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RESEARCH PAPER

The Diet Composition of European Anchovy, *Engraulis encrasicolus* (Linnaeus, 1758) in İzmir Bay, Aegean Sea

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Abstract

In this study, seasonal and size related variations in the diet composition of European anchovy (*Engraulis encrasicolus*) were studied. A total of 545 European anchovy individuals were collected from commercial purse-seine catches in İzmir Bay (Aegean Sea, Turkey) during 2005-2006. Overall, 498 of the stomachs were found with food items and 47 were empty. A total of 19 different prey groups were identified belonging to eight major systematic groups, i.e. Siphonophora, Polychaeta, Crustacea, Mollusca, Echinodermata, Chaetognatha, Appendicularia and Actinopterygii in the stomachs. Crustaceans (especially Copepoda) were the most important preys in terms of IRI% at all seasons and size groups. According to the Bray Curtis similarity index, while there were no significant differences in the diet composition among seasons, only the fishes bigger than 12 cm were seen different from other size groups. This study represents the most detailed information on the organisms in the diet of European anchovy from the Turkish coast of the Aegean Sea.

Introduction

The European anchovy (*Engraulis encrasicolus* L., 1758) is a small pelagic fish species distributed in the Mediterranean Sea (including the Black and the Azov Seas), and also along the eastern Atlantic coast from Norway to the South Africa. This small-sized fish generally forms large schools at the coastal marine areas (Whitehead, Nelson, & Wongratana, 1988). Due to its abundance in pelagic environments, european anchovy is one of the highly commercial target species of the Mediterranean fishery (Lleonart & Maynou, 2003; Palomera, Olivar, Salat, Sabatés, Coll, García, & Morales-Nin, 2007; Giannoulaki, Valavanis, Palialexis, Tsagarakis, Machias, Somarakis, & Papaconstantinou, 2008). European anchovy is the most important small pelagic fish species for the Turkish fisheries and alone comprises almost 65% of the overall marine fish catch (Cihangir & Ünlüoğlu, 2015). The average of total anchovy production in Turkey is 203 501 tonnes during last decade and the contribution of the Aegean Sea is about 5% (TUIK, 2006-2016).

The anchovy is also ecologically important in pelagic ecosystems because of playing a major role either a prey or a consumer in establishing a fundamental link between the lower and upper trophic levels (Bulgakova, 1992; Tudela & Palomera, 1997; Palomera *et al*., 2007). As a prey, anchovy is the main food resource for some highly commercial pelagic and/or demersal fishes such as *Scomber scombrus*, *Thunnus thynnus*, *Thunnus alalunga, Xiphias gladius, Merluccius merluccius* (Karachle and Stergiou, 2017).

Despite its importance in the pelagic ecosystem, most of the studies on trophic ecology of the anchovy in the Mediterranean Sea have been performed in recent years. The diet composition, food consumption rate and feeding periodicity of anchovy have been investigated in the Black Sea (Bulgakova, 1993), in the Catalan Sea (Tudela & Palomera, 1995; 1997), in the Gulf of Lions (Plounevez & Champalbert, 2000; Costalago, Palomera & Tirelli, 2014) in the Adriatic Sea (Borme, Tirelli, Brandt, Fonda Umani & Arneri, 2009), on the Algerian coast (Bacha & Amara, 2009), in the North-western Mediterranean (Morote, Olivar, Villate & Uriarte, 2010), in the North and Baltic Seas (Raab, Nagelkerke, Boerée, Rijnsdorp, Temming, & Dickey-Collas, 2011; Schaber, Petereit & Paulsen, 2010), in the North Aegean Sea (Karachle & Stergiou, 2014) and in waters of Mauritania (Gushchin & Corten, 2015). However, data on food and feeding of the anchovy are scarce in Turkish Seas. Although season related variations in stomach contents of anchovy have been taken into consideration in two studies conducted in the Aegean Sea, limited information has been provided by these studies since the food organisms have been identified to the general taxonomic level such as copepods, cladocerans, molluscs, fish etc (Uçkun, Sever, & Toğulga, 2003; Ünlüoğlu & Benli, 2004).

The aim of this study is to present a more comprehensive diet description for the anchovy in İzmir Bay (the eastern Aegean Sea). Unlike two previous studies had been done in the region, specially copepods and cladocerans were identified as much as possible at species level in this study. The other objective is to evaluate the season and size related variations in the stomach contents.

Materials and Methods

The fish samples were collected by montly from commercial catches during between January and December 2005 in the İzmir Bay (Figure 1). Specimens were preserved in buffered 10% formalin solution and taken to the laboratory for subsequent analysis. The fork length (FL) of each specimen was measured to the nearest mm and after dissection the stomach of each fish was removed and stored in 10% formalin solution until identification. Later the stomachs were cut longitudinally and the contents of each stomach were transferred to a petri dish and identified to the lowest possible taxonomic level under a binocular microscope. All food items were enumerated and weighed wet with a precision of ±0.0001 g after the removal of excess fluid. Food remains, which were not recognizable due to an advanced stage of digestion, were recorded as unidentified.

In order to provide a quantitative description of stomach contents and also to evaluate the relative importance of various prey types in the diet, three common measures, percentage frequency of occurrence (F%), percentage composition by number (N%), and percentage composition by weight (W%) were used (Hyslop, 1980). The index of relative importance (IRI) was also calculated for each prey item by incorporating of these percentage measures (Pinkas, Oliphant & Iverson, 1971). IRI values were expressed as

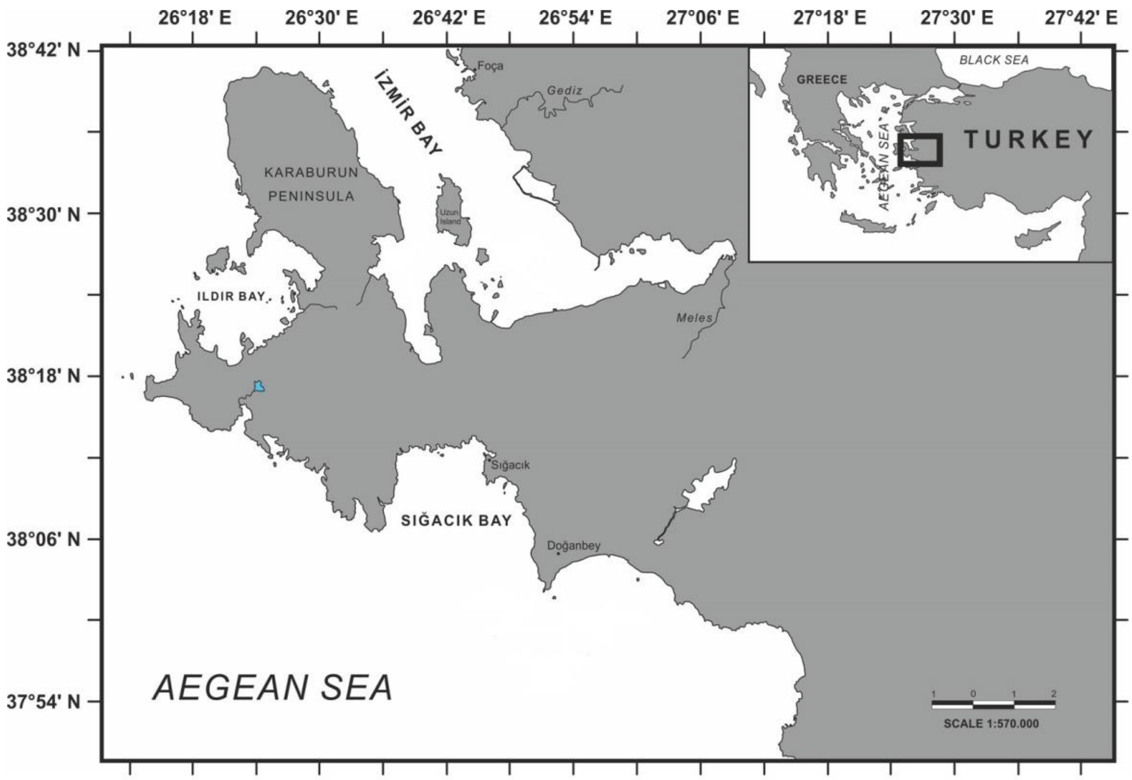


Figure 1. The study area.

a percent basis to obtain a robust estimate of relative importance of each prey in the diet of studied fish and, to promote consistency and facilitate comparison among studies (Cortés, 1998).

To assess for possible changes in diet with respect to size of the anchovy, the sampled fish were grouped arbitrarily into 4 fork length classes, which were arranged as < 8.0 cm and 8.0-9.9 cm, 10.0-11.9 cm and ≥12.0 cm.

Subsequently, food items were grouped into categories of preference using the method proposed by Morato-Gomes (1995). The categories were defined as follows:

IRI≥30 × (0.15 × ΣF%)	main important prey (MIP)
30 × (0.15 × ΣF%)>IRI>10 × (0.05 × ΣF%)	secondary prey (SP)
IRI≤10 × (0.05 × ΣF%)	occasional prey (OP)

Bray-Curtis similarity index on the basis of the percentage number of the food items (N%) were analysed by seasons and size groups (Washington, 1984).

Results

A total of 545 anchovy specimens between 6.0 and 14.4 cm FL were sampled in the study and most of the samples were in 8.0-11.0 cm size group (82.5%) (Figure 2). 47 of the stomachs were empty (8.62%) and the numbers of the empty stomachs varied by seasons as 24 in winter (12.01%), 9 in spring (8.18%), 1 in summer (27.77%) and 13 in autumn (11.81%), respectively. The diet of European anchovy consisted of a wide variety of zooplanktonic organisms and comprised mainly copepods and cladoceras. Organisms found in the stomachs of anchovy were grouped in the 19 different prey category: siphonophora, polychaeta, crustacea, ostracoda, cladocera, copepoda, isopoda, euphausiacea larvae, amphipoda, mysidacea, chaetognatha, appendicularia, decapod crustacean eggs and larvae, brachyura larvae, cirripedia, gastropoda, bivalvia, echinodermata, fish larvae and eggs (Table 1).

Copepods (82.86%IRI) were the main prey group in the diet and almost 49 copepod species were identified. The major copepods were respectively: *Onceae media* (20.56%IRI), *Euterpina acutifrons* (7.03%IRI), *Corycaeus brehmi* (3.56%IRI), *Acartia clausi* (2.18%IRI), *Corycella rostrata* (1.50%IRI). Copepods followed by Bivalvia larvae (29.52% F; 8.78%IRI). Other prey groups such as appendicularia, polychaeta, amphipoda, gastropoda, echinodermata etc. contributed to diet relatively low percentages. Pelagic copepods dominated the diet of anchovy in all seasons, but their percentage contributions showed variations by the seasons. While *Oncaea media* (31.68%IRI), *Euterpina acutifrons* (6.75%IRI) and *Acartia clausi* (3.11%IRI) were predominant in winter, *Corycella rostrata* (3.79%IRI), *O. media* (2.65%IRI), *Oncea mediterranea* (2.50%IRI) and *E. acutifrons* (0.57%IRI) were in spring, *E. acutifrons* (9.16%IRI), *A. clausi* (1.16%IRI), *O. media* (1.26%IRI), *C. rostrata (1.11%IRI), Microsetella norvegica* (0.90%IRI) and *Temora stylifera* (1.18%IRI) were in summer, *E. acutifrons* (12.41%IRI), *O. media* (10.10%IRI), *T. stylifera* (3.07%IRI) and *Centropages typicus* (1.63%IRI).were in autumn (Table 1). The secondary preys in the diet of anchovy were also changed by seasons: bivalvia (12.35%IRI) in winter, decapod crustacean eggs (4.31%IRI), brachyura larvae (2.85%IRI) and cladoceras (2.31%IRI) in spring, unidentified appendicularia (27.25%IRI) in summer, a cladocera species *Penilia avirostris* (12.64%IRI) in autumn (Table 1).

Copepods were constituted the majority of the diet of anchovy in all size-classes (Table 2). Anchovy specimens smaller than 8 cm mostly preyed upon calanoid and cyclopoid copepods and mainly *Oncea media* at species level. In the diet of < 8.0 cm size class, the contribution of the other prey organisms was comparatively lower and of less importance than other

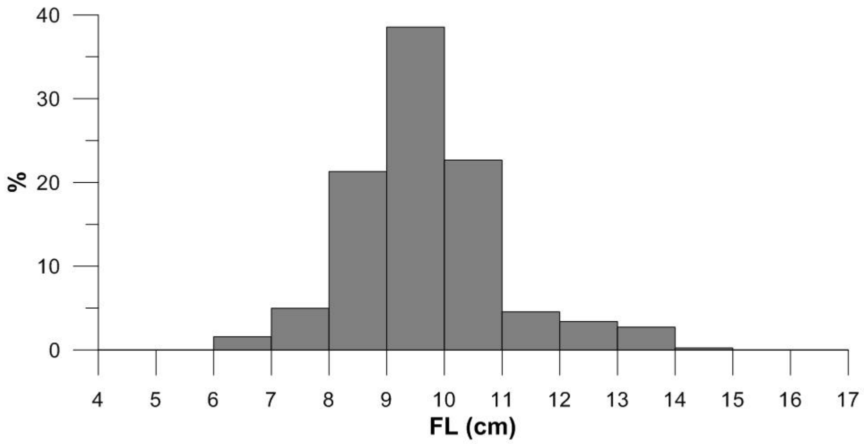


Figure 2. Size distribution of *E. encrasicolus* in the study

Table 1. Overall and seasonal diet composition of *Engraulis encrasicolus* in İzmir Bay

	Overall (N=498)				Winter (N=265)				Spring (N=101)				Summer (N=35)				Autumn (N=97)			
Prey Item	**F%**	**N%**	**W%**	**IRI%**	**F%**	**N%**	**W%**	**IRI%**	**F%**	**N%**	**W%**	**IRI%**	**F%**	**N%**	**W%**	**IRI%**	**F%**	**N%**	**W%**	**IRI%**
Siphonophora	1.81	0.11	1.08	0.05	0.75	0.02	1.71	0.02	6.93	0.55	0.42	0.16								
Polychaeta	1.41	0.07	0.52	0.02	2.26	0.09	0.84	0.04									1.03	0.12	0.1	0.01
Crustacea																				
Ostracoda	0.8	0.04	0.74	0.01					1.98	0.06	2.52	0.12	2.86	0.07	2.99	0.10	1.03	0.21	0.74	0.02
Cladocera																				
Evadne nordmanni	0.80	0.03	1.89	0.03					3.96	0.16	11.73	1.08								
E. spinifera	1.20	0.03	0.54	0.01					4.95	0.16	3.26	0.39	2.86	0.07	0.28	0.01				
E. tergestina	3.01	0.37	0.14	0.03					7.92	1.1	0.43	0.28	20.00	2.33	0.96	0.78				
Podon intermedius	2.01	0.08	1.02	0.05	1.51	0.06	0.45	0.01	2.97	0.13	0.59	0.05	48.57	2.40	0.21	1.51	3.09	0.12	3.78	0.24
P. polyphemoides	0.40	0.01	0.02	0.01									34.29	1.62	0.15	0.72	2.06	0.08	0.14	0.01
Penilia avirostris	12.25	1.64	1.69	0.87	5.66	0.33	0.65	0.1					25.71	1.76	0.44	0.67	38.14	9.66	7.32	12.64
Unidentified cladocera	5.62	0.69	0.59	0.10	1.13	0.05	0.64	0.01	6.93	0.91	0.61	0.24					7.22	1.41	0.49	0.27
Copepoda																				
Calanoida																				
Calanus helgolandicus	0.20	0.02	0.34	0.01													1.03	0.12	1.97	0.04
Nannocalanus minor	0.20	0.01	0.23	0.01	0.38	0.02	0.39	0.01												
Neocalanus tenuicornis	0.20	0.01	0.05	0.01	0.38	0.01	0.08	0.01												
Calanus sp.	0.40	0.01	0.60	0.02	0.38	0.01	0.94	0.01									1.03	0.04	0.22	0.01
Mecynocera clausi	0.60	0.02	2.36	0.03	1.13	0.04	3.34	0.07												
Paracalanus nanus	2.01	0.08	1.37	0.06	2.26	0.1	1.69	0.08					5.71	0.14	2.65	0.19	2.06	0.08	1.04	0.05
P. parvus	7.03	1.24	0.64	0.28	10.19	1.74	0.64	0.44	2.97	0.1	0.03	0.01					5.15	1.12	1.48	0.26
P. pygmaeus	0.60	0.02	0.12	0.01	1.13	0.03	0.2	0.01												
Calocalanus contractus	0.60	0.02	0.60	0.02	0.75	0.02	0.98	0.01									1.03	0.04	0.08	0.01
C.pavo	2.61	0.08	0.70	0.04	3.77	0.11	1.06	0.08	1.98	0.06	0.26	0.01	2.86	0.07	0.38	0.02				
C. styliremis	3.82	0.23	0.88	0.09	7.17	0.37	1.48	0.24												
Calocalanus sp.	3.41	0.20	0.48	0.05	6.04	0.32	0.74	0.12									1.03	0.04	0.22	0.01
Ischnocalanus plumulosus	1.00	0.03	0.64	0.02	1.89	0.05	1.07	0.04												
Clausocalanus arcuicornis	3.01	0.17	0.44	0.04	4.15	0.24	0.58	0.06	2.97	0.13	0.31	0.03					1.03	0.04	0.26	0.01
C. furcatus	2.01	0.20	0.97	0.05	3.02	0.16	1.16	0.07									2.06	0.75	1.61	0.09
Clausocalanus sp.	2.81	0.44	0.86	0.08	3.02	0.49	0.41	0.05					2.86	0.07	0.96	0.04	5.15	0.95	3.11	0.41
Ctenocalanus vanus	1.00	0.04	1.42	0.03	1.89	0.07	2.38	0.09												
Euaetideus giesbrechti	0.20	0.01	0.10	0.01	0.38	0.01	0.17	0.01												
Diaixis pygmoea	1.41	0.10	0.45	0.02	2.64	0.15	0.75	0.04												
Temora stylifera	15.86	1.36	1.34	0.92	14.34	0.92	1.19	0.55	5.94	0.36	0.19	0.08	42.86	1.91	0.41	1.18	20.62	4.36	3.26	3.07
Centropages kröyeri	1.20	0.03	0.30	0.01									8.57	0.21	2.20	0.25	3.09	0.12	0.87	0.06

Turk. J. Fish.& Aquat. Sci. 19(5), 431-445

Table 1 (continued)

C. typicus	9.84	0.59	1.34	0.36	5.66	0.16	0.92	0.11	14.85	0.97	0.85	0.62	5.71	0.21	0.29	0.03	17.53	2.24	2.53	1.63
C. violaceus	0.20	0.01	0.05	0.01	0.38	0.01	0.09	0.01												
Isias clavipes	2.01	0.07	0.54	0.03	3.4	0.09	0.76	0.05	0.99	0.06	0.5	0.01								
Lucicutia flavicornis	0.40	0.01	0.02	0.01					0.99	0.03	0.06	0.01	2.86	0.07	0.15	0.01				
Candacia armata	0.20	0.01	0.01	0.01					0.99	0.03	0.05	0.01								
C. bispinosa	0.20	0.01	0.26	0.01													1.03	0.04	1.49	0.03
C. simplex	0.20	0.01	0.13	0.01													1.03	0.04	0.72	0.02
Candacia spp.	0.80	0.02	1.61	0.03	1.51	0.04	2.7	0.08												
Labidocera wollastoni	0.60	0.02	0.67	0.02					0.99	0.03	2.82	0.06	2.86	0.07	0.43	0.02	1.03	0.04	1.09	0.02
Acartia clausi	23.09	2.84	1.68	2.18	32.45	3.46	1.73	3.11	15.84	1.27	2.45	1.36	17.14	4.80	0.89	1.16	7.22	0.87	0.52	0.2
A. latisetosa	0.40	0.27	0.04	0.01									2.86	1.69	0.30	0.07	1.03	1	0.12	0.02
Unidentified Calanoida	66.47	12.92	2.68	21.86	61.51	8.39	2.45	12.31	69.31	16.07	3.82	31.74	91.43	23.01	1.25	26.31	68.04	23.57	2.43	34.51
Cyclopoida																				
Oithona plumifera	2.81	0.14	1.48	0.10	2.64	0.07	2.09	0.11	0.99	0.03	0.21	0.01	2.86	0.07	0.48	0.02	5.15	0.62	1.22	0.19
O. nana	10.84	0.72	1.07	0.41	12.45	0.59	1.48	0.48	3.96	0.23	0.02	0.02	20.00	1.69	0.31	0.48	10.31	1.33	1.09	0.49
Oncaea media	54.02	16.21	1.97	20.56	67.55	22.95	2.4	31.68	31.68	3.28	0.36	2.65	37.14	2.75	0.10	1.26	46.39	9.91	1.25	10.10
O. mediterranea	9.84	0.67	1.95	0.55	5.28	0.28	1.95	0.22	22.77	2.11	2.67	2.50	14.29	1.06	0.65	0.29	7.22	0.33	2.12	0.35
O. conifera	0.40	0.01	0.13	0.01					0.99	0.03	0.43	0.01	2.86	0.07	1.01	0.04				
O. venusta	0.60	0.02	0.13	0.01	0.75	0.03	0.16	0.01	0.99	0.03	0.2	0.01								
Oncaea spp.	41.37	15.29	0.87	14.10	37.74	12.8	1.06	9.67	53.47	26.14	0.84	33.20	57.14	13.97	0.36	9.72	32.99	13.52	0.57	9.07
Lubbockia squillimana	0.20	0.01	0.20	0.01	0.38	0.01	0.35	0.01												
Sapphirina sp.	1.00	0.04	0.20	0.01	0.38	0.01	0.12	0.01					5.71	0.21	0.94	0.08	2.06	0.12	0.37	0.02
Corycaeus anglicus	0.20	0.03	0.15	0.01	0.38	0.05	0.27	0.01												
C. brehmi	13.25	1.01	11.87	3.56	13.21	0.7	18.65	4.72									3.09	0.21	3.77	0.24
C. clausi	0.60	0.02	0.37	0.01	0.75	0.02	0.35	0.01	0.99	0.03	1.08	0.03								
C. giesbrechti	1.00	0.04	0.34	0.01	1.89	0.06	0.59	0.02												
C. latus	0.20	0.01	0.25	0.01	0.38	0.01	0.44	0.01												
C. typicus	10.64	0.81	2.81	0.78	16.6	1.17	1.7	0.86	2.97	0.26	7.88	0.56	2.86	0.07	2.60	0.09	5.15	0.29	1.28	0.16
Ditrichocorycaeus brehmi	0.40	0.01	0.01	0.01	10.19	0.77	0.21	0.19	1.98	0.06	0.01	0.01					1.03	0.54	0.07	0.01
Urocorycaeus furcifer	0.40	0.01	0.03	0.01					0.99	0.03	0.09	0.01	2.86	0.07	0.21	0.01				
Corycaeus copepodid	0.20	0.01	0.14	0.001													1.03	0.04	0.84	0.02
Corycaeus spp.	39.36	6.45	1.63	6.82	44.15	7.77	2.23	8.16	39.6	7.53	1.69	8.40	42.86	2.68	0.61	1.67	24.74	1.45	0.16	0.78
Corycella carinata	1.61	0.08	0.77	0.03	2.26	0.1	1.04	0.05	1.98	0.1	1.09	0.05								
C. rostrata	19.88	1.79	1.75	1.50	17.74	0.83	2.36	1.04	25.74	5.42	0.97	3.79	31.43	2.75	0.23	1.11	15.46	0.95	1.25	0.67
Corycella sp.	2.21	0.10	0.28	0.02	4.15	0.15	0.49	0.05												
Unidentified Cyclopoida	0.80	0.02	0.42	0.01	0.75	0.02	0.47	0.01	0.99	0.03	0.47	0.01	2.86	0.07	1.09	0.04				
Harpacticoida																				
Microsetella norvegica	14.26	0.84	0.78	0.50	18.11	0.75	1.19	0.65	7.92	0.75	0.21	0.17	25.71	2.26	0.70	0.90	6.19	0.58	0.09	0.08

Table 1 (continued)																				
M. rosea	0.40	0.03	0.40	0.01	0.75	0.05	0.69	0.01												
Microsetella sp.	2.01	0.07	0.21	0.02	3.4	0.11	0.34	0.03									1.03	0.04	0.08	0.01
Euterpina acutifrons	40.56	6.86	1.26	7.03	44.53	6.78	1.43	6.75	15.84	1.27	0.28	0.57	54.29	12.77	1.45	9.16	50.52	10.88	1.72	12.41
Clytemnestra rostrata	0.40	0.03	0.43	0.01	0.38	0.01	0.45	0.01									1.03	0.04	1.02	0.02
Unidenfied Harpacticoida	6.22	0.68	1.44	0.28	6.42	0.97	1.76	0.32	2.97	0.1	0.05	0.01	2.86	0.07	0.81	0.03	10.31	0.46	2.12	0.52
Monstrilloidae																				
Monstrillopsis sp.	0.20	0.01	0.11	0.01	0.38	0.02	0.18	0.01												
Copepod nauplius	2.61	0.10	1.81	0.11	0.75	0.02	0.21	0.01	2.97	0.13	0.41	0.04	8.57	0.28	1.50	0.18	5.15	0.33	8.97	0.94
Isopoda	1.00	0.06	0.79	0.02	0.38	0.01	0.78	0.01					5.71	0.35	2.55	0.20	2.06	0.21	1	0.05
Euphausiacea larvae	0.80	0.06	0.11	0.01	1.13	0.08	0.15	0.01									1.03	0.04	0.14	0.01
Amphipoda	3.21	0.46	5.94	0.42	2.26	0.34	2.23	0.11	0.99	1.04	24.62	0.59	11.43	0.35	1.28	0.22	5.15	0.33	1.85	0.22
Mysidacea	7.63	0.62	1.71	0.38	1.13	0.23	0.89	0.02	12.87	0.81	2.14	0.87	54.29	3.03	7.67	6.89	3.09	0.75	2.02	0.17
Chaetognatha																				
Sagitta spp.	2.21	0.10	0.77	0.04	2.64	0.11	0.82	0.05	1.98	0.06	0.81	0.04					2.06	0.17	1.02	0.05
Appendicularia																				
Oikopleura dioica	0.40	0.01	0.20	0.01	0.75	0.02	0.34	0.01												
Unidentified Appendicularia	8.23	1.42	4.11	0.97	3.02	0.45	0.64	0.06	7.92	1.14	2.1	0.59	45.71	8.20	42.05	27.25	9.28	2.24	3.54	1.05
Decapod Crustacean Eggs	3.82	4.09	1.45	0.45	0.75	0.04	0.01	0.01	5.94	22.73	8.82	4.31	8.57	0.64	0.36	0.10	8.25	0.79	0.22	0.16
Decapod Crustacean Larvae	14.86	0.68	3.10	1.20	9.43	0.36	2.15	0.44	14.85	0.58	1.96	0.87	31.43	1.56	6.20	2.89	23.71	1.74	6.72	3.91
Upogebia sp.	0.40	0.03	0.69	0.01	0.38	0.01	1.18	0.01					11.43	0.49	5.12	0.76	1.03	0.17	0.03	0.01
Brachyura larvae	16.47	2.49	3.17	1.99	14.34	3.15	2.92	1.60	15.84	1.56	6.25	2.85	34.29	1.20	3.00	1.71	16.49	1.41	1.8	1.03
Cirripedia																				
Cirriped nauplius	15.66	1.30	2.67	1.33	21.13	1.78	3.94	2.23	2.97	0.1	0.22	0.03	5.71	0.15	0.14	0.02	17.53	1.37	2.05	1.17
Gastropoda	5.02	0.25	0.67	0.10	4.15	0.23	0.78	0.08	7.92	0.39	0.84	0.23	17.14	0.57	1.30	0.37				
Bivalvia larvae	29.52	12.01	1.91	8.78	31.32	18.48	2.86	12.35	22.77	1.53	0.77	1.2	42.86	1.84	0.63	1.24	26.8	1.87	0.51	1.25
Echinodermata larvae	0.20	0.01	0.40	0.01	0.38	0.01	0.68	0.01												
Fish Larvae	2.41	0.08	4.63	0.23	0.75	0.03	2.62	0.04	2.97	0.13	0.73	0.06	8.57	0.28	1.71	0.20	4.12	0.17	15.27	1.24
Fish Eggs	0.80	0.04	0.27	0.01	0.38	0.01	0.16	0.01	1.98	0.19	0.88	0.05					1.03	0.04	0.25	0.01

Table 2. Diet composition of *Engraulis encrasicolus* according to the size groups

	< 8.0 cm (N= 81)				8.0-9.9 cm (N= 241)				10.0-11.9 (N= 122)				> 12.0 cm (N= 54)			
	F%	**N%**	**W%**	**IRI%**	**F%**	**N%**	**W%**	**IRI%**	**F%**	**N%**	**W%**	**IRI%**	**F%**	**N%**	**W%**	**IRI%**
Siphonophora	1.39	0.05	6.42	0.15	0.43	0.01	1.02	0.01	0.88	0.03	0.08	0.01	13.04	0.69	0.52	0.32
Polychaeta					1.29	0.07	0.65	0.02	3.54	0.22	0.75	0.07				
Crustacea																
Ostracoda					0.43	0.06	0.57	0.01	0.88	0.03	0.08	0.01	2.17	0.04	2.14	0.10
Cladocera																
Evadne nordmanni					0.86	0.02	1.40	0.02	1.77	0.09	5.17	0.20				
E. spinifera					1.72	0.05	0.93	0.03					2.17	0.04	0.20	0.01
E. tergestina	8.33	1.47	0.80	0.32	0.43	0.01	0.01	0.01					2.17	0.04	0.09	0.01
Podon intermedius	1.39	0.05	0.58	0.01	2.59	0.10	1.62	0.09	2.65	0.12	0.44	0.03				
P. polyphemoides									1.77	0.06	0.11	0.01				
Penilia avirostris	15.28	1.24	0.45	0.44	14.22	2.18	2.62	1.32	7.08	1.58	0.92	0.38				
Unidentified cladocera	13.89	2.58	7.50	2.38	2.59	0.11	0.03	0.01					2.17	0.04	0.14	0.01
Copepoda																
Calanoida																
Calanus helgolandicus									0.88	0.09	1.58	0.03				
Nannocalanus minor					0.43	0.02	0.42	0.01								
Neocalanus tenuicornis					0.43	0.01	0.09	0.01								
Calanus sp.					0.43	0.01	1.03	0.01	0.88	0.03	0.18	0.01				
Mecynocera clausi	1.39	0.05	0.31	0.01	0.86	0.03	3.60	0.06								
Paracalanus nanus	4.17	0.28	2.86	0.22	1.29	0.05	0.88	0.02	1.77	0.09	2.34	0.09				
P. parvus	4.17	2.30	0.70	0.21	8.19	1.30	0.49	0.28	11.50	1.77	1.51	0.82				
P. pygmaeus	1.39	0.05	0.47	0.01	0.43	0.01	0.07	0.01	0.88	0.03	0.23	0.01				
Calocalanus contractus					0.86	0.02	1.07	0.02	0.88	0.03	0.06	0.01				
C. pavo	1.39	0.05	0.31	0.01	2.59	0.08	0.28	0.02	4.42	0.19	2.29	0.24				
C. styliremis					7.76	0.46	1.24	0.25	0.88	0.03	0.93	0.02				
Calocalanus sp.	5.56	0.37	0.72	0.10	5.17	0.31	0.71	0.10	0.88	0.03	0.18	0.01				
Ischnocalanus plumulosus					1.72	0.05	1.12	0.04	0.88	0.03	0.12	0.01				
Clausocalanus arcuicornis	2.78	0.18	0.51	0.03	3.45	0.22	0.32	0.04	3.54	0.19	0.77	0.07	2.17	0.09	0.69	0.03
C. furcatus	1.39	0.18	0.37	0.01	2.16	0.11	1.03	0.05	3.54	0.68	1.76	0.19				
Clausocalanus sp.	1.39	0.23	0.39	0.01	3.45	0.59	0.63	0.08	2.65	0.59	1.62	0.13	2.17	0.04	0.69	0.03
Ctenocalanus vanus	1.39	0.05	0.72	0.02	0.86	0.06	0.85	0.02	1.77	0.06	4.14	0.16				
Euaetideus giesbrechti					0.43	0.01	0.18	0.01								
Diaixis pygmoea	1.39	0.37	0.41	0.02	2.59	0.10	0.77	0.04								
Temora stylifera	13.89	1.89	1.26	0.74	12.07	0.88	1.49	0.54	13.27	2.36	1.66	1.15	23.91	1.00	0.47	0.71
Centropages kröyeri					0.43	0.01	0.15	0.01					4.35	0.09	0.73	0.07

Table 2 (continued)																
C. typicus	12.50	0.46	4.53	1.06	6.47	0.31	0.75	0.13	9.73	1.21	1.42	0.55	26.09	1.13	0.85	1.05
C. violaceus					0.43	0.01	0.09	0.01								
Isias clavipes	4.17	0.14	2.96	0.22	2.59	0.09	0.17	0.01	0.88	0.03	1.06	0.02				
Lucicutia flavicornis													2.17	0.04	0.11	0.01
Candacia armata													2.17	0.04	0.08	0.01
C. bispinosa					0.43	0.01	0.48	0.01								
C. simplex					0.43	0.01	0.23	0.01								
Candacia spp.					1.72	0.05	2.95	0.10								
Labidocera wollastoni	1.39	0.05	4.32	0.10	0.43	0.01	0.61	0.01								
Acartia clausi	8.33	4.65	1.03	0.81	34.48	3.09	1.34	2.94	20.35	2.11	3.26	2.36				
A. latisetosa	1.39	1.10	0.29	0.03												
Unidentified Calanoida	68.06	23.43	14.08	43.49	65.09	10.66	2.31	16.22	60.18	10.14	0.71	14.18	67.39	9.44	0.77	14.03
Cyclopoida																
Oithona plumifera	2.78	0.09	0.41	0.02	3.02	0.10	2.31	0.14	1.77	0.34	0.62	0.04	4.35	0.09	0.69	0.07
O. nana	13.89	1.84	4.51	1.50	10.78	0.48	0.56	0.22	10.62	0.68	2.06	0.62				
Oncaea media	68.06	21.21	3.29	28.38	58.19	20.48	2.18	25.45	45.13	16.83	1.25	17.73	45.65	2.69	0.11	2.60
O. mediterranea	4.17	0.46	1.77	0.16	7.33	0.24	2.06	0.32	7.08	0.68	2.56	0.50	34.78	2.21	1.58	2.69
O. conifera													2.17	0.04	0.72	0.03
O. venusta					1.29	0.05	0.24	0.01								
Oncaea spp.	11.11	10.35	0.43	2.04	40.95	10.79	0.55	8.96	55.75	21.67	2.08	28.77	43.48	28.89	0.87	26.42
Lubbockia squillimana					0.43	0.01	0.38	0.01								
Sapphirina sp.					0.43	0.01	0.13	0.01					4.35	0.13	0.67	0.07
Corycaeus anglicus					0.43	0.06	0.29	0.00								
C. brehmi					11.64	0.66	20.21	4.68	9.73	0.74	3.35	0.87				
C. clausi					0.86	0.02	0.39	0.01					2.17	0.04	1.81	0.08
C. giesbrechti					2.16	0.08	0.64	0.03								
C. latus	1.39	0.05	3.66	0.09												
C. typicus	2.78	0.32	0.74	0.05	14.22	1.13	1.24	0.64	12.39	0.90	1.58	0.67	6.52	0.35	14.89	2.05
Ditrichocorycaeus brehmi	4.17	0.78	0.78	0.11	6.90	0.65	0.11	0.10	8.85	0.77	0.11	0.17	2.17	0.04	0.02	0.01
Urocorycaeus furcifer													2.17	0.04	0.15	0.01
Corycaeus copepodid									0.88	0.03	0.68	0.01				
Corycaeus spp.	16.67	2.49	4.05	1.85	42.24	7.25	1.30	6.96	40.71	7.41	1.89	8.25	54.35	8.36	2.28	11.81
Corycella carinata					1.29	0.07	0.67	0.02	4.42	0.25	1.97	0.21				
C. rostrata	4.17	0.46	4.88	0.38	15.95	0.61	1.48	0.63	23.01	1.74	2.56	2.15	47.83	7.02	0.69	7.52
Corycella sp.					4.74	0.19	0.54	0.07								
Unidentified Cyclopoida	1.39	0.05	1.05	0.03	0.86	0.02	0.51	0.01								
Harpacticoida																
Microsetella norvegica	8.33	0.37	1.89	0.32	13.79	0.59	0.52	0.30	11.50	0.77	1.32	0.52	23.91	1.47	0.54	0.98

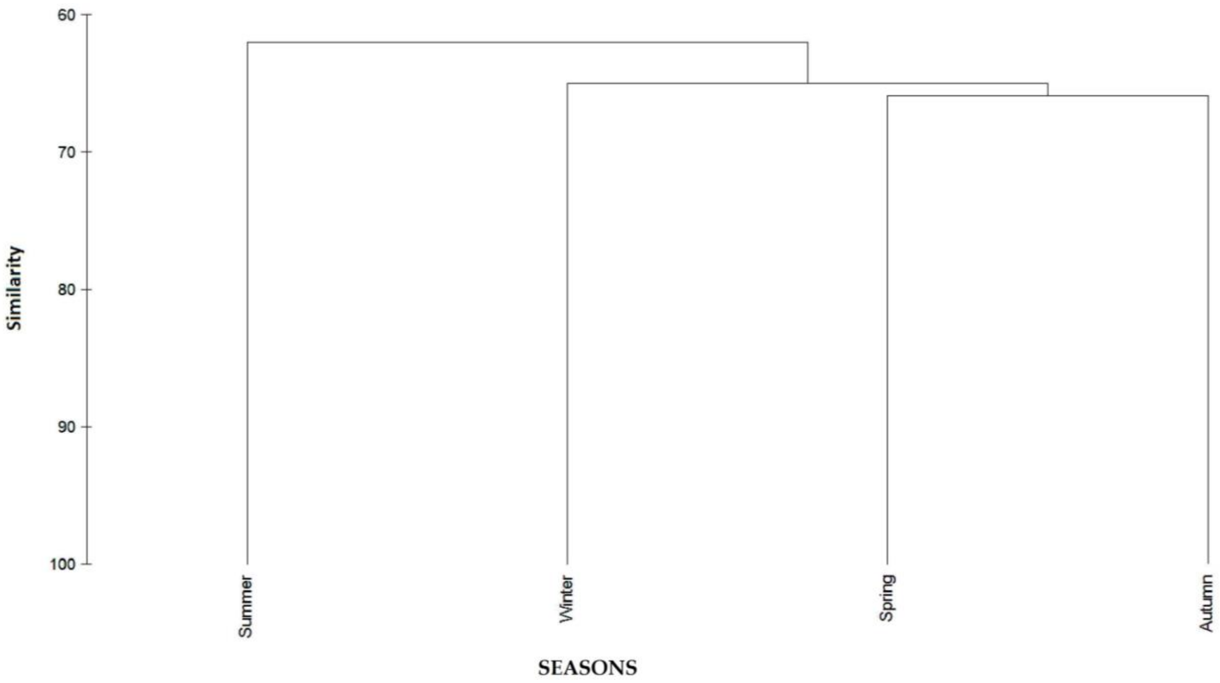
Turk. J. Fish.& Aquat. Sci. 19(5), 431-445

Table 2 (continued)																
Microsetella rosea					0.86	0.06	0.75	0.01								
Microsetella sp.	2.78	0.14	0.41	0.03	3.02	0.10	0.32	0.02	0.88	0.03	0.07	0.01				
Euterpina acutifrons	41.67	11.55	1.83	9.49	45.26	7.23	1.22	7.37	38.05	4.74	1.45	5.12	10.87	0.35	0.83	0.26
Clytemnestra rostrata					0.86	0.02	0.82	0.01								
Unidenfied Harpacticoida	5.56	0.23	4.57	0.45	6.47	1.08	1.88	0.36	8.85	0.59	0.06	0.13	2.17	0.04	0.58	0.03
Monstrilloidae																
Monstrillopsis sp.					0.43	0.02	0.20	0.01								
Copepod nauplius	4.17	0.18	0.26	0.03	0.86	0.03	2.45	0.04	4.42	0.22	1.79	0.19				
Isopoda									0.88	0.03	2.13	0.04	4.35	0.22	1.82	0.18
Euphausiacea larvae	2.78	0.37	0.78	0.05	0.43	0.01	0.06	0.01	0.88	0.03	0.11	0.01				
Amphipoda					3.02	0.41	2.43	0.17	4.42	1.27	19.74	2.02				
Mysidacea									2.65	0.77	2.45	0.19	34.78	1.86	7.24	6.46
Chaetognatha																
Sagitta spp.	2.78	0.23	0.41	0.03	3.02	0.09	0.88	0.06	1.77	0.15	1.31	0.06				
Appendicularia																
Oikopleura dioica					0.86	0.02	0.37	0.01								
Unidentified Appendicularia	1.39	0.28	0.25	0.01	3.45	0.61	1.43	0.15	14.16	2.47	2.47	1.51				
Decapod Crustacean Eggs	4.17	0.41	0.35	0.05					7.08	0.76	0.22	0.15	10.87	29.88	14.43	9.84
Decapod Crustacean Larvae	11.11	0.37	3.91	0.81	15.09	0.62	2.83	1.00	7.96	0.50	2.09	0.45	23.91	0.91	5.04	2.90
Upogebia sp.					0.43	0.01	1.28	0.01	0.88	0.12	0.03	0.01				
Brachyura larvae	6.94	0.51	0.73	0.14	17.67	3.56	2.32	2.00	11.50	2.23	5.08	1.83	23.91	1.43	6.64	3.94
Cirripedia																
Cirriped nauplius	13.89	0.83	2.31	0.78	24.14	2.11	3.73	2.71	8.85	0.87	2.50	0.65				
Gastropoda	1.39	0.14	0.58	0.02	4.31	0.25	0.63	0.07	2.65	0.12	0.58	0.04	10.87	0.35	0.93	0.28
Bivalvia larvae	26.39	5.02	0.99	2.70	35.34	19.07	2.63	14.80	23.89	10.35	1.73	6.26	8.70	0.35	0.40	0.13
Echinodermata larvae					0.43	0.01	0.75	0.01								
Fish Larvae	1.39	0.05	3.17	0.08	0.43	0.01	2.34	0.02	2.65	0.12	0.79	0.05	8.70	0.22	27.66	4.95
Fish Eggs					0.43	0.01	0.17	0.01					6.52	0.30	1.93	0.30

Table 3. Morato Index food preference of *Engraulis encrasicolus* in İzmir Bay

	Season				**Size Group (FL)**			
	Winter	**Spring**	**Summer**	**Autumn**	**< 8.0cm**	**8.0-9.9 cm**	**10-11.9 cm**	**12.0 cm ≥**
(MIP)	IRI ≥ 927.18	IRI ≥ 877.72	IRI ≥ 1864.30	IRI ≥ 1066.99	IRI ≥ 893.74	IRI ≥ 998.91	IRI ≥ 911.92	IRI ≥ 1134.76
	Copepoda	Copepoda	Copepoda	Copepoda	Copepoda	Copepoda	Copepoda	Copepoda
			Appendicularia					
(SP)	IRI > 103.02	IRI > 97.52	IRI > 207.14	IRI > 118.55	IRI > 99.30	IRI > 110.99	IRI > 101.32	IRI > 126.08
	Bivalvia	Cladocera	Mysidacea	Cladocera	Cladocera	Bivalvia	Bivalvia	Decapoda eggs
	Cirripedia nauplius	Decapoda eggs	Cladocera	Decapoda larvae	Bivalvia	Cirripedia nauplius		Mysidacea
		Brachyura larvae	Decapoda larvae			Cladocera		Fish larvae
								Brachyura larvae
								Decapoda larvae
(OP)	IRI ≤ 103.02	IRI ≤ 97.52	IRI ≤ 207.14	IRI ≤ 118.55	IRI ≤ 99.30	IRI ≤ 110.99	IRI ≤ 101.32	IRI ≤ 126.08
	Brachyura larvae	Bivalvia	Brachyura larvae	Fish larvae	Decapoda larvae	Brachyura larvae	Cladocera	Fish eggs
	Decapoda larvae	Mysidacea	Bivalvia	Bivalvia	Cirripedia nauplius	Decapoda larvae	Amphipoda	Gastropoda
	Cladocera	Decapoda larvae	Stomatopoda	Cirripedia nauplius	Brachyura larvae	Amphipoda	Brachyura larvae	Isopoda
	Other groups	Amphipoda	Gastropoda	Appendicularia	Other groups	Other groups	Appendicularia	Ostracoda
		Other groups	Other groups	Other groups			Other groups	Other groups

* (MIP = (MIP = Main Important Prey, SP = Secondary Prey, OP = Occasional Prey)



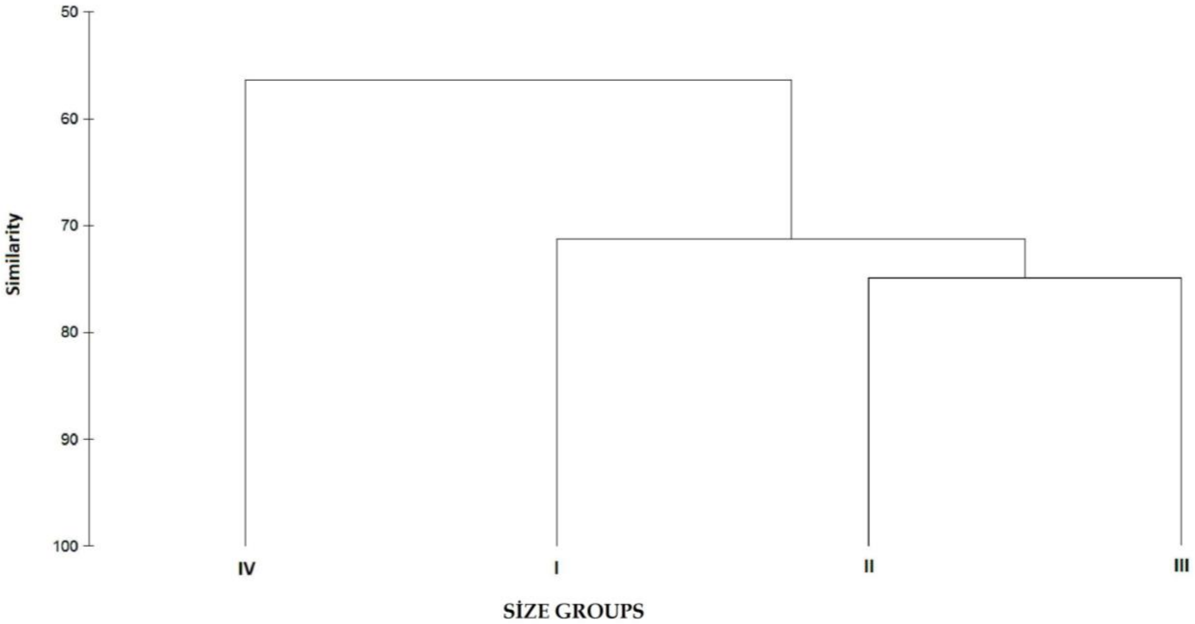


Figure 3. Dendogram showing seasonal and size group similarities of stomach contents for *E. encrasicolus* based on the Bray–Curtis index.

size-classes of anchovy. Bivalvia followed the copepods in 8.0-9.9 cm and 10.0-11.9 cm size classes with 14.80%IRI and 6.26%IRI, respectively (Table 2). However, the importance of the mysidacea, decapoda crustacean eggs and larvae, fish and brachyura larvae were increased in the diets of anchovy specimens bigger than 12 cm (Table 2).

As a result of Morato index values Copepoda were found to be the main important prey group (MIP) in the diet for all seasons and size groups. However, Appendicularia was evaluated in the samecategory with copepods for summer. Secondary prey groups (SP) were bivalvia, cladocera, decapoda larvae and eggs, brachyura larvae, mysidacea, cirripedia and fish larvae, and it has been found that the importance of their abundance changed by seasons and size groups. In addition, the occurence of the specimens of the groups Amphipoda, Isopoda, Stomatopoda, Gastropoda were rare and evaluated as occasional prey groups (OP) (Table 3).

According to the Bray-Curtis similarity index values, the seasonal diets of anchovy were similar to each other approximately 60-66% (Figure 3). While the spring and autumn diets grouped together because of

Table 4. Important prey items of *Engraulis encrasicolus* from different localities

Study area	LR (cm)	LT	Main Prey Items	Method	References
NW Black Sea	7.7-13.0 6.2-12.5 8.7-13.0 7.1-12.8		Phytoplankton, Cladocera, Copepoda Copepoda Mysidacea, fish larvae Fish larvae, Copepoda	N, W, VC	Bulgakova (1993)
Catalan Sea	NA		Copepoda, Mollusca	RA	Tudela & Palomera (1995, 1997)
Gulf of Lions	NA	TL	Copepoda, Cladocera, Crustacea, Appendicularia, Mollusca	F, W, VC, IP	Plouvenez & Champalbert (2000)
İzmir Bay (Aegean Sea)	6.9-14.0	FL	Copepoda	N, W, F, IRI	Uçkun et al. (2003)
İzmir Bay (Aegean Sea)	7.2-16.3	FL	Copepoda	N, F	Ünlüoğlu & Benli (2004)
N. Adriatic Sea	3.0-9.0	TL	Copepoda, Bivalvia larvae, Amphipoda Bacillariophyceae	N, W, F, IRI	Borme et al. (2009)
Algerian Coasts	NA	TL	Copepoda	N, F	Bacha & Amara (2009)
Western Baltic Sea	12.0-16.0	TL	Diatoms, Cumacea, Copepoda, Cirripedia larvae, Amphipoda	N, F, V	Schaber et al. (2010)
North and Baltic Sea	8.0-19.0 < 12.0 12.0-14.0 15.0-16.0 17.0-19.0	TL	Malacostraca, Copepoda Copepoda Copepoda Copepoda Malacostraca	F, W	Raab et al. (2011)
Gulf of Lions	4.0-10.2	SL	Copepoda, Cladocera, Appendicularia	N, W, F	Costalago et al. (2014)
N. Aegean Sea	6.7-16.2	TL	Brachyura, Euphasiacea	N, W, VC	Karachle & Stergiou (2014)
Waters of Mauritania	7.4-11.0	TL	Copepoda, Phytoplankton	F, W	Gushchin & Corten (2015)
İzmir Bay (Aegean Sea)	< 8.0 8.0-9.9 10-11.9 ≥12.0	FL	Copepoda, Cladocera, Bivalvia Copepoda, Bivalvia, Cirriped nauplius Copepoda, Bivalvia Copepoda, Decapod eggs and larvae, Mysidacea	N, W, F, IRI	This study (2017)

* (LR: Length Range; LT: Length Type; NA: Not Available: F: Frequency of Occurence, N: Numerical Percentage, W: Percentage of Weight; VC: Vacuity Coefficient; RA: Relative Abundance; IP: Index of Prepondance; IRI: Index of Relative Importance)

the highest Bray-Curtis Index values (65.89%), the lowest similarity value was found in summer (62.01%). The similarity index values based on size classes were found higher than the similarities on the basis of seasons. Bray-Curtis index values varied between 56.38% and 74.86% according to size classes. While size classes II and III formed a group, the size class IV showed lowest similarity between other size classes (Figure 3).

Discussion

In this study, the diet of the European anchovy in Izmir Bay (the eastern Aegean Sea) were examined owing to the seasons and the size groups. Anchovy entirely fed on zooplankton and mainly pelagic copepods. These findings (Table 4) are in line with many other studies conducted in the Mediterranean (Tudela & Palomera, 1995; 1997; Plounevez & Champalbert, 2000; Uçkun *et al*., 2003; Bacha & Amara, 2009; Raab *et al*. 2011; Costalago *et al*., 2014). However, Bulgakova (1993) in Black Sea, Borme *et al*. (2009) in the northern Adriatic Sea, Schaber *et al*. (2010) in the Baltic Sea, Gushchin and Corten, (2015) in the waters of Mauritania were also determined phytoplankton together with the zooplankton in the anchovy's diet. Bulgakova (1993) and Schaber *et al*. (2010) interpreted that copepods were observed in very low abundances in their plankton samplings in the studied regions. Unlike present and other studies in the Mediterranean Sea, Karachle and Stergiou (2014) found brachyura and euphausiaceae larvae as the most important prey groups for *E. encrasicolus* in the North Aegean Sea because they evaluated only the wet weight of stomach contents.

By considering the results of the Morato index values of this study, the European anchovy is a zooplanktivorous species. Similarly, Bulgakova (1993) found that the species is omnivorous and it is tended to prefer zooplankton (mainlycopepoda and cladocera).

Stergiou & Karpouzi (2002), e also reported the species is omnivorous with the preference of zooplankton.

In our study, pelagic copepods (especially small-sized *E. acutifrons* and *O. media*) were the predominant prey group in the diet of anchovy. However, the frequency of occurrence (F%) and IRI% of the bigger prey groups than copepods (such as mysids, decapods, fish and brachyuran larvae) increased with the fish growth (in the stomachs of bigger fishes than 12.0 cm). On the contrary, F% of small sized copepods (*E. acutifrons, O. media*) decreased with the fish growth. Bulgakova (1993) in the Black Sea, Plounevez and Champalbert (2000) in the Lion Bay, observed that the size of the prey increased in accordance with the size of the anchovy and similarly percentage weight and F% values of the small sized prey groups were decreased.

Borme *et al*. (2009) stated that although small-sized copepod species constituted an important part of the food of both juvenile and adult anchovies, there was no relationship between the size of the fish and the size of the prey items in the northern Adriatic Sea.

The *Oncaea* species were very common in all seasons in present study. It has also been emphasized in previous studies that *Oncaea* species have a crucial role in the feeding of anchovy (Tudela & Palomera, 1997; Bacha & Amara, 2009; Borme *et al*., 2009).

Increasing in the size of the prey organisms with the fish growth indicated that the anchovy feeds in two different ways. Small sized anchovy individuals filter small sized prey groups (like copepods *O. media, E. acutifrons*), cladocera, bivalvia, cirripedia larvae, appendicularia) whereas large sized individuals both filter and feed by biting the large sized prey groups (like copepods *C. armata, C. typicus*, *T. stylifera* and fish larvae, decapoda larvae, mysidacea). Plounevez and Champalbert (2000), in their study in the Lion Bay, stated that the presence of large sized prey groups such as *C. armata* in the stomach of the anchovies with a size larger than 13 cm was as a result of predation. This result supportsto our findings.

According to Bulgakova (1996), the size of the food is a criterion for the feeding of the species, and the anchovy shifts from feeding by filtering to feeding by biting with the abundance of prey organisms in the environment. Costalago *et al*. (2014) have reported that juvenile anchovies (40-110 mm) prefer to feed by biting rather than feeding by filtering. This result contradicts with the results that we have determined. It was indicated in the present study that the individuals bigger than 12 cm tend to prefer the bigger preys.

In the present study the importance of Appendicularia in the european anchovy diet could not be ignored (Table 1). Similarly, Costalago *et al*. (2014) observed the prey group in the juvenile anchovies stomachs in terms of number in winter but not other seasons in the Gulf of Lions. The authors explained the condition because of the slightly more energetic food structure and lower swimming capacities of the group compared with copepods. In contrast, Borme *et al*. (2009) indicated that, although appendicularians were found to be very abundant in the environment, they were not chosen by anchovy and never found in the stomachs in the Adriatic Sea. Differences between the studies could be accepted as unfamilar for a species which use filter feeding as one of the feeding mechanism in its life. In addition to that, the importance of the appendicularians were subjected in *Engraulis anchoita* in the Argentine Sea (Capitanio, Pajaro & Graciela; 1997) and the authors especially indicated that all the appendicularias in the stomachs of anchovy were free swimming adult forms which leaved their gelatinous houses. They also informed that the spawning of appendicularians could be triggered by slight turbulances. So we could imagine that the same water movements in İzmir Bay could resulted in the increase of appendicularians in İzmir Bay.

The diet of anchovy consists of wide variety of zooplanktonic organisms. While the copepods were predominant, some organisms such as Amphipoda, Isopoda, Stomatopoda, Gastropoda and Siphonophora were consumed rarely. In zooplankton studies conducted in the different regions of the Aegean Sea reported that copepods were more dominant than other zooplanktonic groups (Moraitou-Apostolopoulou, 1972; Moraitou-Apostolopoulou, 1974; Matsakis *et al*., 1978; Benli, Tarkan & Sever, 2001; Aker 2002; Sever, 2009).

Aker (2002) reported that *C. typicus, O. media, A. clausi, T. stylifera,* and *C. typicus* were predominant in all seasons in the Aegean Sea. According to the season, the most predominant copepod species found in our study were *O. media*, *O. mediterranea*, *C. rostrata, A. clausi, C. typicus*, *T. stylifera, M. norvegica* and *E. acutifrons*. Copepods were similarly predominant in the zooplankton studies conducted in the Izmir Bay (Tubitak, 2011). Otherwise, all prey organisms encountered in the stomachs of the anchovy were reported as characteristic species for the distribution depth ranges of the anchovy (Aker, 2002; Sever, 2009; Scotto di Carlo, Ianora, Fresi, & Hure, 1984; Weikert and Trinkaus, 1990).

Because of the limited plankton studies in İzmir Bay, it is difficult to make a satisfying comparison for copepods between in the diet of anchovy and the environment both quantitatively and qualitatively. Özel and Aker (2004) found that copepods were dominant in zooplankton fauna and also reported that *Paracalanus parvus* and *Cenropages kröyeri* were the most abundant species in autumn season in the İzmir Bay in front of the Çamaltı Saltern. These species were also observed in the diet of the anchovy in the study but not stand out as some other copepods like *Oncea* spp., *Corycaeus* spp. and *Acartia clausi*. The differences could be related because of the Çamaltı Saltern has coastal lagoon characteristics which includes both freshwater and marine zooplankton and the sampling was only conducted in autumn. In the same study the authors found that Penilia avirostris and Evadne tergestina constitued the main species of cladocerans. These results in accordance with the anchovy diet in İzmir Bay, because our results show that P. avirostris was the main cladoceran in the overall diet of anchovy and especially the increase of the stomach number including P. avirostris in autumn very noticable (F%=38.14). Beside that, in the another study Aker and Özel (2006) indicated that copepods were the main zooplanktonic group for all seasons in the area and it is followed by cladocerans and even in some stations they were represented first place except winter. We also observed a winter decrease of the cladocerans in the anchovy diet and this could reinforce the idea that the diet of *E. encrasicolus* in İzmir Bay is depends on the abundance of zooplanktonic groups.

In conclusion, the study confirms that *E. encrasicolus* is a zooplanktivorous species and the main preys consist of copepods in all over the year base and size groups and to a lesser extent other zooplanktonic categories in İzmir Bay. There is also necessity of more compherensive studies including the effects of abiotic factors, day-night differences and meanwhile plankton surveys for understanding completely the feeding behaviour of anchovy and the role of the zooplanktonic groups in the food of the species.

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