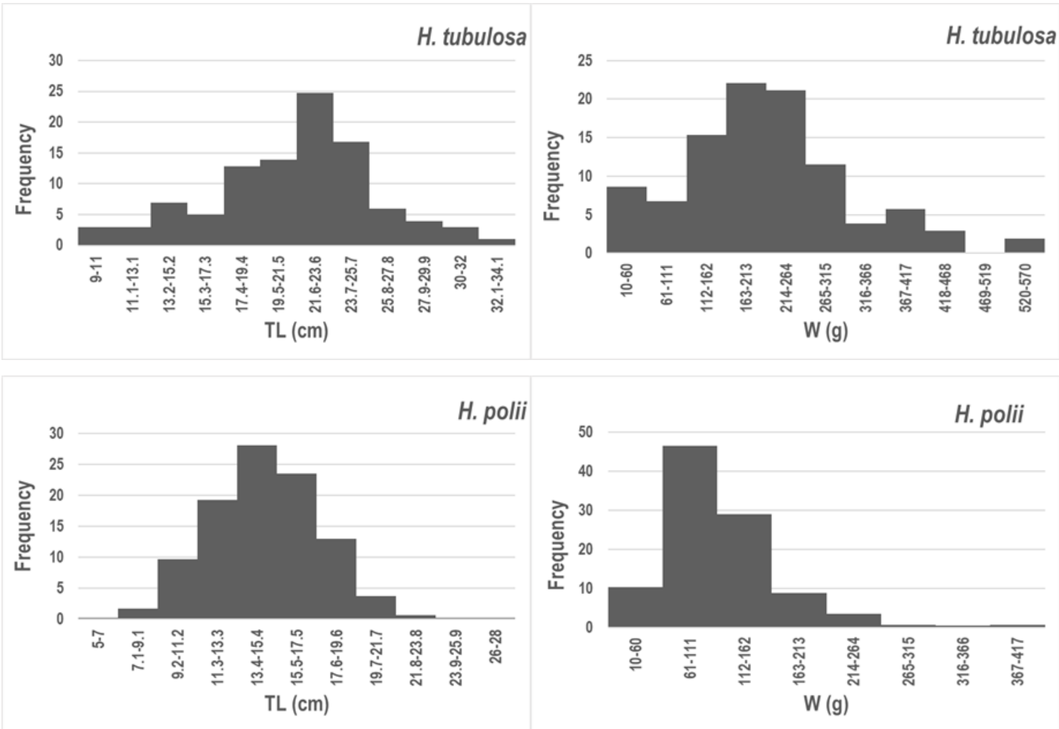

Figure 5. Length-frequency and weight-frequency distributions of *H. tubulosa* and *H. polii* species in Izmir Bay

Table 1. Mean population densities(individuals/m²±sd) of *H. tubulosa* calculated from the data obtained by the underwater transect line method

		Exploited areas		Non-exploited areas	
Season	**Depth counter**	**Denizköy**	**Şakran**	**Urla**	**Gülbahçe**
Fall 2018	0-10 m	0.0025±0.004	0.0008±0.002	0.0183±0.029	0.0058±0.008
	10-20 m	-	-	0.0117±0.013	0.0100±0.015
Winter 2019	0-10 m	0.0008±0.002	0.0008±0.002	0.0400±0.024	0.0146±0.008
	10-20 m	-	0.0008±0.001	0.0025±0.004	-
Spring 2019	0-10 m	0.0063±0.005	0.0033±0.004	0.0129±0.010	0.0008±0.0013
	10-20 m	-	0.0025±0.002	0.0058±0.005	0.0017±0.0029
Summer 2019	0-10 m	0.0063±0.009	0.0054±0.006	0.0125±0.011	0.0067±0.007
	10-20 m	-	-	-	0.0042±0.005
Fall 2019	0-10 m	0.0050±0.005	0.0019±0.002	0.0137±0.009	0.0119±0.011
	10-20 m	-	-	-	-
Winter 2020	0-10 m	0.0062±0.003	0.0012±0.002	0.0281±0.011	0.0144±0.0083
	10-20 m	-	0.0012±0.002	-	-

H. tubulosa was recorded at the 0-10 m contour at all stations and in all samples. It was not observed in any sampling on the 10-20 m contour at Denizköy station.

Considering population density values that can be calculated, the lowest value was found in Denizköy and Şakran with 0.0008 individuals/m², and the highest value was found in Urla station with 0.04 individuals/m². In general, population densities of *H. tubulosa* in Çandarlı Bay stations were found to be quite low compared to the population densities in İzmir Bay. The difference between population density values in Çandarlı Bay and İzmir Bay was found significant ($p<0.05$).

When the population densities of *H. tubulosa* were examined according to the depth contours (0-10 m and 10-20m), it was determined that the densities were higher in the 0-10 m contour ($p<0.05$). Considering the seasonal population density differences, this difference was not significant for *H. tubulosa* ($p>0.05$).

When the population density between stations was compared, the difference between Urla and Gülbahçe in İzmir Bay was significant ($p<0.05$). Urla station has a higher population density. The population density difference between Şakran and Denizköy located in Çandarlı Bay was not significant ($p>0.05$).

Table 2. Mean population densities (individuals/m²±sd) of *H. polii* calculated from the data obtained by the underwater transect line method

		Exploited areas		Non-exploited areas	
Season	**Depth**	**Denizköy**	**Şakran**	**Urla**	**Gülbahçe**
Fall 2018	0-10 m	0.0004±0.001	0.0075±0.012	0.0133±0.018	0.0242±0.025
	10-20 m	-	-	0.0033±0.004	0.0175±0.024
Winter 2019	0-10 m	0.0121±0.013	-	0.0308±0.014	0.0004±0.001
	10-20 m	-	-	0.0033±0.006	-
Spring 2019	0-10 m	-	0.0008±0.001	0.0871±0.012	0.0133±0.014
	10-20 m	-	0	0.0150±0.011	0.0100±0.017
Summer 2019	0-10 m	0.0025±0.003	0.0025±0.005	0.0388±0.018	0.0196±0.009
	10-20 m	-	-	-	0.0250±0.019
Fall 2019	0-10 m	0.0019±0.002	-	0.0521±0.030	0.0450±0.014
	10-20 m	-	-	0.0025±0.002	0.0137±0.012
Winter 2020	0-10 m	0.0106±0.001	0.0012±0.001	0.0550±0.018	0.0950±0.041
	10-20 m	-	-	-	-

H. polii was not detected in all samples at the 10-20 m contour at Denizköy and Şakran stations. This species was not observed in Urla and Gülbahçe stations only in two different seasons. Among the calculated density values, the lowest density was found in Denizköy with 0.0004 individuals/m² and the highest density in Gülbahçe with 0.095 individual/m². The population densities of *H. polii* were found to be higher in İzmir Bay stations than in Çandarlı Bay. Statistically, the difference between the mean density was significant ($p<0.05$). When the population densities of *H. polii* were examined according to the depth contours (0-10 m and 10-20 m), the difference was found to be higher in favor of the 0-10 m contour ($p<0.05$). The difference between the seasonal population densities of *H. polii* was not found significant ($p>0.05$).

When the population density of *H. polii* between stations were compared, the difference between Urla and Gülbahçe in İzmir Bay was higher in favor of Gülbahçe ($p<0.05$), while the difference between Şakran and Denizköy located in Çandarlı Bay was not significant (p>0.05).

The population density of sea cucumber species in waters deeper than 20 m was tried to be determined by beam trawl towings. At the end of the study, a total of 72 valid towings were taken. As a result of all beam trawl operations, one *P. regalis* species was caught at a depth of 40-60 m in Çandarlı Bay for the spring season of 2019 g.

DISCUSSION

This study is more comprehensive than other similar studies conducted in the Mediterranean in terms of the sampling area and sampling time. The results demonstrated that there is a big difference in population densities between studies. The comparison of population density results obtained in this study with other studies conducted in similar species and geography is shown in Table 3.

Table.3 The comparison of the results of this study with other studies

Study	Area/Station	Species	Density (individual/m²)
Coulon and Jangoux (1993)	Naples Bay, Italy	*H. tubulosa*	3.77
Kazanidis et al. (2010)	Pagasitikos Bay, Greece	*H. tubulosa*	0.01
Aydın (2019)	Çandarlı Bay, Şakran, Türkiye	*H. tubulosa*	1.09
		H. polii	0.08
	Izmir Bay, Hekim Island, Türkiye	*H. tubulosa*	0.20
		H. polii	1.52
Aydın et al. (2009)	Aegean Sea, Türkiye	*H. tubulosa*	1.00
		H. polii	1.00
Dereli et al. (2016)	Çanakkale Strait, Türkiye	*H. tubulosa*	0.21
This study (2020)*	Çandarlı Bay, Şakran, Türkiye	*H. tubulosa*	0.002
		H. polii	0.002
	İzmir Bay, Urla, Türkiye	*H. tubulosa*	0.02
		H. polii	0.05

*Mean population density values were used

In a study conducted by Coulon and Jangoux (1993) on the Ischia Island of Italy, the population density of *H. tubulosa* at 9m depth was found to be 3.77 individuals/m². In addition, it has been reported that as the depth increases and the meadows become sparse, the population density decrease to 0.34 individuals/m² at 30 m depth. In this study, higher population densities were found for both species at the 0-10m contour. Furthermore, *H. tubulosa* and *H. polii* individuals were not found in algarna operations carried out from 20 m to 60 m depths. Considering that sea cucumber fisheries started in the late 1990s in the Mediterranean, it would not be surprising to find a high population density in this study conducted in 1993.

In the study carried out by Kazanidis et al. (2010) in Pagasitikos Bay on the shores of the western Aegean Sea, the population density of *H. tubulosa* was determined as 0.01 individuals/m² between 0-10 m depths. This value is close to the values found in Urla station (0.02 individuals/m²) in this study. However, the results at the other three stations are well below this value. In addition, the median value (29.8 cm) of the length distribution found in this study is considerably higher than the value found in our study (22.3 cm in İzmir Bay and 20.6 cm in Çandarlı Bay).

The study conducted by Aydın (2019) on the Aegean Sea coast between 2014 and 2015 is based on one-time sampling at 11 stations. Two of these 11 stations are in similar locations with the Urla and Şakran stations of our study. When we compare the Urla station population density results, it is seen that there is a 10-fold decrease in *H. tubulosa* and a 30-fold decrease in *H. polii*. Likewise, a 545-fold decrease in *H. tubulosa* and a 40-fold decrease in *H. polii* is observed at Şakran station.

In a study by Dereli et al. (2016) on the reproduction and population structure of *H. tubulosa* in the Dardanelles Strait, the density of the species was found to be 0.21 individuals/m². This value is considerably higher than the population density values we found. This situation may be due to the fact that the Dardanelles Strait is a prohibited area for secucumber fisheries, and that the protection activities are carried out more effectively due to the strategic importance of the Strait.

González-Wangüemert et al. (2015) studied the effects of sea cucumber fishing ban on the biometric and genetic characteristics of *H. tubulosa* and *H. polii* in the Aegean Sea. They were compared biological parameters (size distribution and weight classes) in fishery area (Ayvalık) and non-fishery area (Kuşadası). As a result, the mean weights of the samples taken from Ayvalık were found to be lower than the samples taken from Kuşadası. While similar results were found for *H. polii* in our study, there was no difference between stations for

H. tubulosa. This situation in *H. tubulosa* may be due to the higher value of the species.

González-Wangüemert et al. (2016) conducted biometric studies on four sea cucumber species, including *H. tubulosa* and *H. polii*, at 6 different stations extending from the Western Mediterranean to the Eastern Mediterranean. The range and values of length and weight classes found in this study are wider and higher than our study. This confirms the assessment of González-Wangüemert et al. (2016) that the lenght and weight values obtained at stations in the western Mediterranean are greater than those in the eastern Mediterranean. Researchers explained the reason for this by the fact that the amount of nutrients in the western basin is higher in the Mediterranean scale than in the eastern basin. In addition, it may be necessary to take into account that fishing pressure is also a factor in the reduction in length and weight of sea cucumbers.

Habitat and depth are one of the factors affecting the distribution of many marine organisms. Sea cucumbers are the most common and largest deposit-feeder species distributed in Posidonia meadows (Bulteel et al., 1992). In all stations where this study was conducted, the 0-10m depth contour is covered with Posidonia meadows, while after 12-15 m sandy-muddy or muddy ground is dominant. The fact that both sea cucumber species were found to be more abundant in areas with Posidonia meadows (2-4 m for Çandarlı Bay, 4-6 m for İzmir Bay) at all stations supports this finding. In addition, in the study conducted by Dereli et al. (2016) in the Dardanelles Strait, although the samplings were carried out at depths of 0-30 m, the finding of *H. tubulosa* individuals between 0-10 m is consistent with our study.

The results of the Bulteel et al. (1992) demonstrate that *H. tubulosa* are distributed according to a depth gradient, with the smallest individuals in the shallowest part of the meadow and the largest ones in its deepest part. In our study, length measurement was not performed during underwater visual counting sampling. However, all research divers observed small individuals of both species at shallower depths than 5 m, and large individuals at deeper depths.

CONCLUSION

The results of this study clearly reveal that the population density of sea cucumber has decreased tens of times compared to the last 5 years. Considering the density of 3.77 individuals/m^2 found at the end of the study conducted by Coulon and Jangoux (1993) in the years when sea cucumber fishing was not done in the Mediterranean, this determination can be clearly understood.

Within the framework of fisheries management in the Turkish coasts, many administrative tools are used for the regulation of sea cucumber fishing in terms of the closed area, closed season, rotational harvesting regulation, licensing, fishing gear restriction and fishing capacity. In addition to these administrative tools, a Circular was published and implemented by the General Directorate of Fisheries and Aquaculture on the quota application in sea cucumber fishing between January 01, 2020 and May 31, 2020. But despite all these legal regulations, illegal fishing is the biggest problem in sea cucumber fishery. This study showed that there is no difference between fishing and non-fishing areas in terms of mean length and weight of sea cucumber species. Another important problem is that the registration of sea cucumbers caught is not done according to the species. This can cause significant mistakes in fisheries management. Although some of the problems in sea cucumber fisheries can be solved regionally, international cooperation should be sought for comprehensive solutions.

While the importance of sea cucumber species in the coastal ecosystem is obvious, ecological problems that exist especially on the shores of the Aegean Sea also threaten these species. *Posidonia oceanica* meadows, which are crucial for sea cucumber species in our coasts where human activities are very intense (such as İzmir Bay, Çandarlı Bay, Edremit Bay) are withdrawing and their area is decreasing (Duman et al., 2019). Added to this negative picture was the mass death of *Pinna nobilis*, the largest bivalve and water filtration of the coastal ecosystem, as a result of a disease that spread throughout the Mediterranean in 2017. This shows us that we cannot solve problems if we focus on a small piece of the picture (sea cucumber) without considering the big picture (ecosystem).

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AUTHORSHIP CONTRIBUTIONS

Altan Lök: Conceptualization, project administration, funding acquisition, methodology, resources, investigation, writing-reviewing and editing. Aytaç Özgül: Conceptualization, investigation, formal analysis, visualization. Tuğçe Şensurat Genç: Investigation. Evrim Kurtay: Resources, investigation. Aynur Lök: Conceptualization, resources, investigation.

CONFLICTS OF INTEREST

The authors declare that there are no conflicts of interest or competing interests.

ETHICS APPROVAL

No specific ethical approval was necessary for this study.

DATA AVAILABILITY

All relevant data is inside the article.

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