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Catch and discard fish species of trawl fisheries in the Iskenderun Bay (North-eastern Mediterranean) with emphasis on lessepsian and chondricthyan species

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Abstract

Fish species in catch and discard of trawl fisheries in and around Iskenderun Bay were examined within the fishing closure period and fishing period. The sampling was performed from May 2010 to January 2011 by a commercial trawl vessel. Chondricthyan species accounted for 51 % of discard catch biomass while *Gymnura altavela* and *Dasyatis pastinaca* were dominant in hauls. 27 lessepsian fish species were captured during the study, nine of them being target species for trawl fisheries. In total, 14 of the lessepsian fish species were determined as discard species. In both sampling periods, *Equulites klunzingeri* and *Citharus linguatula* contributed to discard fish catch dissimilarity among depth ranges (deeper and shallower than 60 m). *E. klunzingeri* showed high abundance in discard catch. There were no significant differences in the distribution of the discard fish biomass between the sampling periods (ANOVA test, $p>0.05$). However, depth range highlighted significant differences in discard fish catch composition ($p<0.05$). Among major commercial fish species of trawl fisheries, *Mullus surmuletus* and *Sparus aurata* were not separated as discard in any haul by fishermen. Any size of these two species was included in the commercial catch (Total length ranged from 61 to 721 mm).

Keywords: Discard Fish, Trawl Fisheries, North-eastern Mediterranean Sea, Iskenderun Bay.

Introduction

World fisheries have not considered the sustainability of wild food resources until a few decades ago. Destruction of fish stocks was discovered by researchers in 1980s. Thereafter, the discard problem in marine fisheries was described (Alverson *et al.,* 1994; Hall, 1996). Non-target or non-commercial catches are defined as discard, generally brought onto the deck of fishing vessels and then returned to the sea. Although some species are included in the commercial part, they might be determined as discard because of unmarketable consideration (Hall *et al.*, 2000). Unmarketable sizes may change with fishing time and depth depending on fishermen (Kelleher, 2005).

Discard rates in multispecies fisheries are higher than for other fishing methods and the Mediterranean Sea fishery is characterized by multispecies fisheries (Tudela, 2004). Hence, discard rates geographically estimated ranged from 23 to 67 %, and belong to different Mediterranean Sea habitats (Machias *et al.,* 2001; D'Onghia *et al.*, 2003; Sanchez *et al.,* 2004; Tudela, 2004; Alsayes & Fatthouh 2009, Damalas *et al.,* 2010, Edelist *et al.*, 2011). Also, in the Turkish Seas, research has been focused on studies concerning discard catch in the last decade, and most of these studies were carried out using beam trawls (Kınacıgil, 1999a, 1999b; Demirci, 2003; Yazıcı *et al.*, 2006; Bayhan *et al.*, 2006; Soykan *et al.*, 2006; Gökçe & Metin, 2006). Gurbet *et al.* (2013) mentioned that the total discard biomass ratio was 30.5 % in the trawl fisheries of Izmir Bay (Aegean Sea). Gucu (2012) pointed out the status of bottom trawl fisheries from 1980s onwards in Levantine Sea, and compared data considering temporal and depth differences.

The objective of this study is to detect the fish composition of trawl fisheries in Iskenderun Bay and to analyze the commercial and discard fish species with their rates in different periods with emphasis on Lessepsian and Chondrichtiyan fish species.

Material and Methods

Study Area

The study was carried out in and around Iskenderun Bay, which is located in the Levantine Sea (North-eastern Mediterranean) (Fig. 1), an important trawling area in the Eastern Mediterranean Sea. The bay shows high productivity caused by local wind effects and movements such as upwelling and rich terrestrial nutrient inputs. Surface water temperature ranges from 16°C to 33°C, and salinity between 37 and 40 psu (Polat & Piner, 2002; Polat, 2010). Regional fish communities are exposed to fishing pressure from almost one hundred trawlers vessel every

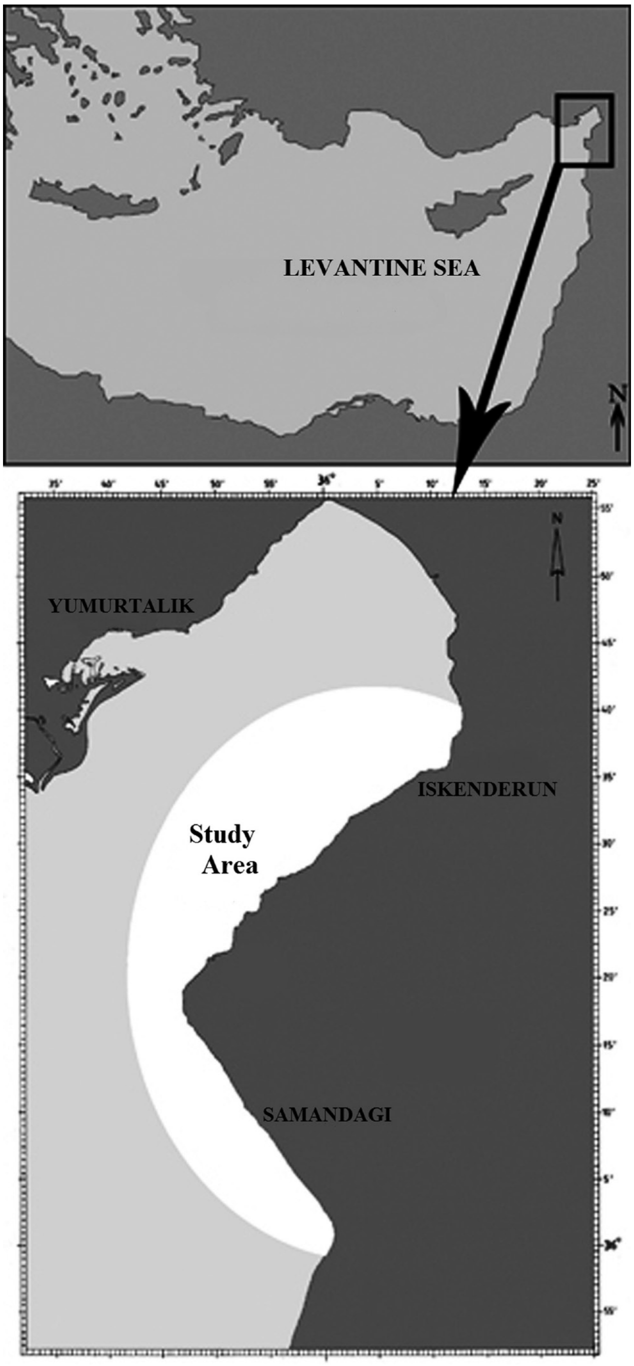

Fig. 1: Study area in and around Iskenderun Bay (Levantine Sea).

year. Marine fisheries along Turkish south coast (North of the Levantine Sea) include 6.93 % of marine fisheries productivity in Turkish seas (Anonymous, 2012a). The trawling ban period is between April 15 and September 15 in Turkish seas, in accordance with the decision of the Ministry of Agriculture and Rural Affairs, General Directorate of Protection and Control Vision of the Republic of Turkey. Trawling is permitted over two miles in the bay and one mile off Samandag coast (Anonymous, 2012b). Thus, in general, trawl fishery activities in the bay take place on bottoms deeper than 60 m.

Sampling Data

Field work was performed from May 2010 to January 2011 in Iskenderun Bay. The May and August surveys were included in the trawl fishing closure period, while the October and January surveys took place during the fishing period. Data was collected using a commercial trawl vessel (23 m in length) with engine power up to 400 HP, and the stretched codend mesh size of the trawl net was 44 mm. A total of 32 hauls were performed at depths between 31 and 110 m determined by the fishermen. Ten hauls were carried out in May, seven hauls in August, seven hauls in October and eight hauls in January. The mean haul duration was 1.5 hours at an average speed of 2.5 knots. The commercial catch in each haul was selected by the crew on board, and the remaining catch was considered as discard. Biomass and abundance data of the fish species was recorded as discard and commercial catch by researchers. We randomly applied subsampling for the most abundant species such as *E. klunzingeri*. The commercial and discard catches were stored at – 20 ºC at the laboratory. After identification of the fish species, total length (mm) and body weight (g) were measured.

Data Analysis

The catch data of each haul was standardized with the catch per unit effort (CPUE) (D'Onghia *et al.*, 2003). It was performed as fish weight divided by catch time, where Cw is the weight of the fish catch and Ct is the towing time.

CPUE = Cw/Ct

The number of species (S) was counted for each haul. The diversity indices were computed using the number of specimens to standardize with catch hour per haul. The estimation was made using the Simpson diversity index, Species Richness, Shannon-Wiener diversity index H´ (log_2) and Pielou evenness index;

Simpson Diversity Index = 1- λ → λ =

$$\frac{\sum n_i(n_i-1)}{N(N-1)} \rightarrow 1 - \frac{\sum n_i(n_i-1)}{N(N-1)}$$

"λ" is the Simpson Index and Simpson diversity index is found 1-**λ,** where "n_i" is the total number of specimens of each species and "N" is the total number of specimens of all species.

Margalef Species Richness index (d) = (S-1) / ln N, where "S" is the number of species in the samples (Beisel and Moreteau, 1997).

Shannon Wiener Diversity Index (H´) = $-\sum p_i \ln(p_i)$ where "p_i" is the proportion of total samples belonging to the species,

Evenness Index (J´) = H´/log S

Diversity indices were compared with sampling months.Eight commercial fish species: *Saurida undosquamis, Nemipterus randalli, Mullus barbatus, M. surmuletus, Pagellus erytrhinus, Upeneus moluccensis,*

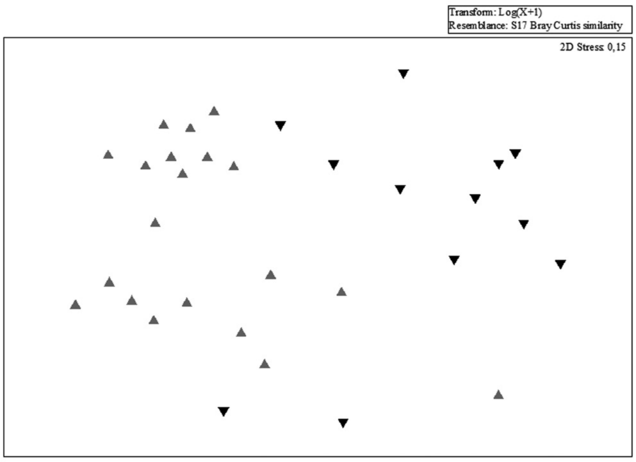

Fig. 2: MDS plot of discard fish catch composition. Each haul was assigned as ▲ ; deeper than 60 m and ▼; shallower than 60 m.

U. pori, Sparus aurata were analyzed to total length measurement in all hauls.

Haul depths were divided in two: hauls with depths shallower than 60 m and deeper than 60 m. Homogeneity of variance was tested with Levene's test. Variances were transformed using the log(x+1) formula. After data transformation, the factor on fish discard biomass was analyzed with the one-way ANOVA statistical test. The analysis was carried out using the statistical programme SPSS, version 17 (Levesque, 2007).

Abundance of fish discard data was transformed [log(x+1)] and then rank-ordered using the Bray Curtis similarity matrix. The Non-parametric Multidimensional Scaling test was performed using the Primer 6 statistical package programme (Clarke & Warwick, 2001). The SIMPER test was performed to determine the level of similarity and dissimilarity according to trawl fishing sampling depth.

Results

77994 individuals were obtained in 32 hauls, belonging to 97 fish species (Table 1). 69 (n=54119) of them were determined as discard. 43 (n=52655) species were thrown back into sea regardless of their size, while 26 species (n=1464) have been considered as unmarketable size of commercial species. 993.4 kg of the total 2491.3 kg of fish catch was discard (Table 1).

Total fish biomass caught per haul was between 5.7 and 119.5 kg/h during the fishing period and between 1.1 and 40.9 kg/h of that amount was discard catch. However, total fish biomass caught per haul ranged from 3.4 to 211.2 kg/h during the fishing closure time, and 0.6 to 151.2 kg/h of that amount was discard catch. The average discard catch rate was found to be 32.2 ± 16.5 % during the study. The estimates of fish biomass have been separately studied in terms of depth ranges (Table 2).

Ecological Index

The ecological indices of total and discard fish catch per month are shown in Table 3. The evenness index (J') ranged from 0.40 to 0.63 in total catch. The Shannon - Weiner diversity index per haul was estimated to be 2.46 in May 2010, 1.91 in August 2010, 2.55 in October 2010 and 2.68 in January 2011.

Abundance of discard catches showed differences according to depth (ANOSIM. R= 0.531, p< 0.001). The SIMPER analysis indicated that *C. linguatula* displayed highest average similarity among discard fish. In waters shallower than 60 m., *E. klunzingeri* showed highest average abundance and nine Lessepsian species contributed mainly to average similarity. Also, these two species contributed to dissimilarity in the sampling depth groups (Table 4).

Comparison of Discard Fish Biomass

The computation of the discard fish rates indicated that 44.5 % of the catch was in the depth range of 30-60 m and 28.1% was in the depth range of 60-110 m. The average of discard rates among sampling months showed close values except of January. The highest discard CPUE was determined in August (average: 44.86 kg/h), while the lowest was in October (average: 9.04 kg/h). Although a significant relationship was found between depth and discard fish biomass ($p < 0.05$, $p = 0.0001$), there is no differences between sampling periods and discard biomass ($p > 0.05$, $p = 0.106$).

Chondrichtyan species

Chondrichtyan species abundance represented 0.9 % in total discard catch. (n=465). Four species were obtained in the commercial catch: *Mustelus mustelus* (n=1). *Carcharhinus plumbeus* (n=2) and *Rhinobatus cemiculus* (n=1), Chondrichtyan species are included in discard catch biomass at a rate of 51 %. *G. altavela* (n=203) and *D. pastinaca* (n=125) were the main species among the chondrichtyans in the study area (Table 1). Discard rates ranged from 27 % to 77 % depending on the sampling periods. Discard of chondrichtyan species was estimated to be 12.5 (May), 19.1 (August), 2.3 (October) and 5.08 (January) (Fig. 3.).

Lessepsian Species

In total, 27 Red Sea originated fish species were found in the study. 13 of them were commercial and 14 species were discard. Lessepsian fish constituted 71 % of total catch abundance. They constituted 55 % of total catch biomass and dominated the commercial catch biomass at the rate of 69.5 %. In January, commercial biomass of Lessepsian fish reached 93.5% in a haul. Furthermore, they represented between 0.7 % and 92.8 % (on average 38.5 %) of the discard catch.

Thirteen (13) specimens of the pelagic pony fish, *E. klunzingeri*, were found, representing with 0.4 % in total catch biomass deeper than 60 m depth, and consti-

Table 1. Commercial (C) or Discard (D); N, number of specimens; F %, frequency of species occurrence in total hauls; Discard Rate % (per each discard species), percentage of discard abundance in total.

Species	N	F %	Total Weight (kg)	Discard Weight (kg)	Discard Rate %	Discard Size (mm)	Commercial Size (mm)	Legal Minimum Landing Size	Value
Lessepsian Fishes	67324		1469.5	399.7	27.2				
Apogon fasciatus	69	40	0.822	0.822	100	53-106	-	-	**D**
Apogon queketti	77	53	1.262	1.262	100	63-128	-	-	**D**
Apogon smithii	138	39	3.244	3.244	100	61-146	-	-	**D**
Callionymus filamentosus	140	30	2.753	2.753	100	76-148*	-	-	**D**
Champsodon sp.	796	51	9.022	9.022	100	46-149	-	-	**D**
Cynoglossus sinusarabici	1	4	0.003	0.003	100	82	-	-	**D**
Decapturus russeli	2	3	0.154	0.075	100	90-92	-	-	**C**
Dussumieria elopsoides	4	7	0.1	0	0	-	146-161	-	**C**
Equulites klunzingeri	46841	62	354.895	354.895	100	46-102	-	-	**D**
Etremeus teres	5	12	0.293	0	0	-	158-240	-	**C**
Fistularia commersoni	6	7	0.792	0.057	100	258-338	-	-	**D**
Lagocephalus sceleratus	3	6	0.655	0.655	100	71-385	-	-	**D**
Lagocephalus spadiceus	103	41	7.541	7.541	100	60-291	-	-	**D**
Lagocephalus suezensis	136	39	5.548	5.548	100	106-177	-	-	**D**
Nemipterus randalli	3372	100	166.046	3.61	6	52-130*	85-194	-	**C**
Oxyrichthys papuensis	53	32	0.763	0.763	100	113-170	-	-	**D**
Pomadasys stradiens	19	3	0.996	0	0	-	132-186	-	**C**
Saurida undosquamis	7177	100	653.681	1.747	1.8	61-172	131-362	-	**C**
Siganus rivulatus	3	7	0.052	0.052	100	106-124	-	-	**C**
Sillago sihama	4	7	0.164	0	0	-	170-181	-	**C**
Sphyraena chrysotenia	22	8	1.949	0	0	-	197-275	-	**C**
Sphyraena flavicauda	2	4	0.193	0	0	-	250-278	-	**C**
Stephanolepis diaspros	158	58	4.534	4.534	100	80-202	-	-	**D**
Torquigener flavimaculosus	9	14	0.104	0.104	100	72-109	-	-	**D**
Trachurus indicus	1	3	0.048	0	0	171	-	-	**C**
Upeneus moluccensis	613	68	10.147	1.203	28	66-115	70-218	100	**C**
Upeneus pori	7570	54	243.776	1.859	2	80-154	106-167	-	**C**
Native Fishes			1021.8	593.7					
Chondrichthyes	474		519.8	503.0	96.8				
Carcharhinus plumbeus	2	4	4.9	0	0	-	708-721	-	**C**
Dasyatis marmorata	32	28	20.314	20.314	100	458-668	-	-	**D**
Dasyatis pastinaca	125	52	162.685	162.685	100	450-1100	-	-	**D**
Mustelus mustelus	1	3	4.358	0	100	1030	-	-	**C**
Gymnura altavela	203	29	246.133	246.133	100	265-1040	-	-	**D**
Pteromylaeus bovinus	5	14	12.08	12.08	100	535-1490	-	-	**D**
Raja miraletus	16	23	1.375	1.375	100	80-394	-	-	**D**
Raja radula	31	23	19.061	19.061	100	208-505	-	-	**D**
Raja sp.	5	3	0.02	0.02	100	50-85	-	-	**D**
Rhinobatos cemiculus	51	26	48.347	40.847	98	185-764	1300	-	**C**
Torpedo marmorata	2	7	0.196	0.196	100	162	-	-	**D**
Torpedo torpedo	1	4	0.327	0.327	100	295	-	-	**D**
Teleosts	10196		502.6	90.7	18.1				
Argyrosomus regius	6	7	1.297	0	0	-	225-337	250	**C**
Arnoglossus kessleri	4	7	0.041	0.041	100	82-100	-	-	**D**
Arnoglossus laterna	6	3	0.078	0.078	100	94-130	-	-	**D**
Arnoglossus sp.	9	13	0.047	0.047	100	64-102	-	-	**D**
Arnoglossus thori	36	34	0.661	0.661	100	80-117	-	-	**D**
Balistes capriscus	1	3	0.231	0	100	183	-	-	**D**
Blennius ocellaris	2	6	0.055	0.055	100	128	-	-	**D**
Boops boops	15	17	0.726	0	0	-	136-188	-	**C**
Bothus podas	73	22	1.981	1.981	100	78-179	-	-	**D**

(continued)

Table 1 (continued)

Species	N	F %	Total Weight (kg)	Discard Weight (kg)	Discard Rate %	Discard Size (mm)	Commercial Size (mm)	Legal Minimum Landing Size	Value
Caranx rhonchus	9	7	0.994	0	0	-	214	-	**C**
Chelidonichthys lucernus	376	82	33.765	0.342	4	107-148	150-286	180	**C**
Citharus linguatula	3219	78	58.643	58.643	100	75-206	-	-	**D**
Conger conger	1	3	0.404	0.404	100	661	-	-	**D**
Dactylopterus volitans	1	3	0.13	0.13	100	233	-	-	**D**
Deltentosteus quadrimaculatus	46	20	0.215	0.215	100	48-95	-	-	**D**
Dentex dentex	1	4	0.138	0	0	-	217	350	**C**
Diplodus annularis	41	19	2.182	0.171	12	-	114-182	-	**C**
Diplodus sargus	4	3	0.228	0	0	-	144-165	210	**C**
Diplodus vulgaris	6	5	0.353	0	0	-	149-164	180	**C**
Echeneis naucrates	2	6	0.374	0.374	100	360-448		-	**D**
Engraulis encrasicolus	26	12	0.276	0.037	100	62-133		90	**C**
Epinephelus aeneus	86	33	37.828	0.054	49	120-170	196-920	450	**C**
Epinephelus haifensis	2	3	0.074	0	0	-	125-133	-	**C**
Epinephelus marginatus	3	6	1.065	0	0	-	179-390	-	**C**
Gobius niger	4	14	0.069	0.069	100	82-137	-	-	**D**
Lepidotrigla cavillione	67	46	0.773	0.773	100	62-111	-	-	**D**
Lithognathus mormyrus	110	10	11	0	0	-	145-212	-	**C**
Merluccius merluccius	1	4	0.04	0	0	-	185	250	**C**
Microchirus ocellatus	61	7	1.348	1.348	100	106-131	-	-	**D**
Mullus barbatus	253	76	16.865	0.253	9.37	71-116	114-257	130	**C**
Mullus surmuletus	63	28	4.303	0	0	-	103-235	110	**C**
Pagellus acarne	281	26	4.876	2.413	62	73 -123	122 - 162	-	**C**
Pagellus erythrinus	3937	86	219.346	2.85	0.38	71-135	105-245	-	**C**
Pagrus caeruleostictus	16	9	2.629	0.036	15	98-110	190-288	-	**C**
Phycis phycis	1	3	0.006	0.006	100	92	-	-	**C**
Pomadasys incisus	27	6	2.144	0	0	-	69-183	-	**C**
Sardinella aurita	1	3	0.001	0.001	100	130	-	110	**C**
Sarpa salpa	1	3	0.05	0	100	151	-	-	**C**
Scomber japonicus	5	9	0.314	0	0	-	139-191	180	**C**
Scorpaena notata	2	6	0.246	0.061	50	141	228	-	**C**
Scorpaena scrofa	2	3	0.114	0.114	100	152	-	150	**C**
Seriola dumerili	1	4	0.186	0	0	-	245-336	300	**C**
Serranus cabrilla	18	16	0.302	0.269	100	85-161	-	-	**D**
Serranus hepatus	88	49	0.677	0.677	100	58-101	-	-	**D**
Solea kleini	4	7	0.16	0.03	25	152	158-176	-	**C**
Solea lascaris	1	3	0.047	0.047	100	172	-	-	**D**
Solea solea	173	79	13.397	0.82	13	139-217	141-323	200	**C**
Sparus aurata	544	94	50.855	0	0	-	165-209	200	**C**
Sphyraena sphyraena	54	18	6.73	0	0	-	280-409	-	**C**
Spicara flexuosa	14	15	0.482	0.185	0	-	129-170	-	**C**
Spicara maena	2	3	0.127	0	0	-	157-180	-	**C**
Spicara smaris	1	4	0.005	0	100	80	-	-	**D**
Spondyliosoma cantharus	8	3	0.393	0	0	-	121-170	-	**C**
Synodus saurus	14	10	0.518	0.518	100	126-226	-	-	**C**
Trachinus draco	30	32	2.429	2.429	100	171-296	-	-	**D**
Trachurus trachurus	43	36	1.718	0.068	9	91-223	91-236	130	**C**
Trichiurus lepturus	125	42	9.172	9.172	100	409-556	-	-	**D**
Trigloporus lastoviza	81	28	3.914	0.657	53	74-159	152-228	-	**C**
Uranoscopus scaber	65	39	2.072	2.072	100	83-115	-	-	**D**
Zeus faber	123	41	3.473	2.64	95	118-164	188-226	-	**C**

Table 2. Average total and discard catch biomass (kg/h) and discard rates according to depth ranges and sampling months.

	May		August		October		January		Total	
Depths (m)	***30-60***	***60-110***	***30-60***	***60-110***	***30-60***	***60-110***	***30-60***	***60-110***	***30-60***	***60-110***
Sampling Hauls	4	6	4	3	1	6	3	5	12	20
Total Catch Biomass	70.4	13.8	135.8	71	21.6	21.9	68	21.7	87.6 ± 61.01	26.78 ± 22.86
Discard Biomass	31.4	5.1	71.7	9.1	10	8.9	17.7	7.8	39.61 ± 39.23	7.5 ± 8.06
Discard Rate (%)	44.5	37.2	52.8	12.8	46.3	40.6	26	35.9	39.83 ± 16.13	27.6 ± 14

Table 3. Ecological parameter means for the sampling periods in Iskenderun Bay. S: Species number (S), N (Total specimens), d (Species Richness), J´ (Evenness Diversity index), H' (Shannon-Wiener Diversity Index), 1-λ (Simpson Diversity Index), Mean, SD (Standard Deviation).

	May		August		October		January		Total			
									Catch		Discard	
	Catch	Discard	Catch	Discard	Catch	Discard	Catch	Discard	*30-60*	*60-110*	*30-60*	*60-110*
N	10704	4651	41746	30826	5479	4271	20065	14357	64772	13222	48507	5598
S	21± 6	13±4	28 ± 4	20 ± 4	22 ± 5	16 ± 5	21 ± 3	12 ± 2	26 ± 4	22 ± 6	17 ± 3	14 ± 6
H´	2.46 ± 0.52	1.49 ± 0.72	1.91 ± 0.70	0.68 ± 0.56	2.55 ± 0.59	1.23 ± 0.37	2.68 ± 0.65	1.5 ± 0.64	1.85 ± 0.72	2.75 ± 0.31	0.92 ± 0.95	1.46 ± 0.3
J	0.57 ± 0.13	0.62 ± 0.27	0.40 ± 0.14	0.12 ± 0.08	0.59 ± 0.15	0.26 ± 0.14	0.63 ± 0.16	0.38 ± 0.14	0.39 ± 0.15	0.6 ± 0.09	0.33 ± 0.35	0.59 ± 0.15
d	3.51 ± 0.55	2.56 ± 0.9	3.47 ± 0.70	2.8 ± 0.92	3.40 ± 0.53	2.6 ± 0.7	3.08 ± 0.37	2.28 ± 0.83	3.33 ± 0.55	3.39 ± 0.57	2.52 ± 0.8	2.57 ± 0.91
1-λ	0.71 ± 0.11	0.6 ± 0.27	0.55 ± 0.18	0.25 ± 0.22	0.69 ± 0.18	0.5 ± 0.18	0.76 ± 0.16	0.63 ± 0.25	0.55 ± 0.2	0.8 ± 0.09	0.33 ± 0.36	0.62 ± 0.13

Table 4: Results of SIMPER analysis of discard catch. Av. Ab.; Average of abundance, Av. Sim.; Average of Similarity, Sim./SD; Similarity of Standard Deviation, Contrib.; Contribution Percentage, Cum.; Cumulative Percentage. Av. Diss.; Average of Dissimilarity.

Species	**Av.Ab.**	**Av.Sim**	**Sim/SD**	**Contrib%**	**Cum.%**	
Deeper than 60 m depth (60-110 m) average similarity : 38.78						
Citharus linguatula	3.88	13.7	2.22	35.34	35.34	
Saurida undosquamis	1.32	4.22	1.49	10.89	46.23	
Champsodon sp.	2.04	4.14	0.61	10.68	56.91	
Nemipterus randalli	1.46	3.6	1.22	9.29	66.2	
Lepidotrigla cavillione	0.87	2.05	0.72	5.28	71.48	
Serranus hepatus	1.01	1.65	0.71	4.27	75.74	
Zeus faber	0.86	1.65	0.45	4.25	79.99	
Uranoscopus scaber	0.74	1.08	0.54	2.79	82.77	
Upeneus moluccensis	0.88	0.89	0.4	2.28	85.06	
Apogon quaketti	0.64	0.88	0.48	2.28	87.34	
Shallower than 60 m depth (30-60) average similarity : 38.29						
Equulites klunzingeri	5.43	11.36	1.01	29.68	29.68	
Apogon smithii	1.64	3.47	0.89	9.07	38.75	
Upeneus pori	1.44	2.85	1.01	7.45	46.2	
Dasyatis pastinaca	1.41	2.83	1.04	7.4	53.6	
Nemipterus randalli	0.99	2.09	0.91	5.47	59.07	
Stephanolepis diaspros	0.94	1.95	1.48	5.08	64.15	
Saurida undosquamis	0.83	1.4	0.79	3.64	67.8	
Apogon fasciatus	0.85	1.39	0.56	3.63	71.43	
Lagocephalus spadiceus	1.1	1.16	0.55	3.03	74.46	
Citharus linguatula	1.07	1.13	0.45	2.95	77.41	
Shallower & Deeper than 60 m average dissimilarity: 78.08						
	> 60 m Av.Abund	60 m > Av.Abund	Av.Diss	Diss./SD	Contrib. %	Cum. %
Equulites klunzingeri	0.64	5.43	9.99	1.48	12.79	12.79
Citharus linguatula	3.88	1.07	6	1.95	7.69	20.48
Champsodon sp.	2.04	0.39	4.15	1.05	5.32	25.8
Apogon smithii	0.11	1.64	3.37	1.26	4.31	30.11
Upeneus pori	0.29	1.44	2.67	1.38	3.41	33.53
Dasyatis pastinaca	0.38	1.41	2.66	1.27	3.41	36.94
Nemipterus randalli	1.46	0.99	2.16	1.33	2.76	39.7
Upeneus moluccensis	0.88	0.6	2.12	0.91	2.72	42.42
Gymnura altavela	0.25	0.99	2.11	0.88	2.7	45.12
Stephanolepis diaspros	0.68	0.94	2.07	1.46	2.65	47.77

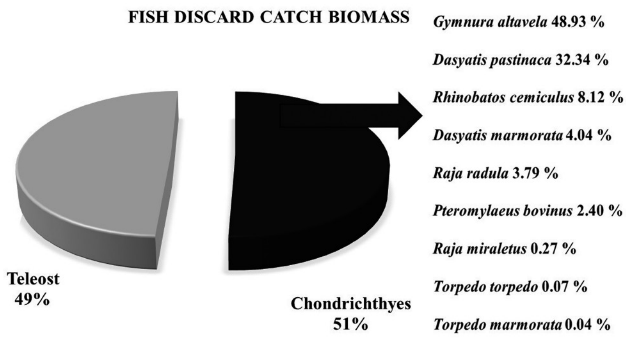

Fig. 3: Chondrichtyan species in fish discard.

tuting 20 % of the total fishing rate in terms of abundance values. When its CPUE is compared with the its depth range, the pony fish had 17.4 kg/h at depths between 30 to 60 m and 0.02 kg/h in waters deeper than 60 m.

Some of the other Lessepsian species such as *N. randalli, U. moluccesis, U. pori* and *S. undosquamis* were mainly commercial species for regional fisheries. Biomass values of these species in total catch were 3.4 kg/h, 0.2 kg/h, 5 kg/h and 13.6 kg/h, respectively. While *U. moluccensis* was found in waters deeper than 60 m, *U. pori* was detected at depths between 30 and 60 m.

Length Ranges of the Commercial Species

S. undosquamis (654 kg), *U. pori* (244 kg), *P. erythrinus* (219 kg), *N. randalli* (166 kg) and *S. aurata* (51 kg) constitute the major target species in commercial trawl fisheries of Iskenderun Bay. These five species consisted of 54 % of the commercial catch these species. Besides, these fishes have low discard weight rates (0 to 2.2%). *S. undosquamis,* the highest biomass commercial species, attained a length range of 61 to 172 mm (mean = 129 mm, SD= 45.2) in discard. The length of *P. erythrinus* ranged between 71 mm and 135 mm (mean = 113 mm, SD = 21.8) in discard. However, individuals that were bigger than 105 mm were evaluated to have economic value. Discard length of *N. randalli* was between 52 mm and 130 mm (mean = 97.2 mm, SD= 14.3), while *Upeneus moluccensis* attained a discard length of 66 to 115 mm (mean = 89 mm, SD= 12.2) (Fig. 5).

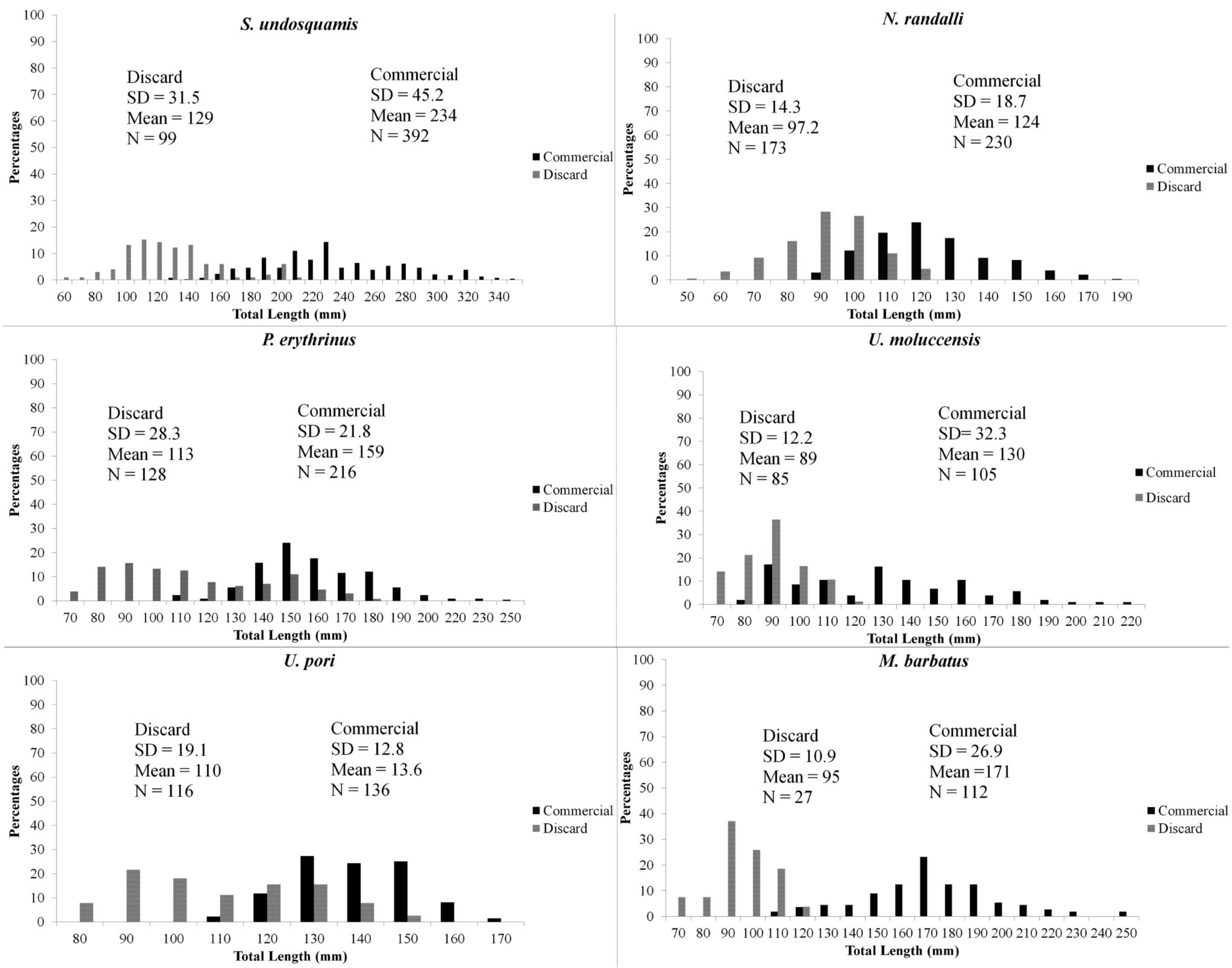

Fig. 4: Commercial and discard catch length ranges of eight commercial fish species in trawl fisheries; mean, standard deviation (SD), number of specimens (N).

S. aurata and *M. surmuletus* were not in the discard catch. Body size of the commercial fish ranged from 69 mm to 721 mm (Fig. 5).

Discussion

The variations of abundance and biomass data demonstrate the direct effect of fisheries on fish fauna. The percentages of discard fish species showed different results due to the changeable factors such as depth and time in Mediterranean Sea trawl fisheries (Machias *et al.,* 2001; D'Onghia *et al*., 2003; Sanchez *et al*., 2004; Tudela, 2004; Alsayes & Fatthouh, 2009; Damalas *et al.*, 2010; Edelist *et al.*, 2011).

The study area is highly exploited during the fishing season (September 15 - April 15). High rates of discard were accompanied by low homogeneity in August (Table 2). The fish catch shown a more homogenous structure in fishing season. Also, the number of discard species declined toward the end of fishing season (Table 3).

Sanchez *et al.* (2007) showed that *M. barbatus* had low discard rates in the Adriatic and Catalan sea. Gucu (2012) verified that discard rates increased toward shallower depths in Mersin Bay. *Bothus podas* and the unmarketable size of *M. barbatus* were included in discard composition shallower than 100 m in Mersin Bay (North-Western Levantine Sea) (Gucu, 2012). In our study, *M. barbatus* also had a low ratio in discard catch. Besides. *S. aurata* and *M. surmuletus* was not included in discard catch. All specimens were considered as marketable, but some were not suitable for the minimum landing size regulation (Fig. 4).

Discard biomass ratios were calculated to be 44 % for the shallower than 60 m depth, and its value was 75 % of all the discard catch. 28 % of the total catches consisted of biomass of trawl fishing area (deeper than 60 m). These ratios indicate that shallow water has higher fish productivity than the trawl fishing area. We can support this opinion with biomass of *S. undosquamis.* It was found to be 9.94 kg/h and 19.57 kg/h in shallower water and deeper depths, respectively. It could be followed by long-term researches on commercial species biomass such as *S. undosquamis* in order to get more information in the fishing closed area of Iskenderun bay.

Chondrichtyan Fishes

The biomass percentages of cartiloginous species constituted the main discard group within the discard catch (Fig.3). *Carcharhinus plumbeus, Gymnura altavela* and *Mustelus mustelus* are classified as "vulnerable", while Rhinobatos *cemiculus* is "endangered" on the IUCN list (IUCN, 2013). There are some studies on *Carcharhinus plumbeus* in the Turkish Seas. One of these studies was carried out in Boncuk Bay (South-eastern Aegean Sea), which is thought to be a spawning and hatching area for the species (Bilecenoglu, 2008; Akca, 2010). Although the marketing of this specie is banned by law in Turkey (Anonymous, 2012b). *C. plumbeus* is still caught and sold on the markets due to the poor control mechanism. Damalas & Vassilopoulou (2009) pointed out that *Dasyatis pastinaca* and *Mustelus sp*. are mostly marketed in the central Aegean Sea. However, Gurbet *et al.* (2013) mentioned that cartilaginous species were not included in the commercial catch composition in Izmir Bay (Aegean Sea). *Mustelus* species are rarely found, and it is evaluated as an incidental commercial catch in Iskenderun Bay. *Dasyatis* is not considered as a marketable species in the area.

Lessepsian fishes

The structure of the coastal fish community shows variability in the area because of new immigrant species entering from the Red Sea. In addition, the majority of the total catches consisted of these species in the regional fisheries. For example, *N. randalli* was recorded in 2008 (Bilecenoglu & Russell, 2008), and is now considered as a commercial species by fishermen. The biomass of *N. randalli* was found to be 2.42 kg/h in the study. Gucu *et al.* (2010) found that the percentages of Lessepsian fish species decreased in total catch when compared to the 1980s and 2000s, but the number of Lessepsian fish species increased. Gucu *et al.* (1994) reported 20 Lessepsian fish species in the 1980s. Recently, we captured 27 Lessepsian fish species in Iskenderun Bay. Until now, over 50 Lessepsian fish species are known in Turkish Seas (Bilecenoglu *et al.*, 2002; Erguden *et al.*, 2012; Dalyan *et al.,* 2012; Bodilis *et al.*, 2014). In the 1980s, *S. undosquamis* and *E. klunzingeri* formed the highest biomass at the rate of 23 % and 14 % of total catch in the Levantine Sea (Gucu *et al.*, 2010). We obtained practically the same results for these species (*S. undosquamis* 26 % and *E. klunzingeri* 13 % of total fish catch). *Equulites klunzingeri* was a major species within the discard catch. On the continental shelf of the North Eastern Levantine Sea, *E. klunzingeri* was found at the rates of 9.4 %, 2.3 % and 20.9 % of the fish fauna in fall 1983, spring 1984 and fall 1984, respectively (Gucu *et al.*, 2010). Çiçek (2006) mentioned that *E. klunzingeri* was 0.81 kg/h in Tasucu Bay (The west of Iskenderun Bay). The distribution of Pony fish probably decreases towards the west of Iskenderun Bay. In the sampling area, its distribution depends on the depth range (Table 3). In our study, it was observed that *Citharus linguatula* and *Champsodon sp.* replaced *E. klunzingeri* within the discard catch of deeper than 60 m. It was also observed that *Champsodon sp.* and *C. linguatula* constituted 11.26 and 9.13 % of total catch, respectively. In the last five years, three *Champsodon* species were recorded from the Mediterranean Sea (Cicek & Bilecenoglu 2009; Dalyan *et al*., 2012; Gokoglu & Ozvarol, 2013). Our laboratory studies showed that the obtained *Champsodon* species belonged to *C. capensis* and *C. nudivittis*. However, samples were classified as

Champsodon sp. because it was not possible to identify the differences between species on board. In this way, incorrect values were not employed while calculating abundance and biomass values. They were found in increasing rates during sampling.

The minimum landing sizes of the commercial fishes could be consider inappropriate according to legislative regulations of fisheries management in Turkey (Table 1). The reason is that weak control mechanism of trawl fisheries in the studying area. In the last declaration of minimum landing size of commercial fish species, one Lessepsian fish species, namely *U. moluccensis*, was on the list. But almost 60 % of the commercial fish species biomass consisted of Lessepsians in Iskenderun Bay. Biological research on commercial species should increase not only for the conservation of commercial species but also for taking management measures for the fisheries in the area.

Studies on discard catches are important for the management of fisheries activities, especially for multispecies trawl fisheries. Additional comprehensive studies on fisheries and their problems in the area, which is characterised by a dynamic structure due to the entry of new Red Sea originating fish species.

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