http://www.egejfas.org
Ege Journal of Fisheries and Aquatic Sciences, 37(4), 353-356 (2020)

Su Ürünleri Dergisi (2020)
DOI: 10.12714/egejfas.37.4.05

RESEARCH ARTICLE ARAŞTIRMA MAKALESİ

Species diversity and dominancy indexes in Izmir Bay (Aegean Sea) purse seine fishery

İzmir Körfezi (Ege Denizi) gırgır balıkçılığında tür çeşitliliği ve baskınlık indeksleri

Ahmet Mert Şenbahar[1]* ● Özlem Güleç[2] ● Zafer Tosunoğlu[3]

[1] Ege University, Faculty of Fisheries, Department of Marine-Inland Waters Sciences and Technology, Izmir, Turkey https://orcid.org/0000-0001-6613-8932
[2] Ege University, Faculty of Fisheries, Department of Fishing and Processing Technology, Izmir, Turkey https://orcid.org/0000-0003-2217-2316
[3] Ege University, Faculty of Fisheries, Department of Fishing and Processing Technology, Izmir, Turkey https://orcid.org/0000-0002-1168-9611

Corresponding author: a.mertsenbahar@gmail.com
Received date: 11.03.2020 *Accepted date: 09.05.2020*

How to cite this paper:
Şenbahar, A.M., Güleç, Ö. & Tosunoğlu, Z. (2020). Species diversity and dominancy indexes in Izmir Bay (Aegean Sea) purse seine fishery. *Ege Journal of Fisheries and Aquatic Sciences,* 37(4), 353-356. DOI: 10.12714/egejfas.37.4.05

Abstract: Purse seine fishery is known with its importance in Aegean Sea to catch pelagic species. In this study, to determine the diversity index values of species caught by purse seine, all samplings were carried out between September 2, 2017, and April 6, 2018 in Izmir Bay. As a result, a total of 17 fish species (Osteichthyes) belonging to 11 families and also 2 species from invertebrates (Cephalopoda and Arthropoda) were determined. Bony fishes and invertebrates consist of 99.9% and 0.1% of the total biomass, respectively. *Sardina pilchardus* was the most dominated species that occupied as 80.2% of the overall bony fishes followed by *Engraulis encrasicolus* (14.6%) and *Sardinella aurita* (1.5%). Diversity index values of species were found-1.026 by Shannon-Weaver and 0.63 by Simpsons, respectively. The highest dominancy was found for *S. pilchardus* with 71.1%. Overall final results indicate that the diversity of species in Izmir Bay purse seine fishery is very low and also *S. pilchardus* is the most over-dominant species.

Keywords: Izmir Bay, purse seine fishery, diversity, dominancy

Öz: Gırgır balıkçılığı, Ege Deniz'ndeki pelajik türlerin yakalanmasındaki önemiyle bilinmektedir. Bu çalışmada, İzmir Körfezi gırgır balıkçılığında, türlerin çeşitlilik indeks değerlerini belirlemek için 2 Eylül 2017 ile 6 Nisan 2018 tarihleri arasında örneklemeler yapılmıştır. Çalışmada, 11 familya'ya ait toplam 17 balık türü (Osteichthyes) ve ayrıca omurgasızlardan (Cephalopoda ve Arthropoda) 2 adet tür belirlenmiştir. Toplam biyokütlenin %99,9'u kemikli balıklardan, %0,1'i de omurgasızlardan oluştuğu tespit edilmiştir. Toplam av kompozisyonu içinde *Sardina pilchardus*, kemikli balıkların %80,2'sini, bunu sırasıyla %14,6 ile *Engraulis encrasicolus* ve %1,5 ile *Sardinella aurita* izlemiştir. Türlerin çeşitlilik indeks değerleri Shannon-Weaver -1,026 ve Simpsons 0,63 olarak bulunmuştur. %71,1 ile en yüksek baskınlık, *S. pilchardus*'da tespit edilmiştir. Tüm bu sonuçlar, İzmir Körfezi gırgır balıkçılığında tür çeşitliliğinin çok düşük olduğunu, ayrıca *S. pilchardus* türünün de aşırı baskın olduğunu göstermektedir.

Anahtar kelimeler: İzmir Körfezi, gırgır balıkçılığı, çeşitlilik, baskınlık

INTRODUCTION

Izmir Bay is situated at the western coast of the Anatolian peninsula, and is connected to the Aegean Sea. The bay is roughly "L" shaped (Sayın, 2003) and also, one of the important fishing areas for Turkey due to the diversity and abundance of fish with high commercial value (Metin et al., 2000; Cihangir et al., 2001; Cihangir et al., 2004). Due to its nature, Izmir Bay constitutes one of the rich areas of the Aegean Sea in terms of nutrients leading to rich and abundance of the living resources (Ünlüoğlu et al., 2017). Purse seine fishery is not only important for Aegean Sea but also for the Black Sea to catch small pelagic species, especially European anchovy, sardines, Atlantic bonito, bogue, etc. as well as big pelagics such as tunas. In addition, the catch quantity of a purse seiner is too much to compare with other fishing gears (e.g. trawls, seines). Vast majority marine fish landing (approximately 60-70%) supplied by purse seine in 2018 fishing season (Turkstat, 2019). In 2018, 373 purse seine vessels worked on all Turkish seas, but the number of these fishing vessels are between 3-5 for the Izmir Bay. Also, Izmir Bay is also known as an important spawning and nursery ground for many pelagic fish species (Ünlüoğlu et al., 2017).

Species diversity is considered to be main index of the species structure in a community that can be evaluated by information indices and it has been established that the more equal the distribution of species according to their relative abundance in a fish community, the higher is the species diversity in it (Ziliukas, 2005; Korkmaz and Zencir, 2009). However, studies with purse seine fishery are scarce and require much more studies to established sustainable purse seine fishery in all Turkish Seas. For these reasons and necessities, this study aims to reveal diversity and dominancy results of the Izmir Bay purse seine fishery.

MATERIAL AND METHODS

In this study, samplings have been performed 11 times between September 2, 2017, and April 6, 2018, mostly occurred in four locations of Izmir Bay (Figure 1) in depths

between 26 and 60m As a clarification note, sampling was made only for eight months (three seasons) due to the 4/1 notification regulates commercial fishery by the Ministry of Agriculture and Forestry of Turkey. According to the regulation, there is a closed season for purse seine fishery between 15th April and 31st August in all Turkish Seas. The purse seine net used by the commercial purse seiner Afala (24m LOA) is overall 750m in length, 164m net in height and 14mm stretched mesh size.

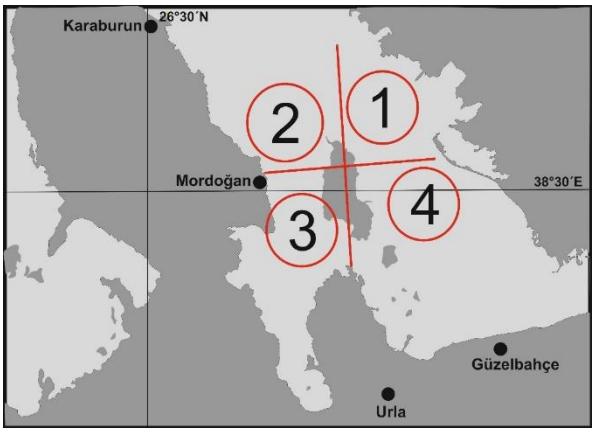

Figure 1. Purse seine fishing cites in Izmir Bay

The relationship between landing and surface water temperature data which are obtained from the global sea temperature website (Seatemp, 2018) was investigated by a linear equation. The index calculations were calculated according to Shannon and Weaver (1949) and Simpson (1949). In determining the diversity index, the basic equation of "$H = -\Sigma P_i \log_2 P_i$" was used, in the estimations; $P_i = n_i . q_i$ (kg) / $\Sigma n_i.q_i$, where (n_i) is the number of individual of i, (q_i) is average weight of i and ($_i$) are numerical codes of species. In Simpson's index equation "$Is = \sum N_i (N_i-1) / N(N-1)$", where ($N_i$) is the number of individuals of i and (N) is total individuals. In the general dominancy equation, which is $D = (n_i / N) *100$, the letter values represent the same as above. The total number of each fish species was calculated by the dividing of number of measured fish by the sampling ratio (sampled weight / total weight).

RESULTS

During the fishing period, surface water temperature (Seatemp, 2018) which is directly related to the obtained species quantity were investigated to find a relationship (Figure 2). It has been clearly shown that this relation decreased in the month of January and February and it completely deteriorated in March and April. However, as a weak linear relationship (0.38) between the water temperature and the landing of species was found (Figure 3). On the other hand, the relationship between working days in seasons, surface water temperature and landed fish has been shown parallelism naturally. As a result of annual landing report, a total of 17 fish species (Osteichthyes) belonging to 11 families and also 2 species from invertebrates (Cephalopoda and Arthropoda) were obtained (Table 1).

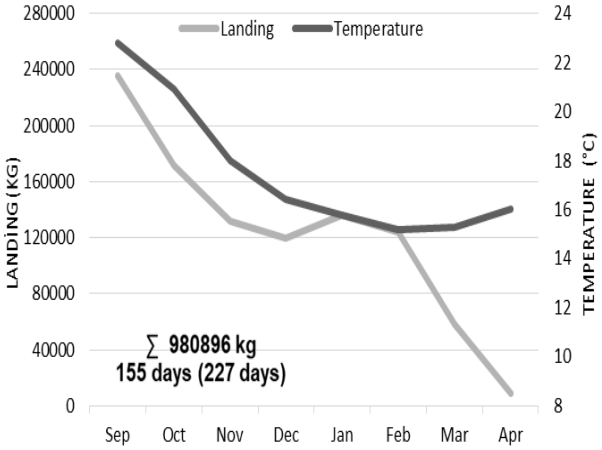

Figure 2. Relationship between monthly landing and water surface temperature in Izmir Bay

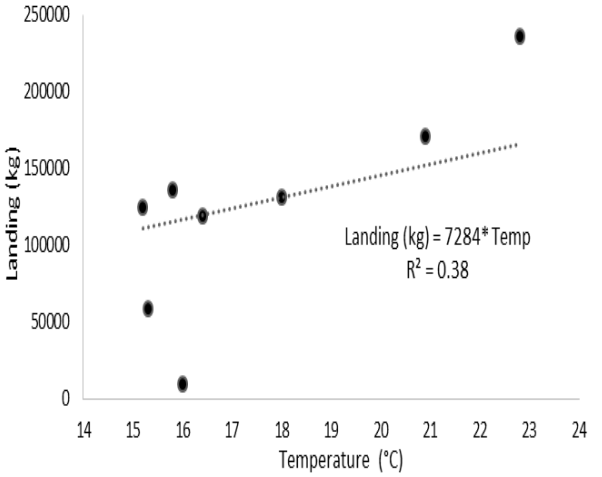

Figure 3. The linear relationship between the amount of landed fish and sea surface temperature

Table of index values of Izmir Bay has been obtained in Table 2 and Shannon-Weaver and Simpson's index values were found as -1.026 and 0.63, respectively. As a dominancy result, *S. pilchardus* landing compose of the vast majority with 71.1% and this is indicating that one of the most landed species and there is no other such species richness in the fishing area. Additionally, the percentage of the species proves that fact 99.9% of the total biomass has belonged to bony fishes and 0.1% belong to invertebrates. Within the data, *S. pilchardus* compose of 80.2% of the overall bony fishes followed by *E. encrasicolus* 14.6% and *S. aurita* as 1.5%, respectively. Considering the data, the abundance of clupeid and engraulid species is remarkable other than the rest of the marine specimens (Table 2).

Table 1. Annual landing data of the specimens

Species	Family	Average box weight (kg)	Average number of fish in a box	Annual ∑ kg	Percent
Pisces					
Osteichthyes					
Sardina pilchardus	Clupeidae	14 kg	1105	786731	80.205
Sardinella aurita	Clupeidae	14 kg	229	15302	1.560
Engraulis encarasicolus	Engraulidae	15 kg	2563	143947	14.675
Sarda sarda	Scombridae	10 kg	12	7370	0.751
Scomber scombrus	Scombridae	13 kg	67	10073	1,027
Scomber japonicus	Scombridae	13 kg	52	518	0.053
Auxis rochei	Scombridae	8 kg	12	8	0.001
Belone belone	Belonidae	12 kg	228	960	0.098
Sarpa salpa	Sparidae	13 kg	13	456	0.046
Sparus aurata	Sparidae	14 kg	75	1603	0.163
Boops boops	Sparidae	12 kg	532	5694	0.580
Coryphaena hippurus	Coryphaenidae	10 kg	5	20	0.002
Pomatomus saltatrix	Pomatomidae	12 kg	20	226	0.023
Sphyraena sphyraena	Sphyraenidae	12 kg	35	180	0.018
Liza aurata	Mugilidae	13 kg	15	5642	0.575
Dicentrarchus labrax	Moronidae	13 kg	13	173	0.018
Trachurus trachurus	Carangidae	12 kg	233	966	0.098
Cephalapoda					
Loligo vulgaris	Loliginidae	15 kg	30	153	0.016
Arthropoda					
Penaeus kerathurus	Penaeidae	8 kg	280	875	0.089
∑				**980896**	**100**

Table 2. Diversity and dominancy index values of species in Izmir Bay purse seine fishery

Species	Family	n_i	q_i (kg)	$n_i.q_i$	p_i	$p_i \log p_i$	Shannon - Weaver Index	Simpson's Index	Dominancy
Pisces									
Osteichthyes						$P_i = n_i \cdot q_i$ (kg) / $\Sigma n_i.q_i$	$H = -\Sigma P_i \log_2 P_i$	$/s = \sum N_i (N_i-1) / N(N-1)$	$D = (n_i / N) * 100$
Sardina pilchardus	Clupeidae	62095530	0.013	786730.697	0.802	0.077			71.095
Sardinella aurita	Clupeidae	250297	0.061	15302.000	0.016	0.028			0.287
Engraulis encarasicolus	Engraulidae	24595795	0.006	143947.298	0.147	0.122			28.161
Sarda sarda	Scombridae	8844	0.833	7370.000	0.008	0.016			0.010
Scomber scombrus	Scombridae	51915	0.194	10073.060	0.010	0.020			0.059
Scomber japonicus	Scombridae	2072	0.250	518.000	0.001	0.002			0.002
Auxis rochei	Scombridae	12	0.667	8.000	0.000	0.000			0.000
Belone belone	Belonidae	18240	0.053	960.000	0.001	0.003			0.021
Sarpa salpa	Sparidae	456	1.000	456.000	0.000	0.002			0.001
Sparus aurata	Sparidae	8588	0.187	1603.093	0.002	0.005			0.010
Boops boops	Sparidae	252434	0.023	5694.000	0.006	0.013			0.289
Coryphaena hippurus	Coryphaenidae	10	2.000	20.000	0.000	0.000			0.000
Pomatomus saltatrix	Pomatomidae	376	0.600	225.600	0.000	0.001			0.000
Sphyraena sphyraena	Sphyraenidae	525	0.343	180.000	0.000	0.001	**-1.026**	**0.631**	0.001
Liza aurata	Mugilidae	6510	0.867	5642.000	0.006	0.013			0.007
Dicentrarchus labrax	Moronidae	173	1.000	173.000	0.000	0.001			0.000
Trachurus mediterraneus	Carangidae	18757	0.052	966.026	0.001	0.003			0.021
Cephalapoda									
Loligo vulgaris	Loliginidae	305	0.500	152.500	0.000	0.001			0.000
Arthropoda									
Penaeus kerathurus	Penaeidae	30625	0.029	875.000	0.001	0.003			0.035

DISCUSSION

The overall result of the diversity index value is generally expected to be between 0 and 5 (Balık et al., 2011). If the value increases, it is concluded that there is a species richness in the sampled environment. For this reason, dominancy is directly depended on the species diversity resulted in higher landing. So as to diversity index value was found weak in the Izmir Bay purse seine fishery, Simpson's index value was determined as 0.63 in accordance with the crosscheck of the fishery. All these results showed that the diversity of species is low in Izmir Bay purse seine fishery, consequently single species *S. pilchardus* is dominant.

The linear relationship between water temperature and landed species did not reveal a solid correlation. In addition, a consistent relationship for diversity index has been not found. However, Izmir Bay exchanges water with the Aegean Sea almost the whole year long (Sayın et al., 2006) and it would be wrong to conclude that this situation is the same for the throughout the whole Aegean Sea.

During the sampling, it has been reported of some species such as *Dentex gibbosus*, *Pagellus erythrinus*, *Thunnus thynnus*, *Mustelus mustelus*, *Xiphias gladius* and *Octopus vulgaris* obtained during some fishing operations but the quantity of the specimens was not quite abundant (almost 1 or 2 individual for the whole year long) in the field. Therefore, it was not important to add to the estimations of the diversity index for the Izmir Bay. Besides, sampling methodology is another substantial factor to detect/obtain the specimens which are local and abundant animals within the sea. Thereto, purse seine nets are creating a limitation for sampling while trawl net and also other fishing gears independently cause different results which are depending on sampled specimens. Purse seine fishing tends to capture pelagic marine species in worldwide and purse seine nets are very important fishing gear used for capturing pelagic fishes (Demirci and Demirci, 2006). In this present study, all the identified and captured individuals are belonging upper pelagic zone community except *Penaeus kerathurus*. Apart from this, due to the inability to capture demersal and mesopelagic specimens are the main obstacle to unveil for all trophic levels of Izmir Bay. Thus, the expected studies of diversity index mainly tend to be established in minor fields or smaller areas. Mainly, it is a difficult task to gather all the data and agglomerate the fish quantity of the specimens per year. As a descriptive conclusion within the major field such as this study, we have done the calculations with only one annual landing report (∑kg) and converted it to approximately average fish quantity in a single styrofoam box. Eventually, the fisher's reports/observations and our estimations have been shown parallelism on the diversity, abundance and dominance for the Izmir Bay.

ACKNOWLEDGEMENTS

We would like to thank Ege University Scientific Research Project Coordination Unit (Project No.2017/SUF/002), project researcher and Afala purse seiner staff.

REFERENCES

Balık, S., Koray, T. & Ustaoglu, M.R. (2011). Applications of Fisheries Biology. (2nd edition). Ege University Press.

Cihangir, B., Önen, M., Kocataş, A., Ergen, Z., Mater, S., Koray, T., Katağan, T., Özel, İ., Demirkurt, E., Tıraşın, E.M., Ünlüoğlu, A., Çınar, M.E., Çolak, F., Çoker, T., Öztürk, B. & Doğan, A. (2001). Some biological properties of Izmir Bay. Workshop on the role of The Physical, Chemical and Biological Processes in Marine Ecosystems, ECOSYSTEM 99, vol.2, 19-48.

Cihangir, B., Ünlüoğlu, A. & Tıraşın, E.M. (2004). İzmir Körfezi'nde 1997-2003 yılları arasında dip trolü ile yakalanan demersal balıkların miktarı ve çeşitliliği üzerine incelemeler. (*in Turkish with English abstract*). *Turkish Journal of Aquatic Life*, 2, 85-93.

Demirci, A. & Demirci, S. (2006). Purse seine fishery in Iskenderun Bay, Determining the fishing gears and equipments of fishing vessels (In Turkish). Mustafa Kemal Üniversitesi, Su Ürünleri Fakültesi, Avlama Teknolojisi, 9 pp.

Korkmaz, A. S. & Zencir, O. (2009). Fish community structure in Suveri stream, Central Anatolia, Turkey. Journal of Animal and Veterinary Advances, 8, 2305-2301.

Metin, C., Tosunoğlu, Z., Tokaç, A., Lök, A., Aydın, C. & Kaykaç, H. (2000). Seasonal variations of demersal fish composition in Gülbahçe Bay (Izmir Bay). *Turkish Journal of Zoology*, 24, 437-446.

Sayın, E. (2003). Physical features of the Izmir Bay. *Continental Shelf Research*, *23*, 957-970. DOI: 10.1016/S0278-4343(03)00083-9

Sayın, E., Pazı, I. & Eronat, C. (2006). Investigation of water masses in İzmir Bay, western Turkey. *Turkish Journal of Earth Sciences*, 15, 343-372.

Seatemp (Global Sea Temperature). (2018). World Wide Web electronic publication. Retrieved in April 6, 2018 from https://www.seatemperature.org/middle-east/turkey/karaburun-march.htm

Shannon C.E. & Weaver, W. (1949). *The Mathematical Theory of Communication*, Urbana, University of Illinois Press, 117 pp.

Simpson, E.H. (1949). Measurement of diversity. *Nature* 163, 688. DOI: 10.1038/163688a0.

Turkstat (Turkish Statistical Institute). (2019). World Wide Web electronic publication. Retrieved in December 28, 2019 from http://www.tuik.gov.tr

Ünlüoğlu, A., Cihangir, B. & Tıraşın, E.M. (2017). Fisheries resources of Izmir Bay (*in Turkish*), Fishery of Izmir (In Turkish) (pp 27-32). Izmir Büyükşehir Belediyesi.

Žiliukas, V. (2005). Diversity and Density of Shoreline Juvenile Fish Communities of the Šventoji River. *Acta Zoologica Lituanica*, 15, 239-247.