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RESEARCH ARTICLE ARAŞTIRMA MAKALESİ

Feeding habits of two skate species, *Raja miraletus* Linnaeus, 1758 and *Dipturus oxyrinchus* (Linnaeus, 1758) (Chondrichthyes, Rajidae), around the Gökçeada Island (Northern Aegean Sea)

Gökçeada (Kuzey Ege Denizi) çevresindeki iki vatoz türünün, *Raja miraletus* Linnaeus, 1758 ve *Dipturus oxyrinchus* (Linnaeus, 1758) (Chondrichthyes, Rajidae) beslenme alışkanlıkları

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Abstract: This study investigated the feeding habits of *Raja miraletus* Linnaeus, 1758 and *Dipturus oxyrinchus* (Linnaeus, 1758). For the purpose of this study, the specimens were obtained monthly from the commercial trawlers operating around the Gökçeada Island in the Northern Aegean Sea between February 2019 and February 2020. A total of 29 (24 female and 5 male) brown rays (*Raja miraletus*) and 36 (20 female and 16 male) longnosed skates (*Dipturus oxyrinchus*) were captured. The total lengths of the *R. miraletus* specimens ranged between 24.0 cm and 53.9 cm, while the *D. oxyrinchus* specimens measured between 17.1 cm and 85.0 cm. Total length-weight relationships of *R. miraletus* and *D. oxyrinchus* specimens, respectively; $W=0.0002TL^{3.92}$ ($R^2=0.97$) and $W=0.0007TL^{3.43}$ ($R^2=0.97$) were calculated. The analysis of the stomach content of the specimens showed that crustacea were the primary and the most important prey group for *R. miraletus* (IRI% = 67.09), followed by teleosts (IRI% = 1.00) and cephalopods (IRI% = 0.45). The *D. oxyrinchus* specimens were determined to primarily feed on crustacea (IRI% = 74.3), followed by teleosts (IRI% = 6.50) and nematoda (IRI% = 0.40).

Keywords: Feeding habits, *Raja miraletus*, *Dipturus oxyrinchus*, Gökçeada Island, Northern Aegean Sea

Öz: Bu çalışmada *Raja miraletus* Linnaeus, 1758 ve *Dipturus oxyrinchus*'un (Linnaeus, 1758) beslenme alışkanlıkları incelenmiştir. Bu çalışmanın amacı doğrultusunda, Şubat 2019-Şubat 2020 tarihleri arasında Kuzey Ege'de Gökçeada ve çevresinde faaliyet gösteren ticari trol teknelerinden aylık olarak numuneler alınmıştır. Toplam 29 (24 dişi ve 5 erkek) kahverengi vatoz (*Raja miraletus*) ve 36 (20 dişi ve 16 erkek) sivriburun vatoz (*Dipturus oxyrinchus*) avlandı. *R. miraletus* örneklerinin total boyları 24,0 cm ile 53,9 cm arasında, *D. oxyrinchus* örneklerinin ise 17,1 cm ile 85,0 cm aralığında ölçülmüştür. *R. miraletus* ve *D. oxyrinchus* örneklerinin toplam boy-ağırlık ilişkileri sırasıyla; $W=0,0002TL^{3,92}$ ($R^2=0,97$) ve $W=0,0007TL^{3,43}$ ($R^2=0,97$) olarak hesaplanmıştır. Örneklerin mide içeriği analizi, kabukluların *R. miraletus* (%IRI = 67.09) için birincil ve en önemli av grubu olduğunu, onları kemikli balıklar (%IRI = 1.00) ve kafadan bacaklılar (%IRI = 0,45) takip ettiğini göstermiştir. *D. oxyrinchus* örneklerinin ise başlıca kabuklularla (%IRI = 74,3), ardından kemikli balıklarla (%IRI = 6,50) ve nematoda (%IRI = 0,40) beslendiği belirlenmiştir.

Anahtar kelimeler: Beslenme alışkanlıkları, *Raja miraletus*, *Dipturus oxyrinchus*, Gökçeada, Kuzey Ege Denizi

INTRODUCTION

The Gökçeada Island is in the Northern Aegean Sea. Because found on a significant streamline, the region where the island is located is rich in nutrients brought by the Meriç River, in addition to the nutritious waters flowing from the Black Sea via the Dardanelles. The Gulf of Saros plays a vital role in the fish population around the island. Besides, the fact that pelagic fish are available on the migration routes increases this importance even more (Karakulak, 2002). Fishing activities in the vicinity of the island are mostly performed with bottom trawls, longlines, and gillnets.

The brown ray, *Raja miraletus* Linnaeus, 1758 has a wide distribution, including the northeast of the Atlantic Ocean and the Mediterranean. It is a benthic species, mostly distributed between 50-150 m depths (Bianchi et al., 1999). The maximum length reported to date is 63.0 cm in males and 59.7 cm in females (McEachran et al., 1989). They show oviparous spawning characteristics and usually spawn in spring and summer. An individual lays an average of 40-72 egg capsules per year. Embryos in the egg capsule are fed only with yolk (Dulvy and Reynolds, 1997). It feeds on all kinds of benthic organisms. Although the status of *R. miraletus* is classified as "Least Concern (LC)" by the International Union for Conservation of Nature (IUCN), it is caught as bycatch (IUCN, 2021).

The longnosed skate, *Dipturus oxyrinchus* (Linnaeus, 1758) has a wide distribution including the Eastern Atlantic,

Faroe Islands, Canary Islands and the Mediterranean. It has been reported that *D. oxyrinchus*, a bathy-demersal species, ranges between 70-1230 m depths (Last et al., 2016). This species, which shows oviparous reproduction, reproduces in spring and summer (Stehmann and Bürkel, 1984). They lay their egg capsules on sandy or muddy ground. Embryos in the egg capsule are fed only with yolk (Dulvy and Reynolds, 1997). While the main food of *D. oxyrinchus* is cephalopods and crustaceans, they also feed on all kinds of benthic organisms (Stehmann and Bürkel, 1984; Yığın and İşmen, 2010a). Although the status of *D. oxrinchus* is "Near Threatened (NT)" by the International Union for Conservation of Nature (IUCN), this species is still caught as bycatch by fishermen (IUCN, 2021).

The fact that the majority of skate species typically exhibit low fecundity, slow growth, and late maturity suggests that these species are exclusively susceptible to overfishing and over-exploitation (Walker and Hislop, 1998; Sağlam et al., 2010). Most skate species are often captured as bycatch along with the commercially targeted species in their environment. Skates are benthic and demersal species, primarily feeding on fish and invertebrates (McEachran and Musick, 1975; Ajayi, 1982; Ebert et al., 1991; Ellis et al., 1996; Orlov, 1998; Sağlam et al., 2010).

Investigation on the feeding habits of these fish and the predator-prey relationships are worthwhile to assess the role of the species in the ecosystem. Furthermore, data on diet composition are worthwhile for developing trophic models as a tool for understanding the complexity of marine ecosystems (Lopez-Peralta and Arcila, 2002; Stergiou and Karpouzi, 2002). Removal of these fish from ecosystems can result in cascading effects through the trophic levels below, completely restructuring the food web (Frank et al., 2005). Many skate species are overly fished, which gravely affects them due to their life cycle characteristics. For the sustainable management of fish stocks, it is necessary to investigate the biological characteristics of these species. The present study described the food compositions of the poorly investigated Northern Aegean Sea stock of *R. miraletus* and *D. oxyrinchus* to contribute to the sustainability and management of the respective ecosystems.

MATERIALS AND METHODS

Samples were obtained as bycatch from commercial bottom trawler boats using with a mesh size of 44 mm between February 2019 and February 2020. Commercial trawlers operate 12-14 hours a day at depths of 100-400 m at intervals of 3-6 hours (Figure 1).

A total of 29 brown rays (*R. miraletus*) and 36 longnosed skates (*D. oxyrinchus*) were captured, and they were stored in a fish box filled with ice and immediately transported to the laboratory. Each specimen was sexed and their total lengths (TL) were measured to nearest 0.1 cm and weights (TW) to ± 0.1 g. The stomachs of the specimens were removed and weighed and then placed in 4% formaldehyde solution to be used in analysis. The allometric equations (Sparre and Venema, 1992) – i.e., $W = aTL^b$ were operationalized to find the TL-W relationships. $W = aL^b$ where, W is the total weight (expressed in g), L is the total length (expressed in cm), "a" and "b" are the power regression coefficients (i.e., "a" is a coefficient of body form and "b" is an exponent referring to isometric growth when equal to 3 and to allometric growth when significantly different from 3) (Froese, 2006; Loyola Fernández et al., 2017).

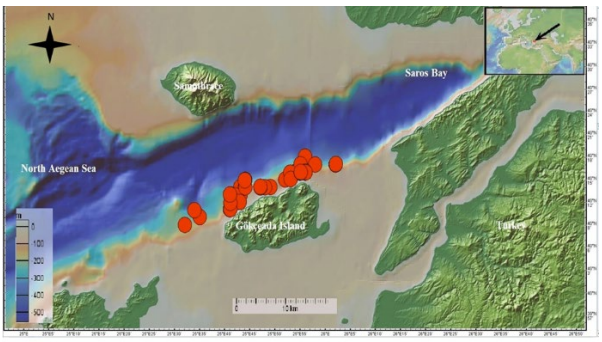

Figure 1. Study area and sampling stations around the Gökçeada Island, Northern Aegean Sea

Pauly's t-test was performed (Pauly, 1984). Pauly's t-test statistic was calculated; Sd_{logTL}= is the standard deviation of the log TL values, Sd_{logW}= is the standard deviation of the log W values, n is the number of specimens used in the computation (eq.1). The value of b is different from b = 3 if calculated t value is greater than the tabled t values for n-2 degrees of freedom (Pauly, 1984; Ahmed et al., 2015).

After each specimen's stomach was excised and left to dry on blotter paper, the stomachs' weights were recorded. The items were categorized, enumerated, and weighed on a precision balance, each of which was identified to the lowest possible taxonomic level. The individuals of each determined group were enumerated. The references availed of to identify the food items are as follows: (Murduchay-Boltouski, 1969; Fischer, 1973; Whitehead et al., 1986a,b; Fischer et al., 1987a,b). Formulas used in dietary component analysis; $N_i\%$ is the percent of prey i, N_i is the total number of prey i, N_p is the total number of prey, $O_i\%$ is the percent frequency of occurrence of prey i, FO_i is the frequency of occurrence of prey i, N_s is the total number of stomachs examined, $W_i\%$ is the percent by weight of prey i, W_i is the total weight of prey i, W_p is the total weight of prey (eq.2,3,4,), (Hyslop, 1980; Demirhan et al., 2007) and the Index of Relative Importance (IRI) (Pinkas et al., 1971) were the parameters factored in for the analyses of their contexts. IRI was used to determine the important food items in the diet of the fish (eq.5,6) (Pinkas et al., 1971; Windell and Bowen, 1978).

$$t=(Sd_{log\,TL} / Sd_{log\,W})(\,|\,b-3\,|\,/(\sqrt{1-r^2}))(\sqrt{n-2}) \quad \text{eq.1}$$

$$O_i\% = (FO_i/N_s)*100 \quad \text{eq.2}$$

$$N_i\% = (N_i/N_p)*100 \quad \text{eq.3}$$

$$W_i\% = (W_i/W_p)*100 \quad \text{eq.4}$$

$$IRI = O_i\% (N_i\% + W_i\%) \quad \text{eq.5}$$

$$(IRI / \sum IRI)*100 \quad \text{eq.6}$$

RESULTS

A total of 29 (24 females and 5 males) *R. miraletus* and 36 (20 females, 16 male) *D. oxyrinchus* specimens which were sampled the commercial bottom trawling season. Since the b value was significantly different from the three, it was determined that both species showed positive allometric growth (P>0.05) (SPSS/21.0) (Table 1).

Table 1. Length–weight relationships for *R. miraletus* and *D. oxyrinchus* from Gökçeada Island

Species	Sex	N	Length (cm)		Weight (g)		Relationship parameters				Growth
			Min.	Max.	Min.	Max.	a	b	95% CI of b	R^2	
Raja miraletus	M	5	28.30	46.60	67.40	493.40	0.0001	4.01	3.73-4.28	0.99	(+)A
	F	24	24.00	53.90	37.70	788.10	0.0002	3.88	3.57-4.19	0.97	(+)A
	C	29	24.00	53.90	37.70	788.10	0.0002	3.92	3.65-4.18	0.97	(+)A
Dipturus oxyrinchus	M	16	17.10	79.80	9.43	2375.00	0.0005	3.48	3.26-3.71	0.99	(+)A
	F	20	17.50	85.00	13.10	3550.00	0.0008	3.41	3.07-3.74	0.96	(+)A
	C	36	17.10	85.00	9.43	3550.00	0.0007	3.43	3.22-3.64	0.97	(+)A

N, sample size; Min., minimum; Max., maximum; a and b, intercept and slope of length–weight relationships; 95% CI of b, confidence intervals of b; R^2, coefficient of determination; (+)A, positive allometric growth type; M, male; F, female; Combined, males and females.

The stomach contents of 21 of 29 *R. miraletus* individuals were examined. In 20 of the examined stomachs, the food content was identified, while one was empty. On the otherhand 8 out of 29 stomachs had suffered damage that cannot be examined. The total number of the preys in the examined stomachs was 58.

The analyses revealed no significant between-sex differences in the indices of relative importance (IRI%; p > 0.05). The analysis of the stomach contents in the *R. miraletus* individuals showed that Crustacea were their primary and most important prey group (IRI% = 67.09), followed by teleosts (IRI% = 1.00) and cephalopods (IRI% = 0.45). The by-percentage numbers (N%), weights (W%), occurrence (O%), and indices of relative importance (IRI%) of the main prey items are presented in Table 2.

Considering the frequency of the prey groups consumed by *R. miraletus* individuals according to size groups, it was determined that crustaceans were consumed in every size group. However, it was observed that the prey groups diversified with the increase in length (>40 cm) (Table 3).

Table 2. Food composition of *R. miraletus*

Prey taxa	Prey weight (g)	n	N%	W%	O%	IRI%
Crustaceans						
Decapoda						
Caridea	13.50	26	44.10	31.80	32.50	56.50
Parapenaeus longirostris	9.50	5	8.47	22.40	10.00	7.06
Brachyura						
unidentified Brachyura	2.34	6	10.20	5.51	7.50	2.69
Isopoda	0.23	3	5.08	0.54	5.00	0.64
Stomatopoda	1.08	1	1.69	2.54	2.50	0.20
Teleost						
Trachurus trachurus	6.67	1	1.69	15.70	2.50	1.00
Cephalopoda						
Loligo sp.	2.63	1	1.69	6.19	2.50	0.45
Nematoda	0.02	2	3.39	0.05	2.50	0.20
Unidentified	6.49	14	23.70	15.30	35.00	31.30

Percentage by number (N%), weight (W%), occurrence (O%) and index of relative importance (IRI%).

Table 3. Frequency of prey groups for each size class of *R. miraletus*

N	Size	Crustaceans	Brachyura	Teleost	Isopoda	Cephalopoda	Stomatopoda	Nematoda	Unidentified
6	20	20.70							28.60
6	30	31.00	33.30					100.00	28.60
4	40	48.30	66.70	100.00	100.00	100.00	100.00		35.70
1	50+								7.14

N: Number of fish.

The stomach contents of 34 of 36 *D. oxyrinchus* individuals were examined. Three of the examined stomachs were empty, while stomach contents were determined in 31. On the otherhand 2 out of 36 stomachs had suffered damage that cannot be examined. The total number of the preys in the examined stomachs amounted to 85. The calculated indices of relative importance were not significantly different between the sexes (IRI%; P > 0.05). The analysis of the stomach contents in the *D. oxyrinchus* individuals showed that crustacea were their primary and most important food group (IRI%= 74.3), followed by teleosts (IRI% = 6.50) and Nematoda (IRI% = 0.40). The by-percentage numbers (N%), weights (W%), occurrence (O%), and indices of relative importance (IRI%) of the main prey categories are presented in Table 4. Considering

the distribution frequency of the food groups consumed by *D. oxyrinchus* according to size groups, it was observed that it mostly fed on crustacea and teleostei (Table 5). Seasonal and sexual variations of the percentage of relative importance (IRI%) of *R. miraletus* and *D. oxyrinchus* were presented in Table 6.

Table 4. Food composition of *D. oxyrinchus*

Prey taxa	Prey weight (g)	n	N%	W%	O%	IRI%
Crustaceans						
Decapoda						
Caridea	42.50	51	60.00	43.40	38.30	71.70
Parapenaeus longirostris	11.00	4	4.70	11.20	8.50	2.50
Plesionika sp.	0.96	1	1.18	0.98	2.10	0.10
Teleost	23.20	7	8.20	23.60	10.60	6.10
Trachurus trachurus	8.09	2	2.35	8.26	2.10	0.40
Nematoda	0.80	4	4.70	0.80	4.30	0.40
Unidentified	11.50	16	18.80	11.70	34.00	18.80

Percentage by number (N%), weight (W%), occurrence (O%) and index of relative importance (IRI%).

Table 5. Frequency of prey groups for each size class of *D. oxyrinchus*

N	Size class (cm)	Crustaceans	Teleost	Nematoda	Unidentified
8	20	24.10	16.70		26.70
11	30	29.60	16.70		26.70
7	40	9.30	16.70	100.00	20.00
8	50+	37.00	50.00		26.60

N: Number of fish.

Table 6. Seasonal and sexual variations of the percentage of relative importance (IRI%) of *R. miraletus* and *D. oxyrinchus*

Species	Prey	Season				Sex	
		Spring	Summer	Autumn	Winter	F	M
R. miraletus	Crustaceans	36.31		100.00	74.39	78.99	27.61
	Teleost	15.69				1.24	
	Nematoda				0.31		2.47
	number of prey	10.00		5.00	43.00		
D. oxyrinchus	Crustaceans	18.90	77.70	27.70	94.70	78.7	78.10
	Teleost	11.50	11.70		4.01	6.10	8.38
	Nematoda	69.60		3.51	0.87	0.27	0.41
	number of prey	22.00	9.00	9.00	21.00		

DISCUSSION

In the length-weight relationship of *R. miraletus* and *D. oxyrinchus* specimens, the "a" value was calculated as 0.0002, while the "b" value was observed to vary between 3.43-3.92 (Table 7 and Table 8). In studies conducted in similar species in the Aegean Sea, it was determined that the "b" values of the species showed positive allometric growth (P>0.05) (Filiz and Mater, 2002; Yankova et al., 2011). Moutopoulos and Stergiou (2002) stated that the reasons for these differences in "b" values are based on differences in sample number, region and seasonal parameters. In addition, other important reasons for these differences may be caused by various ecological factors such as temperature, specific spawning and feeding conditions, and biotopic characteristics (Ricker, 1975). The depths and sampling methods of fish species are effective in these differences. It is thought that the difference between the length-weight relationships determined in this study and the studies conducted in other regions is mostly due to the sampling methodology of the species, sample size and sampling season.

The obtained results showed that *R. miraletus* and *D. oxyrinchus* feed on benthic prey items, with observed differences in the indices of relative importance (IRI%) among the prey groups, crustaceans being the most important diet of these skates. This finding is substantiated by many research studies where crustaceans are reported to be the main food item for skates (Demirhan et al., 2005; Sağlam and Başçınar, 2008; Follesa et al., 2010; Karachle and Stergiou, 2010; Sağlam et al., 2010; Yığın and İşmen, 2010a, b; Šantić et al., 2012; Kadri et al., 2014a, b; Eronat and Özaydın, 2015; Mulas et al., 2015; Yemişken et al., 2017; Biton-Porsmoguer, 2020; Cabbar and Yığın, 2021). According to the total IRI, the other prey groups (Brachyura, Teleosts, Cephalopoda, Isopoda, Stomatopoda, and Nematoda) were of less importance (Rosecchi and Nouaze, 1987).

D. oxyrinchus exhibits large ontogenetic changes in feeding behaviour, and their early life stages are characterized by a benthopelagic diet that changes during growth (Mulas et al., 2015). *Parapenaeus longirostris* was detected to be their favourite prey group. In consideration of the IRI% values between the sexes, there were no significant differences in the dietary compositions of the male and female longnosed skates (P = 0.66). The frequency of occurrence (F%) with size showed that crustacea were always present in their diet (Yığın and

İşmen, 2010a). In this study, it was determined that crustaceans constituted the most important food group of *D. oxyrinchus*. The most prominent species among the crustaceans was *Parapenaeus longirostris*.

Table 7. Length-weight relationships parameters of *Raja miraletus* from different regions

Region	Sex	N	Length (cm)		Weight (g)		Relationship parameters			Reference
			Min.	Max.	Min.	Max.	a	b	R^2	
Balearic Islands, Western Mediterranean	C	28	16.60	41.00	-	-	0.002	3.25	0.99	Merella et al., 1997
North Aegean Sea	C	13	30.00	56.50	100	1001	0.0001	4.02	0.93	Filiz and Mater, 2002
Aegean Sea	C	16	25.60	49.30	-	-	0.003	3.29	0.94	Moutopoulos and Stergiou, 2002
Eastern Adriatic Sea	C	339	13.40	50.00	10.40	633	0.005	2.98	0.95	Pallaoro et al., 2005
Saros Bay, North Aegean Sea	C	30	6.50	30.50	6.00	350	0.009	3.22	0.97	İşmen et al., 2007
İzmir Bay, Aegean Sea	C	12	39.00	53.50	-	-	0.006	2.95	0.96	Özaydın et al., 2007
Aegean Sea	C	10	23.90	45.10	-	-	0.035	2.83	0.98	İlkyaz et al., 2008
Saros Bay, North Aegean Sea	C	52	10.50	53.50	5.82	1010	0.002	3.27	0.95	Yığın and İşmen, 2009
İskenderun Bay	C	22	24.00	54.00	58.00	998	0.002	3.26	0.95	Başusta et al., 2012
South Aegean Sea	C	62	26.70	49.30	-	-	0.001	3.44	0.97	Bilge et al., 2014
Lebanese marine waters, eastern Mediterranean	C	30	25.00	44.00	72.00	490	0.002	3.34	0.91	Lteif et al., 2016
Marmara Sea	C	9	22.40	54.60	41.70	830	0.002	3.18	0.95	Karadurmuş, 2022
Gökçeada Island North Aegean Sea	C	29	24.00	53.90	37.70	788	0.0002	3.92	0.97	In This Study

C, both males and females; N, sample size; Min., Minimum; Max., Maximum; a and b, intercept and slope of total length–weight relationships; R^2, coefficient of determination.

Table 8. Length-weight relationships parameters of *Dipturus oxyrinchus* from different regions

Region	Sex	N	Length (cm)		Weight (g)		Relationship parameters			Reference
			Min.	M	Min.	Max.	a	b	R^2	
North Aegean Sea	C	8	17.90	62	10.40	851.00	0.001	3.40	0.99	Filiz and Bilge, 2004
Saros Bay, North Aegean Sea	C	1	10.00	63	9.00	4056.00	0.004	3.29	0.99	İşmen et al., 2007
Saros Bay, North Aegean Sea	C	1	14.90	10	8.00	4074.00	0.001	3.35	0.99	Yığın and İşmen, 2009
İzmir Bay and Sığacık Bay	C	8	18.10	46	14.80	285.00	0.031	3.13	0.99	Eronat and Özaydın, 2014
Gulf of Gabes, Tunisia, Central	C	5	16.50	10	30.00	5300.00	-	3.01	-	Kadri et al., 2014a
Northeastern Mediterranean	C	2	8.00	93	8.50	3828.00	0.002	3.19	0.97	Başusta and Özel, 2017
Syrian, Eastern Mediterranean	C	2	34.10	10	-	-	0.001	3.35	0.96	Alkusairy and Saad, 2017
Aegean Sea	C	6	17.10	34	10.70	112.80	0.001	3.37	0.99	Soykan and Kınacıgil, 2021
Northeastern Mediterranean Sea	C	2	12.20	93	8.34	3828.00	0.002	3.19	0.97	Başusta and Özel, 2022
Gökçeada Island, Northern Aegean Sea	C	3	17.10	85	9.43	3550.00	0.001	3.43	0.99	In This Study

C, both males and females; N, sample size; Min., Minimum; Max., Maximum; a and b, intercept, and slope of total length–weight relationships; R^2, coefficient of determination.

Considering the foods consumed by *R. miraletus* according to size groups, Šantić et al. (2013) stated that specimens smaller than 25.0 cm mostly feed on amphipoda and mysidacea, while specimens larger than 25.0 cm feed on decapoda, teleost and cephalopoda in the Adriatic Sea. Kadri et al. (2014c) determined that *R. miraletus* specimens smaller than 38 cm fed on mysidacea and amphipoda, while specimens larger than 38 cm fed on decapoda, cephalopoda and isopoda, mostly teleost in the Gulf of Gabes. In this study, when we look at the food groups consumed by *R. miraletus* specimens according to size groups, it was observed that crustaceans were consumed in every size group, and food groups diversified (crustaceans, brachyura, teleost, isopoda, cephalopoda, stomatopoda, nematoda) with an increase in length (>40cm).

Although most of the diet of *D. oxyrinchus* in the Sardinian Sea consists of crustaceans at all life stages, their importance decreases during growth and consumption of cephalopods and teleosts increases (Mulas et al., 2015). It is thought that these differences in the studies may differ according to the number of specimens sampled, the number of specimens in length groups and habitats.

All in all, because skates are opportunistic predators, the results may vary across research studies performed in different research areas. Particular species – e.g., crustaceans – were found to be the major prey items in the dietary compositions of the *R. miraletus* and *D. oxyrinchus* specimens in the Northern Aegean Sea.

Despite the known high biodiversity of the respective research field (Daban et al., 2022), the lower prey biodiversity in *R. miraletus* and *D. oxyrinchus* requires attending to a critical research question: How strongly can it compete for food? This question calls for further research to develop a better understanding of the food overlap across all living competitors. Furthermore, very little is known about such subject matters as early life biology, habitat use, post-fishing survival rates, selectivity of trawls, and stock size. More comprehensive research is mandatory to present more applicable data for fisheries management authorities.

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AUTHORSHIP CONTRIBUTIONS

All authors contributed equally to the idea, data collections, design and writing of the manuscript.

CONFLICTS OF INTEREST

The authors declares that there is no conflict of interest in this manuscript.

ETHICS APPROVAL

No specific ethical approval was necessary for this study.

DATA AVAILABILITY

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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