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RESEARCH ARTICLE

Biomass of some lessepsian fish species in the soft bottoms of Iskenderun Bay (Northeast Mediterranean)

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ABSTRACT

1. In this study, the variation of the biomass of some lessepsian fish species by depth was investigated. For this reason, 15 bottom trawl operations were conducted at 0-20, 20-40 and 40-60 m depth contours of Iskenderun Bay, in September 2013.
2. A 300 mesh trawl net was employed to collect samples. In this study, 79 different species belonging to 46 families comprising 87024 individuals were sampled. Fifty five of the 79 species caught were teleosts.
3. To determine the differences in species number among the stations, Kruskal-Wallis test was used. The Cath Per Unit Area (CPUA kg/km^2) and Index of Relative Importance (IRI) were also calculated for each species according to the stations. In terms of the number of species, it was determined that the difference according to the depth contours was not statistically significant (p>0,05, X2=3,33). The results showed that 19 (35%) of the 55 teleost fish species sampled and 74.59% of the total teleost fish biomass (total: 995.79 kg/km^2; lessepsian: 742.80 kg/km^2) were composed of lessepsian fishes.
4. When all of the stations were evaluated, the first five species in CPUA rank were *Equulites klunzingeri, Mullus barbatus, Pomadasys stridens, Nemipterus randalli, Saurida lessepsianus*.

KEYWORDS: Biomass, Bottom Trawl, CPUA, Lessepsian Fish.

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ARAŞTIRMA MAKALESİ

İskenderun Körfezi Yumuşak Zemininde Lesepsiyen Balık Türlerinin Bioması

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ÖZ

1. Bu çalışmada, lesepsiyen balık türlerinin biomasının, derinliğe göre değişimi incelenmiştir. Bu amaçla, örneklerin temini için, 2013 yılı Eylül ayında, 0-20m 20-40m ve 40-60m derinlik konturlarında 300 göz trol ağı ile 15 trol operasyonu gerçekleştirilmiştir.
2. Çalışma süresince 46 familyaya ait 79 farklı türden toplam 87024 birey örneklenmiştir. Yakalanan 79 türün elli beşi kemikli balık türüdür. Tür sayısı bakımından istasyonlar arasındaki fark olup olmadığını incelemek için Kruskal-Wallis test istatistiği kullanılmıştır.
3. Türlere ve istasyonlara göre Birim Alandan Elde Edilen Ürün (CPUA kg/km^2) ve Göreli Önem İndeksi (IRI) değerleri hesaplanmıştır. Tür sayısı bakımından, derinlik konturlarına göre farkın istatistiksel olarak önemli olmadığı belirlenmiştir ($p>0,05$, $X2=3,33$). Elde edilen sonuçlar, örneklenen 55 kemikli balık türünün 19 tanesinin (%35) ve toplam kemikli balık biyokütlesinin %74.59'unun lesepsiyen balıklardan oluştuğunu (toplam: 995.79 kg/km^2; lesepsiyen: 742.80 kg/km^2) göstermiştir.
4. Tüm istasyonlar değerlendirildiğinde, CPUA sıralamasında ilk beş sırayı alan türler; *Equulites klunzingeri, Mullus barbatus, Pomadasys stridens, Nemipterus randalli, Saurida lessepsianus'*dur.

ANAHTAR KELİMELER**:** Biomas, CPUA, Dip Trolü, Lesepsiyen Balıklar.

INTRODUCTION

Human interventions in nature may affect the distribution of species and the biodiversity of certain areas (Gücü *et al*. 1994). One concrete example of this is the critical zoogeographic and ecological effects caused by the Suez Canal, whose primary purpose is to shorten the commercial route from Europe to India and to the Far East (Golani 1998). The canal resulted with a link between the tropical Red Sea and the subtropical Mediterranean (Golani 1998, 2010). After the removal of geographical barrier a migration began mainly from the Red Sea to the Mediterranean. Recently, more than 100 lessepsian teleost species were recorded in the Mediterranean (Arnt and Schembri 2015, Rothman *et al*. 2016).

On the Turkish coast, the first recorded lessepsian fish species was *Equulites klunzingeri* (Erazi 1943). Because lessepsian migration is a continuous process, the number of lessepsian species is increasing in the Mediterranean Sea (Turan 2010). The Turkish coast has been investigated at intervals of 20 years, and a severe increase in the lessepsian migration, especially in the last 20-30 years, was observed (Bilecenoğlu *et al*. 2014). Recently, the number of lessepsian fishes reached 63 in Turkish coasts (Gurlek *et al*. 2016).

The Iskenderun Bay is of 65-km length, 35-km width and 2275 km^2 surface area, and its maximum depth is 70 m. This bay has a wide continental shelf compared with other areas of the eastern Mediterranean. It is known that lessepsian species are usually located at up to 60 m depth in the Northeast Mediterranean (Gücü *et al*. 2010). The abiotic parameters of the Iskenderun Bay such as temperature and salinity are similar to those of the Red Sea (Avşar 1999). Hence, it would be not wrong to say that the Iskenderun Bay is a suitable biotope for the lessepsian species. There have been several studies about the first records of lessepsian species in this area (Bilecenoğlu and Russel 2008, Bilecenoğlu *et al*. 2009, Akamca *et al*. 2010, Akamca *et al*. 2011, Dalyan *et al*. 2014, Turan *et al*. 2015, Doğdu *et al*. 2016), but the information on their biomass is quite limited (Gücü *et al*. 1994).

In this study, the occurrence of lessepsian fishes distributed in the Iskenderun Bay demersal stock was investigated. It is believed that these data will be useful in filling the knowledge gaps on this particular area.

MATERIALS AND METHODS

Study area and sampling procedure

Surveys were carried out between 09.09.2013 and 13.09.2013 in Iskenderun Bay (Figure 1). Samples were collected by trawling operations conducted at three different depths (I:0-20 m, II:20-40 m, III:40-60 m). A traditional Mediterranean trawl net with

300 mesh (locally called Ottoman) was used in the operations. The towing duration was one hour for all hauls, and the towing speed varied between 2.7 and 3.1 knots. To retain small individuals, a 44 mm cod-end was covered with a nonselective cover cod-end with a 6 mm stretched mesh size. Thus, the individuals that would escape from a cod-end with a 44 mm stretched mesh size could be caught.

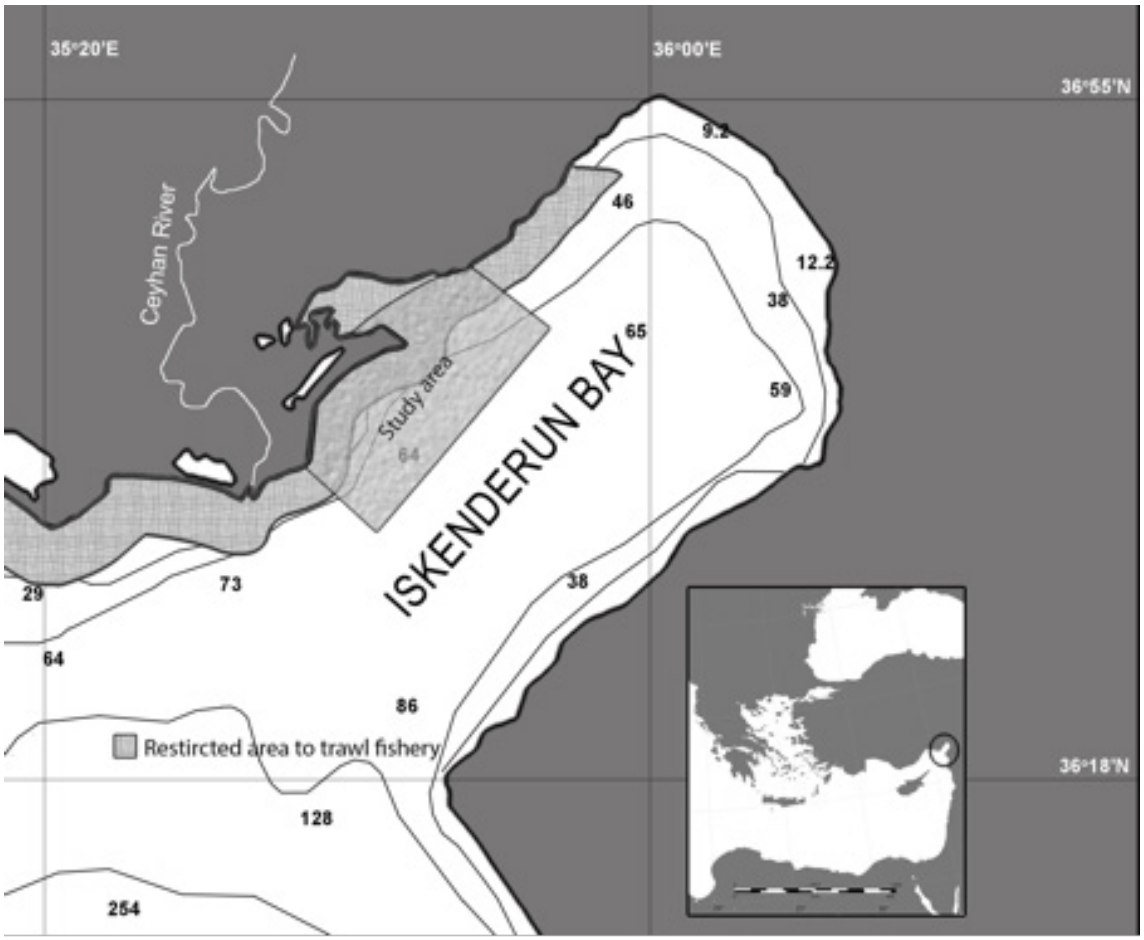


Figure 1. Iskenderun Bay and sampling area.

After the hauls, the marine organisms caught in the cod-end and the cover cod-end were emptied onto the deck of ship and separately placed in plastic boxes. These obtained samples were carried to the Fisheries Faculty Laboratory in cold storage. After the taxonomical analyses, the total length and weight of each specimen were measured with 1 mm and 0.1 gr precision, respectively.

Statistical analysis

The Catch Per Unit Area (CPUA, kg/km^2) was calculated for each species using the data obtained from the cod-end and cover cod-end together (Arab *et al*. 2008). To explain the importance of the differences between species, the Index of Relative Importance (IRI), whose equation is given below, was used.

IRI= (N + W)*F

In this equation,

F,(Occurrence frequency): How many hauls a given species was observed in; %N, (% Occurrence in number): The total number of a species as a portion of all species; %W (% Occurrence in weight): The total weight of a species as a portion of that of all species.

The differences in species number among the depth contours were analysed using a Kruskal-Wallis test. To analyse the difference between CPUA values, we conducted ANOVA with Tukey and HSD multiple comparison tests (Sokal and Rohlf 1995).

RESULTS

In this study, 79 species belong to 49 families comprising 87024 individuals were sampled. 55 of the species sampled were teleosts. There were not any significant differences in the species number among stations according to the Kruskal-Wallis test ($p>0.05$). However the species composition showed some differences.

General composition of lessepsian fish species by depth contours

Approximately 35% (19) of the 55 teleost species caught in this study and 74.59% of the total biomass were composed of lessepsian fish (total: 995.79 kg/km^2 ; lessepsian: 742.80 kg/km^2). The IRI and CPUE of teleosts according to station are given in Table 1.

The data showed that 13 of the 38 species and 71.1% of the total biomass in I Station were lessepsian (total: 599.34 kg/km^2; lessepsian: 426.13 kg/km^2), According to rank-biomass sorting, Indo-pacific fishes constituted the first three (*E. klunzingeri*, *P. stridens*, *U. pori*, *M. barbatus* , *S. aurata*).

In the II Station, 17 of 33 species, 65.23% of the total biomass (total: 1171.48 kg/km^2; lessepsian: 764.26 kg/km^2) and four of the first five species by CPUA (*E. klunzingeri*, *M. barbatus* , *N. randalli*, *P. stridens*, *S. lessepsianus*) comprised lessepsian fish.

13 of the 31 species caught in III Station were lessepsian. The proportion of these fish was 85.26% of the total biomass (total: 1211.49 kg/km^2; lessepsian: 1032.96 kg/km^2). Similar with the other depth contours three of the most dominant five species in CPUA rank were also lessepsians (*E. klunzingeri*, *M. barbatus* , *S. lessepsianus*, *N. randalli* and *Trichiurus lepturus*).

Table 1. IRI and CPUA (kg/km^2) for teleosts according to stations

Family/Species	I. Station (0-20 m)		II. Station (20-40 m)		III. Station (40-60 m)		All Stations	
	IRI	kg/km^2	IRI	kg/km^2	IRI	kg/km^2	IRI	kg/km^2
Apogonidae								
Ostorhinchus fasciatus *	-	-	0.0019	1.980	0.0046	1.729	0.0017	1.236
Apogonichthyoides pharaonis *	0.0002	0.135	0.0003	0.391	-	-	0.0001	0.175
*Apogon queketti**	-	-	0.0001	0.443	-	-	<0.0001	0.147
*Apogon smithi**	-	-	0.0048	6.264	0.0022	3.113	0.0018	3.125
Balistidae								
Balistes capriscus	0.0024	2.736	-	-	-	-	0.0002	0.912
Bothidae								
Arnoglossus laterna	-	-	<0.0001	0.041	0.0035	2.619	0.0006	0.886
Bothus podas	0.0133	6.809	-	-	-	-	0.0009	2.269
Callionymidae								
Callionymus filamentosus *	0.0073	4.853	0.0017	2.091	-	-	0.0014	2.315
Carangidae								
Caranx rhonchus	0.0018	1.824	0.0002	0.614	-	-	0.0002	0.812
Trachurus mediterraneus	0.0019	0.842	0.0005	0.756	0.0085	7.699	0.0036	3.099
Champsodontidae								
*Champsodon nudivittis**	-	-	-	-	0.0014	1.740	0.0002	0.580
Citharidae								
Citharus linguatula	<0.0001	0.020	-	-	0.0034	3.529	0.0006	1.183
Congridae								
Conger conger	-	-	-	-	0.0006	2.656	0.0001	0.885
Gnathophis mystax	<0.0001	0.050	-	-	-	-	<0.0001	0.017
Cynoglossidae								
Cynoglossus sinusarabici *	<0.0001	0.006	<0.0001	0.525	<0.0001	0.264	<0.0001	0.265
Dussumieriidae								

Family/Species	I. Station (0-20 m)		II. Station (20-40 m)		III. Station (40-60 m)		All Stations	
	IRI	kg/km^2	IRI	kg/km^2	IRI	kg/km^2	IRI	kg/km^2
*Dussumeria elopsoides**	-	-	0.0014	2.054	0.0028	3.274	0.0011	1.776
Engraulidae								
Engraulis encrasicolus	-	-	-	-	<0.0001	0.145	<0.0001	0.048
Gobiidae								
Aphia minuta	-	-	<0.0001	0.002	-	-	<0.0001	0.0009
Gobius niger	-	-	-	-	0.0001	0.238	<0.0001	0.079
Oxyurichthys papuensis	-	-	-	-	<0.0001	0.190	<0.0001	0.063
Haemulidae								
Pomadasys incisus	-	-	0.0009	4.207	-	-	<0.0001	1.402
*Pomadasys stridens **	0.1366	64.228	0.0992	84.166	-	-	0.0435	49.464
Centracanthidae								
Spicara smaris	-	-	0.0006	2.319	-	-	0.0001	0.773
Labridae								
Xyrichtys novacula	0.0005	1.118	-	-	-	-	<0.0001	0.372
Leiognathidae								
*Equulites klunzingeri **	1.1751	191.125	1.2533	450.089	1.7293	936.326	1.4348	525.847
Mugilidae								
Liza aurata	0.0008	1.840	-	-	-	-	<0.0001	0.613
Mullidae								
Mullus barbatus	0.0810	39.334	0.2333	220.640	0.1207	128.518	0.1549	129.498
Mullus surmuletus	<0.0001	0.084	-	-	0.0003	1.264	<0.0001	0.449
*Upeneus moluccensis**	0.0073	2.812	-	-	0.0074	7.934	0.0031	3.582
*Upeneus pori**	0.0942	42.199	0.0158	14.204	0.0006	2.195	0.0198	19.533
Nemipteridae								
*Nemipterus randalli**	0.0331	18.650	0.0893	94.273	0.0314	32.096	0.0542	48.340
Pomatomidae								
Pomatomus saltatrix	0.0002	0.358	-	-	-	-	<0.0001	0.119

Family/Species	I. Station (0-20 m)		II. Station (20-40 m)		III. Station (40-60 m)		All Stations	
	IRI	kg/km^2	IRI	kg/km^2	IRI	kg/km^2	IRI	kg/km^2
Sciaenidae								
Argyrosomus regius	0.0040	4.651	0.0137	20.963	0.0010	4.759	0.0052	10.125
Scombridae								
Scomber colias	-	-	-	-	<0.0001	0.233	<0.0001	0.077
Serranidae								
Epinephelus aeneus	-	-	0.0109	50.861	-	-	0.0014	16.593
Sillaginidae								
Sillago sihama *	0.0447	24.073	0.0019	4.071	-	-	0.0053	9.381
Sparidae								
Boops boops	<0.0001	0.030	-	-	-	-	<0.0001	0.010
Diplodus annularis	0.0168	8.881	0.0273	26.598	0.0017	3.644	0.0127	13.041
Diplodus sargus	0.0018	4.089	-	-	-	-	0.0001	1.363
Diplodus cervinus	0.0006	1.486	-	-	-	-	<0.0001	0.495
Lithognathus mormyrus	0.0459	26.143	0.0051	7.333	-	-	0.0069	11.158
Pagellus acarne	0.0001	0.175	-	-	0.0005	0.894	<0.0001	0.356
Pagellus erythrinus	0.0644	29.146	0.0580	46.742	0.0048	6.419	0.0344	27.435
Pagrus caeruleostictus	0.0017	3.970	-	-	-	-	0.0001	1.323
Sparus aurata	0.0555	30.541	0.0152	19.859	0.0013	1.768	0.0164	17.389
Sphyraenidae								
Sphyraena chrysotaenia *	-	-	0.0022	4.797	0.0008	1.786	0.0008	2.194
Soleidae								
Pegusa lascaris	0.0062	6.321	0.0011	2.088	-	-	0.0011	2.803
Buglossidium luteum	0.0012	0.734	-	-	-	-	0.0001	0.244
Solea solea	0.0014	0.810	0.0010	3.898	0.0004	0.748	0.0011	1.819
Synodontidae								
*Saurida lessepsianus**	0.0561	29.475	0.0631	65.401	0.0333	63.106	0.0494	43.661
Terapontidae								

Family/Species	I. Station (0-20 m)		II. Station (20-40 m)		III. Station (40-60 m)		All Stations	
	IRI	kg/km^2	IRI	kg/km^2	IRI	kg/km^2	IRI	kg/km^2
*Pelates quadrilineatus**	0.0490	22.818	0.0122	15.367	-	-	0.0095	12.728
Tetraodontidae								
*Lagocephalus spadiceus**	0.0268	14.317	0.0116	16.286	0.0067	9.438	0.0126	13.347
*Lagocephalus suezensis**	0.0125	11.430	0.0015	1.848	0.0005	2.017	0.0033	5.098
Trichiuridae								
Trichiurus lepturus	0.0005	1.208	-	-	0.0071	11.005	0.0014	4.071
Triglidae								
Trigla lucerna	-	-	<0.0001	0.293	0.0016	2.194	0.0003	0.829

* Lessepsian species

When the data aggregated for all three stations, four of the first five dominant species were lessepsians (*E. klunzingeri*, *M. barbatus* , *P. stridens*, *N. randalli*, *S. lessepsianus*). The percentages of native and lessepsian teleosts and the first five species by CPUA in the stations are given in Figure 2 and Figure 3, respectively.

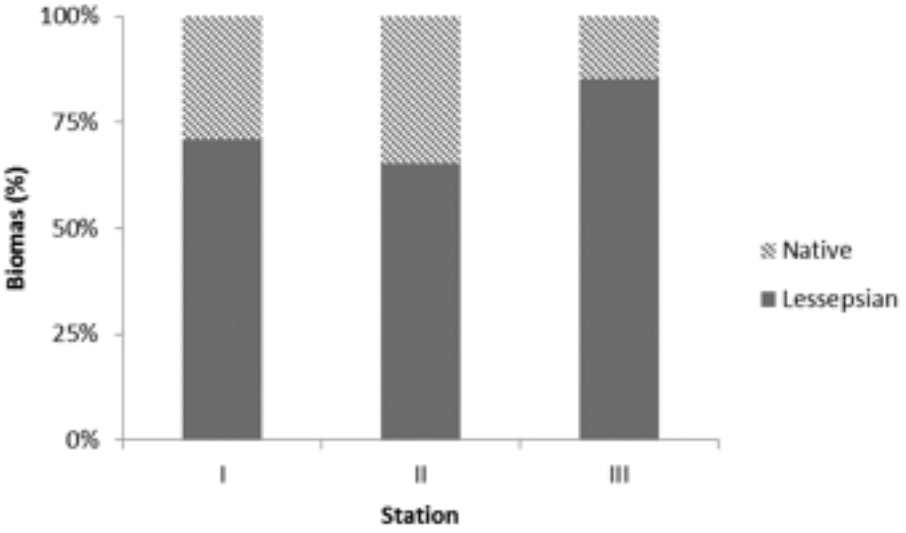


Figure 2. Proportional biomass of lessepsian and native species according to stations.

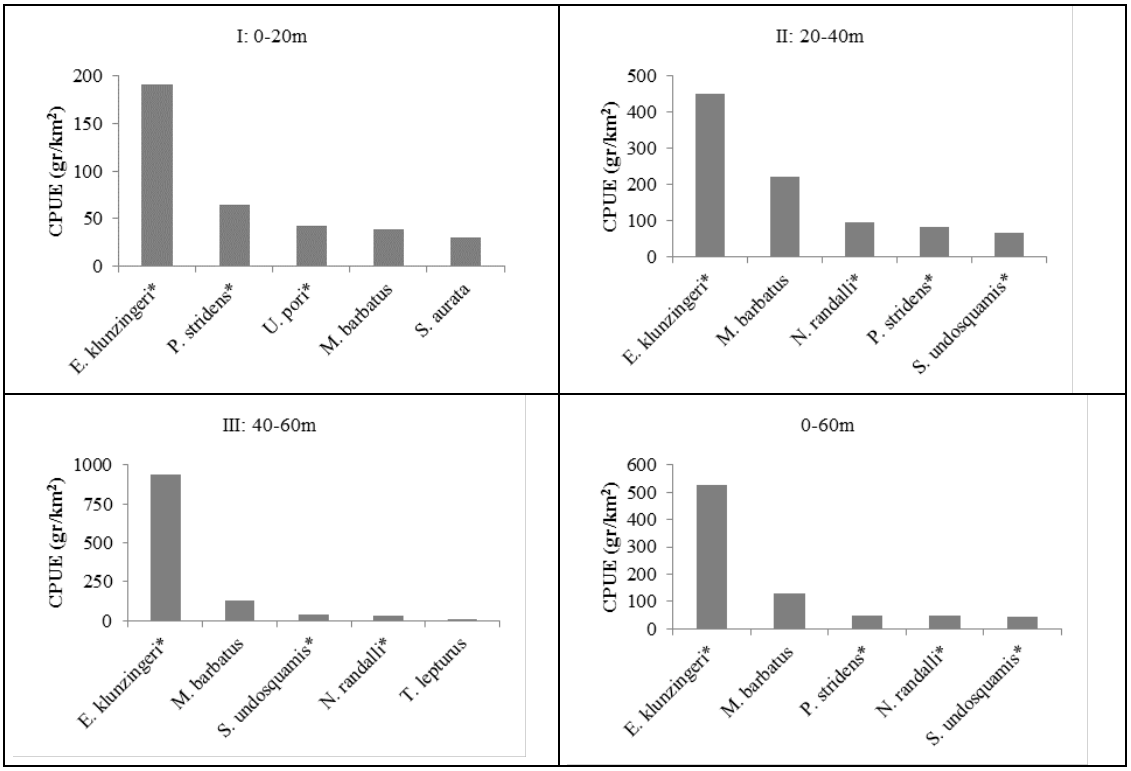


Figure 3. Rank-CPUA distribution of the first five species.

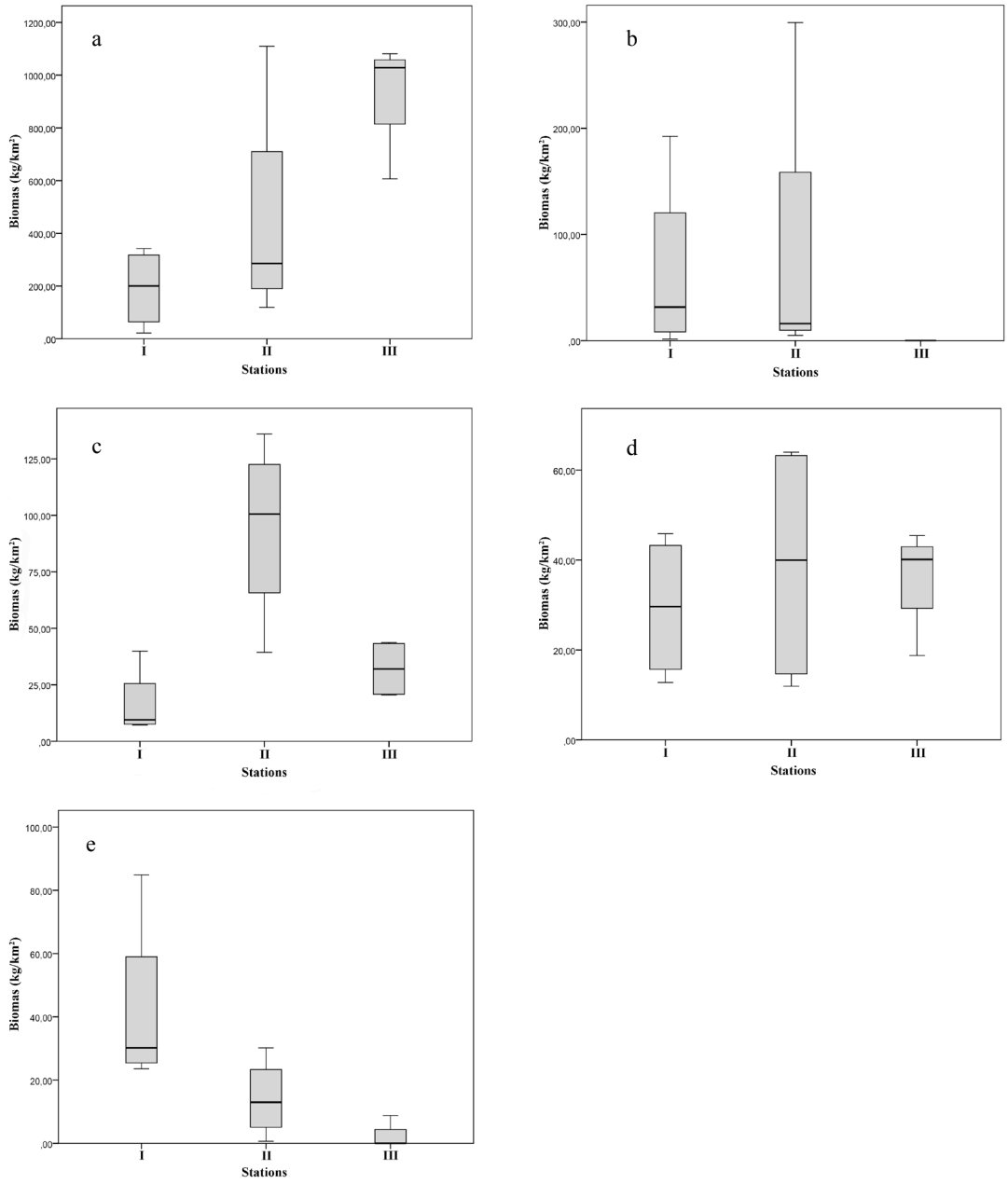


Figure 4. Depth distribution of lessepsian fish according to stations. (a: *E. klunzingeri*, b: *P. stridens*, c: *N. randalli*, d: *S. lessepsianus*, e: *U. pori*)

Equulites klunzingeri (Leiognathidae)

This species had the highest mean CPUA in the three stations. The data showed that the mean CPUA values in I, II, and III. Stations were 191.13±75.87, 450.09±223.51 and 936.33±110.58 kg/km^2, respectively (Figure 4a). This variation showed that there is an increase in the mean CPUA value moving offshore. The differences among the mean CPUE values by station were significant ($p<0.05$). I and III Stations were different from each other, but II Station was similar to both of them.

Pomadasys stridens (Haemulidae)

This species was only encountered at the I and II stations, and no significant difference between these stations with respect to the mean CPUE was determined ($p>0.05$) Namely, it is observed that this species is dispersed up to 40 m. *P. stridens* was within the first five species in CPUA rank in the I and II Stations, with values of 64.22±43.84 kg/km^2 and 84.15±71.86 kg/km^2, respectively (Figure 4b).

Nemipterus randalli (Nemipteridae)

This species was observed in all stations. *N. randalli* was in the fifth rank in the II and III Stations but in the eleventh rank in the first station with respect to the mean CPUA. The mean CPUA of this species in the I, II, and III Stations were 16.51±7.84, 94.10±20.38 and 32.02±6.48 kg/km^2, respectively (Figure 4c). These values showed that the CPUA values in the II station were higher than those of the other two stations, and the differences were significant ($p<0.05$). The I and III stations were similar to each other.

Saurida lessepsianus (Synodontidae)

This species had the fifth rank at the II and III Stations and the sixth rank in the I Station in terms of the mean CPUA. The mean CPUA values at the I, II and III Stations were 29.47±8.10, 38.96±14.06 and 36.10±5.92 kg/km^2, respectively (Figure 4d). The CPUA value in the II Station was the highest, but the differences were not significant ($p>0.05$).

Upeneus pori (Mullidae)

This species had the fifth rank in the I. station according to the CPUA values but the 16th and 17th ranks in the II and III Stations, respectively. The CPUA value which was 42.19±14.35 kg/km^2 in the I station, decreased to 14.20±6.23 kg/km^2 in the II station and to 2.19 kg/km^2 in the III Stations (Figure 4e), showing a decline in the direction of offshore. The differences among the mean CPUAs for the different stations were significant ($p<0.05$).

DISCUSSION

The first detailed study on the distribution and biomass of lessepsian fish on Turkey's coast of the Northeast Mediterranean were conducted by Gücü *et al*. (1994) between 1980 and 1989. In this study, the status of lessepsian fish in Iskenderun and Mersin Bay, between the areas of Incekum and Anamur was investigated. 13 lessepsian fish species were evaluated in these area and the CPUA values of the rate of lessepsian fish species were 62%, 34% and 24%, respectively. A total of 19 lessepsian species were sampled from the Iskenderun Bay. Lessepsian migration occurs in a continuous way, so Gücü *et al*. (1994) reported that the number of lessepsian species reaching the Mediterranean coast of Turkey was calculated as 1.7 fish/year. Hence, that more lessepsian species are encountered in this study was an expected result.

Although the rate of lessepsian species in CPUA was found to be 62 % by Gücü *et al*. (1994), in this study the rate was 75 %. However, asserting that the rate of lessepsian species increased in time might be misleading because the difference between the two studies might also have resulted from the net selectivity. Gücü *et al*. (1994) used a codend with a 28 mm mesh size. In this study, a cover codend of 6 mm mesh size was rigged over a codend of 44 mm. This case might have caused *E. klunzingeri*, which is a small and flattened species, to be retained more. Gücü *et al*. (1994) determined the rate of *E. klunzingeri* in CPUA to be 18.66%. However, in this study, it was 52.80%, and it was found that 50% of the *E. klunzingeri* was retained in the cover codend.

Another striking finding about *E. klunzingeri* was the prominent increase in CPUA from the shallow water station to the deeper one (For I, II, and III stations; 191.13±75.87, 450.09±223.51 and 936.33±110.58 kg/km^2, respectively). All of the first station areas and some areas of the second station are restricted for trawl operations. Hence, the lowest CPUA value was calculated in the first station areas that have no fishing pressure, while the higher CPUA values were found in the stations with successively higher fishing pressure. This variation suggests that there is a parallel relationship between the fishing pressure and the ratio of *E. klunzingeri* in CPUA values. The depth contours may be one factor explaining this variation. However, this may also resulted from the fact that *E. klunzingeri*, which is a flattened species of small length, is less affected by the fishing pressure compared to the other species by being able to escape from the net mesh.

In the Iskenderun bay, the natural mortality, fishing mortality, total mortality and exploitation rate of *E. klunzingeri* were determined to be M=0.646, F=0.315, Z= 0.961 and E=0.33, respectively (Özütok and Avşar 2004). Researchers report that the fishing pressure for this species is less. When all of these are evaluated, it would not be wrong to say that *E. klunzingeri* is less affected by the fishing pressure than other species. Its main predator *S. lessepsianus* and competitors, *M. barbatus* and *U. pori* are caught intensively in the area (Bingel and Avşar 1988). Therefore, we hypothesised that this situation may provide an advantage for *E. klunzingeri* in respect to the colonization in the area in which the fishing pressure is high.

The first record of *P. stridens* was reported from the Iskenderun Bay in 2009 (Bilecenoğlu *et al*. 2009). Golani (1993a) stated that this species was widespread in the sandy and muddy bottom of the Red Sea and the South-eastern Mediterranean shallow waters. However, while it was frequently found in Israel and Lebanon, it was rarely observed in Iskenderun Bay (CIESM 2013). This species has been observed more frequently in trawling and angling in İskenderun Bay after it was first recorded in Iskenderun Bay. In this study, it was found that rate of *P. stridens* in CPUA was 4.96%. In addition, this species was within the first five species in CPUA rank (third rank within all species, second rank within lessepsians). This result showed that both the occurrence and commercial importance of *P. stridens* were recently increased. This result is in accordance

with the observations of Ergüden *et al*. (2010) which have reported that *P. stridens* was intensively caught by commercial fishermen in the Iskenderun Bay.

The first record of *N. randalli* in the Mediterranean was documented by Golani and Sonin (2006) and then, it was reported on the Turkish coasts by Bilecenoğlu and Russel (2008). After first occurrence in the Iskenderun Bay, it became a very common fish for trawl and set net fishery in a short time. A similar observation was also reported on the Israeli coasts. This species formed 14.3% of the total catch of the Israeli trawl fleet in the following five years after 2006 (Stern *et al*. 2014). In this study, the rate of *N. randalli* in CPUE was calculated to be 4.85%, and this was the fourth rank in both of all species and of the lessepsians. It was found that in light of these findings, ~~that~~ there was an increase both in its occurrence and commercial value. As in *N. randalli*, it was seen that the populations of some invasive fish species increased steeply within a few years after their first record. (Ben-Yami and Glaser 1974, Por 1978, Golani 1993b, Goren *et al*. 2009, Goren *et al*. 2010, Yokes *et al*. 2010, Edelist *et al*. 2011). When the stations were evaluated, the minimum CPUA of this species was observed in the I station (0-20 m depth) which was also observed by Stern *et al*. (2014) in Israeli coasts.

The first record of *S. lessepsianus* was documented by Ben-Tuvia (1953) in the Mediterranean. After this record, its population increased rapidly, and it became a target species of the Israeli and Turkish trawl fishery. Gücü *et al*. (1994) found that the rate of *S. lessepsianus*in CPUA was 31.99% in the Iskenderun Bay. However, in this study, the value was only 4.38% in the same area. The rates of this species in CPUA in the 1980s and 2000s were determined to be 14.04% and 2.9% in ~~the~~ Mersin Bay, respectively (Gücü *et al*. 1994; Gücü *et al*. 2010). These data show that the occurrence of this species was significantly decreased in the period between the two studies.

The *U. pori* was firstly reported in İskenderun Bay by Koswing (1950). In general, this species is distributed in the sandy and muddy bottoms in coastal areas up to 50 m. The data obtained supports this distribution. It was observed in this study that a prominent decrease in the average CPUA from shallow to deeper waters. The rate of *U. pori* was determined as 1.58% by Gücü *et al*., (1994) and 1.96% in this study. Hence, the proportion given by the both studies were similar.

It is known that the number of Lesbian species and their occurrence in stock varies depending on the time. This change affects both the professional fishery and the ecosystem. For this reason, it is important that these changes should be monitored with certain periods.

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