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Research Article

Feed comparison and feeding ecology in five sympatric teleost species of the northern Oman Sea

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Abstract

Investigating the relations and mechanisms of coexistence among sympatric species is essential to comprehend their ecological roles in the food webs. In the present study, the diet and trophic interactions of 5 abundant teleost species coexisting in the northern Oman Sea were examined using stomach contents analyses. The cumulative prey curves showed that the sample size of each studied species was large enough to clarify the general dietary preferences. The vacuity indices of *Netuma thalassina*, *Plicofollis dussumieri* and *Otolithes ruber* were less than 50%, indicating the comparatively gluttonous behavior of these species, while the estimated vacuity indices of *Lutjanus johnii* and *Carangoides malabaricus* were more than 50%. Assessment of %IRI (index of relative importance) revealed that diets of *N. thalassina*, *O. ruber* and *C. malabaricus* were similar and consisted mostly of teleost fishes followed by crustaceans. Conversely, *P dussumieri* and *L. johnii* mostly fed on crustaceans followed by teleost fishes. Results showed that *P. dussumieri* and *L. johnii* occupied an intermediate trophic level, whereas *N. thalassina*, *O. ruber* and *C. malabaricus* occupied high trophic levels, placing them as top predators in the food web. In total, analyses indicated that there were no significant differences in diets between these 5 teleost species.

Keywords: Feeding ecology, Oman Sea, Sympatric species, Teleost fish

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Introduction

Knowledge of feeding habits is important for understanding the ecological role and productive capacity of fish populations and understanding these processes is crucial to the development of conservation and ecosystem-based management plans (Teixeira and Cortes, 2006). Food is an important limiting factor in determining competition between species in fish populations (Farooq *et al*., 2017). Species with similar feeding habits could compete with each other if they co-occur in a similar habitat. However, species coexist in the natural environment due to differences in their search for food, feeding times, reproduction, currents, and diurnal migrations. Pianka (1969) noted that separation may occur due to habitat, food and time. Prey-predator assembly is becoming increasingly familiar with the marine ecosystem (Persson *et al*., 1992; Vander Zanden *et al*., 1999).

Ariids, Carangids, Sciaenids and Lutjanids are abundant species groups found in the northern Oman Sea. They contribute to a large portion in terms of biomass to the overall fish catch (Valinassab *et al*., 2006). Several studies have been carried out regarding their feeding habits in the Persian Gulf and the Oman Sea (Karimi *et al*., 2012; Cheraghi Shevi *et al*., 2013; Pourbabaie *et al*., 2013; Vahabnezhad, 2015; Taghavi Motlagh *et al*, 2015; Kamali *et al*., 2016; Behzadi, 2016; Ghorbani Ranjbari *et al*., 2016; Abdi and Ghazizadeh, 2019; Mohseni, 2019; Hashemipour *et al*., 2019). However, the comparative diets of these teleost species have yet to be studied.

In the present study, the stomach contents of *Netuma thalassina* and *Plicofollis dussumieri* (Ariids), *Otolithes ruber* (Sciaenids), *Lutjanus johnii* (Lutjanids) and *Carangoides malabaricus* (Carangids) have been analyzed to characterize their diets and examine the comparative dietary of these five sympatric teleost species in the Oman Sea that could shed new light on what might allow these species to coexist.

Materials and methods

Study area

The present study was conducted in the northern part of the Oman Sea between latitudes 24º 15' N and 25º 17' N and longitudes 58º 50' E and 61º 25' E (Fig.1). The Oman Sea, with an area of 94,000 km^2 connects the Persian Gulf to the north-west Arabian Sea and then to the Indian Ocean. It borders on the north, Iran and Pakistan, in south Oman and the United Arab Emirates on the west. It is relatively deep, with a depth of more than 1,000 m in 3/4 of its waters (Reynolds, 1993), and reaches to a maximum depth of 3400 m (Valinassab *et al*., 2006). The coastal waters of Oman are described by one of the most intense coastal upwelling phenomena globally (Reynolds, 1993; Al-Hashmi *et al*., 2010). The monsoonal regime controls the wind-driven circulation of the mixed layer, with the frequent formation of cyclonic and anti-cyclonic eddies influencing the vertical flow of nutrient-rich and low-oxygen subsurface waters.

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In the northern Oman Sea, in particular, such vertical motions of water cause a strong variability in the temperature of the water, stronger temperature variations between March and October, and the temperatures between November and February relatively cooler and less variable (Al-Hashmi *et al*., 2010). The sub-surface water temperature (8 m depth) ranges on average from 23°C in February to 33°C in June (Al-Hashmi *et al*., 2010).

Sample collection

All samples were collected seasonally between February and October 2017 during day-time from bottom-trawling cruises (R/V Ferdows1) and landing sites on the entire coast of the northern Oman Sea (Fig. 1).

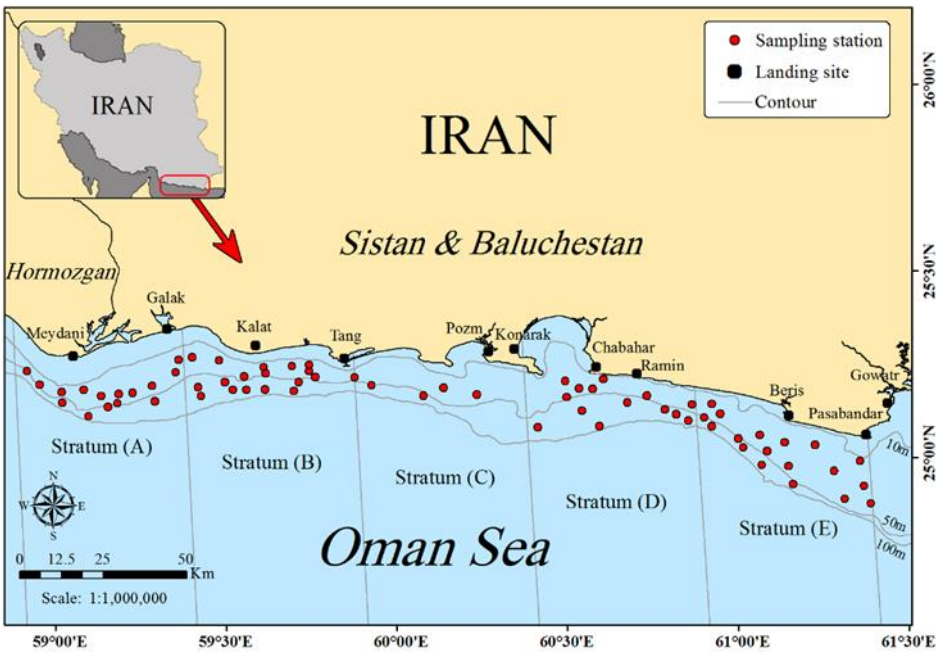

Figure 1: Study area and sampling locations.

Stomach content analysis

Before removing the stomachs, the total body weight (W) was weighed to the nearest 0.1 g. Then the stomachs of the specimens were weighed, and the stomach contents were recovered during the laboratory dissections. Most of the samples were adult with few juvenile ones. All recovered prey parts were separated, identified as the lowest possible taxon (Asadi and Dehghani, 1996; Carpenter *et al*., 1997; Jereb and Roper, 2005), counted, and weighed to the nearest 0.1 g. In order to avoid overestimation of the occurrence of a particular prey item, the number of individuals of each type of prey was determined to be the least number from which these fragments could have originated. The stomach contents data were merged into eight functional groups (teleosts, crustaceans, cephalopods, gastropods, bivalves,

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polychaetes, echinoderms, and algae), and the vacuity index was calculated as:

$$VI = (ES / TS) \times 100 \quad (1)$$

Where, ES is the number of empty stomachs and TS the total number of stomachs being examined (Hyslop, 1980).

In order to assess whether a sufficient number of individuals have been sampled for each species, the cumulative mean number of functional prey groups was plotted against the cumulative number of stomachs analyzed for each teleost species (Ferry and Caillet, 1996). Magurran (2004) noted that adequate sample size was assumed if the resulting curve approached the asymptote and showed a reduction in variability.

In this study, the composite index of relative importance (IRI) was used to describe fish diets and to determine the relative importance of the common food categories (Pinkas *et al*., 1971; Prince, 1975) of each teleost species, in other words, and to allow interspecific comparisons as follows:

$$IRI_i = FO_i\% \times (N_i\% + W_i\%) \quad (2)$$

Where, FO_i is the frequency of occurrence of a specific functional prey group ($_i$) in relation to the total number of stomachs, N_i is the contribution of the type of prey group ($_i$) in relation to the total content of the stomach and W_i is the weight of the prey group ($_i$) in relation to the total content of the stomach (Ugwumba and Ugwumba, 2007).

IRI values have been expressed as a percentage to allow comparisons between prey groups and species (Cortés, 1997):

$$IRI_i\% = 100 \times IRI_i / \sum_{i=1}^{n} IRI\ i \quad (3)$$

Statistical analysis

The feeding strategy for each of the five teleost species was defined by plotting the prey-specific abundance of the prey groups against FO% (Amundsen *et al*., 1996). Prey-specific abundance was determined to be the number of prey (i) divided by the total number of prey in the stomachs containing prey (i) expressed as a percentage. The vertical axis is the predator's feeding strategy (specialization or generalization). Points in the upper part of the graph represent preferred prey items, while points in the lower part indicate items that have been consumed rarely. If no points were located in the top right of the diagram and all points fell along or below the diagonal from the top left to the bottom right, the predator was thought to have a generalist diet and, therefore, a broad niche width.

Trophic level of each of the five teleost species was calculated based on each prey component's the proportion (by weight) in their diet using the TrophLab software (Froese and Pauly, 2000). TrophLab calculates the TL with the dietary composition and the TL of the different prey present in the diet, based on the percentage of weight (Pauly *et al*., 2000):

$$TL_i = 1 + \sum_{j=1}^{G} DCij \times TL_j \quad (4)$$

Where, DCij is the fraction of prey (j) in the diet of consumer i;TLj is the trophic level of prey (j); whereas G is the number of prey categories (Froese and Pauly, 2000).

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For testing variation among the five teleost species, a similarity matrix with the transformed estimated contribution values of food items was used based on the weight of main zoological prey groups. The test was then developed using the Bray–Curtis similarity coefficient (Bray and Curtis, 1957). Diet similarity was analyzed with non-metric multidimensional scaling analysis (nMDS).

One-way analysis of similarity (ANOSIM) was used to investigate data. This test was used to check similarities (distance) within defined factors and calculates the R-value, which varies between -1 and +1. The R-value close to zero represents that there are no differences between the factors, and the R-value close to 1 indicates that the factors were dissimilar between the levels of each factor. In addition, the similarity of percentages (SIMPER) was used to estimate the contribution of each main zoological prey to dietary differences. All statistical tests were carried out using PRIMER v.6 software (Clarke and Gorley, 2006).

Results

A total of 702 stomachs were studied, of which 40.91% of *N. thalassina*, 29.54% of *P. dussumieri*, 42.59% of *O. ruber*, 64.51% of *L johnii* and 56.43% of *C. malabaricus* were empty (Table 1). The cumulative prey curves based on diversity of prey exceeded an asymptote for all five species, showing that the sample size was large enough to clarify the general dietary preferences (Fig. 2).

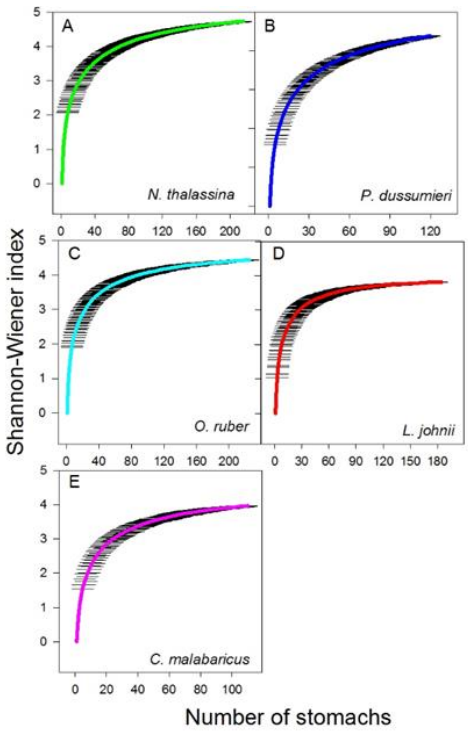

Figure 2: Cumulative prey curve for each new prey taxa in relation to the number of stomachs analyzed of five species sampled.

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Feed composition of the teleost species

In general, eight prey groups were identified in the stomach contents of the specimens of five teleost species (including teleosts, crustaceans, cephalopods, gastropods, bivalves, polychaetes, echinoderms, and alga). Besides, seventeen and five lower taxonomic groups were recorded within the teleosts and crustaceans, respectively. Assessment of %IRI revealed that teleosts were the most important ingested prey group in the stomach contents of *N. thalassina*, *O. ruber* and *C. malabaricus* (%IRI = 73.20, 87.13 and 96.50, respectively), whereas crustaceans were the most important feed of *P. dussumieri* and *L. johnii* (%IRI = 59.28 and 85.00, respectively) (Table 1).

Table 1: Number of specimens, Trophic levels and diet composition of five teleost species caught from the northern Oman Sea expressed in percentage by number (N%), weight (W%), frequency of occurrence (FO%) and percentage of the Index of Relative Importance of food (IRI%).

Teleost species	***Netuma thalassina***				***Plicofollis dussumieri***				***Otolithes ruber***			
N	**198**				**132**				**108**			
Trophic Level	**4.24**				**3.75**				**4.43**			
Food items	**N%**	**W%**	**FO%**	**IRI%**	**N%**	**W%**	**FO%**	**IRI%**	**N%**	**W%**	**FO%**	**IRI%**
TELEOSTS	31.8	82.91	74.35	73.20	12.42	61.03	25.80	22.47	86.01	86.21	93.54	87.13
Carangidae	3.53	15.34	8.54	3.73	4.76	31.66	12.00	15.70	2.92	6.41	17.74	2.66
Mullidae	2.28	6.46	5.98	1.21	1.83	6.75	5.33	1.61	6.06	9.54	29.03	5.46
Cynoglossidae	0.50	0.17	1.71	0.03	0.73	0.36	2.66	0.10	0	0	0	0
Nemipteridae	2.02	10.35	5.98	1.71	2.19	11.00	6.66	3.15	0	0	0	0
Haemulidae	0.50	10.38	1.71	0.43	0	0	0	0	0	0	0	0
Sphyraenidae	1.26	7.29	4.27	0.85	1.09	10.30	4.00	1.63	0	0	0	0
Myctophidae	0.25	0.02	0.85	0.01	0	0	0	0	0	0	0	0
Engraulidae	1.51	0.10	4.27	0.16	1.46	0.13	4.00	0.23	10.43	3.86	29.03	3.60
Hydrophiidae	0.50	1.70	1.71	0.09	0.36	0.83	1.33	0.06	0	0	0	0
Mugilidae	0	0	0	0	0	0	0	0	17.12	36.70	61.29	45.00
Clupeidae	0	0	0	0	0	0	0	0	22.13	14.05	17.74	20.2
Gerreidae	0	0	0	0	0	0	0	0	6.68	4.55	27.42	3.33
Leiognathidae	0	0	0	0	0	0	0	0	14.82	6.12	24.19	4.36
Pennahia anea	0	0	0	0	0	0	0	0	5.85	4.98	24.19	2.52
Synodontidae	0	0	0	0	0	0	0	0	0	0	0	0
Pristigasteridae	0	0	0	0	0	0	0	0	0	0	0	0
Platycephalidae	0	0	0	0	0	0	0	0	0	0	0	0
Digested fish	19.45	31.10	55.55	65.00	0	0	0	0	0	0	0	0
CRUSTACEANS	44.71	11.54	63.24	22.76	53.5	22.71	62.36	59.28	10.64	7.75	70.96	6.61
Portunidae	21.71	5.09	25.64	15.90	24.9	10.16	32.00	40.20	0	0	0	0
Xanthidae	8.84	1.23	13.67	3.19	11.37	3.00	17.33	8.93	0	0	0	0
Epialtidae	7.32	2.66	8.54	1.97	9.17	5.00	12.00	6.09	0	0	0	0
Squilla mantis	2.80	1.90	9.40	1.02	2.56	3.00	9.33	1.86	3.96	4.00	22.58	2.04
Penaeidae	1.26	0.11	2.56	0.08	1.83	0.25	4.00	0.30	6.68	3.75	35.48	4.57
Digested crustaceans	2.78	0.55	7.70	0.59	3.66	1.30	10.66	1.89	0	0	0	0
CEPHALOPODS	3.30	3.41	11.11	1.73	4.76	7.91	17.33	7.87	3.35	6.04	19.35	6.26
GASTROPODS	3.03	0.06	2.56	0.18	4.39	0.43	4.00	0.69	0	0	0	0
BIVALVES	0.50	0.21	1.70	0.03	0.73	0.51	2.66	0.12	0	0	0	0
POLYCHAETES	3.28	0.07	3.42	0.27	4.77	0.28	5.33	0.96	0	0	0	0
ECHINODERMS	10.35	0.74	6.83	1.75	15.04	6.91	10.66	8.39	0	0	0	0
ALGAE	3.03	1.06	0.85	0.08	4.39	0.22	1.33	0.22	0	0	0	0

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Table 1 (continued):

Teleost species	*Lutjanus johnii*				*Carangoides malabaricus*			
N	**124**				**140**			
Trophic Level	**3.66**				**4.48**			
Food items	**N%**	**W%**	**FO%**	**IRI%**	**N%**	**W%**	**FO%**	**IRI%**
TELEOSTS	20.14	26.38	55.45	12.55	86.14	79.10	90.16	96.50
Carangidae	1.05	2.62	18.18	0.69	0	0	0	0
Mullidae	3.21	6.10	27.27	2.62	3.46	10.40	18.00	2.42
Cynoglossidae	0	0	0	0	0	0	0	0
Nemipteridae	0	0	0	0	0	0	0	0
Haemulidae	1.20	2.97	15.91	0.68	0	0	0	0
Sphyraenidae	0	0	0	0	0	0	0	0
Myctophidae	0	0	0	0	0	0	0	0
Engraulidae	9.62	6.10	38.64	6.27	27.90	16.40	27.90	9.47
Hydrophiidae	0	0	0	0	0	0	0	0
Mugilidae	0	0	0	0	0	0	0	0
Clupeidae	0	0	0	0	0	0	0	0
Gerreidae	0	0	0	0	0	0	0	0
Leiognathidae	0	0	0	0	63.86	52.30	75.40	84.58
Pennahia anea	0	0	0	0	0	0	0	0
Synodontidae	3.21	5.06	20.45	1.75	0	0	0	0
Pristigasteridae	1.05	2.18	11.36	0.38	0	0	0	0
Platycephalidae	0.80	1.35	9.09	0.22	0	0	0	0
Digested fish	0	0	0	0	0	0	0	0
CRUSTACEANS	75.19	66.70	75.19	85.00	8.17	11.60	22.95	2.37
Portunidae	21.00	17.3	65.91	26.04	2.72	5.02	11.50	0.86
Xanthidae	25.8	22.2	56.82	28.72	0	0	0	0
Epialtidae	0	0	0	0	0	0	0	0
Squilla mantis	11.40	14.40	50.00	13.32	1.98	4.23	11.50	0.69
Penaeidae	16.99	12.80	56.82	17.54	3.47	2.35	14.80	0.83
Digested crustaceans	0	0	0	0	0	0	0	0
CEPHALOPODS	2.14	5.57	20.45	1.63	1.73	7.50	9.84	0.88
GASTROPODS	2.53	1.35	20.45	0.82	0	0	0	0
BIVALVES	0	0	0	0	0	0	0	0
POLYCHAETES	0	0	0	0	3.96	1.80	4.92	0.27
ECHINODERMS	0	0	0	0	0	0	0	0
ALGAE	0	0	0	0	0	0	0	0

The ANOSIM found no significant differences in the diet composition among five studied teleost species (Global *R* statistic=0.122; $p > 0.05$) (Fig. 3). Also, pair-wise tests from the ANOSIM indicated that the diets of all the five species were similar (Table 2). SIMPER analysis revealed that the main categories of prey that contributed to the dissimilarity of the feed of the studied species were teleosts and crustaceans. Analyses were conducted between five teleost species using the Bray-Curtis dissimilarity index. Results have shown that the highest mean Bray–Curtis dissimilarity between *P. dussumieri* and *C. malabaricus* was 75.55% and consisted of teleosts (45.53%), crustaceans (35.12%) and cephalopods (10.06%). In contrast, the lowest dissimilarity was between *O. ruber* and *C. malabaricus* (32.11%). Feeding strategy plots further confirmed that teleosts and crustaceans were important prey categories for all five studied species, especially for *N. thalassina*, *P. dussumieri* and *O. ruber*. However, there was a high degree of specialization in the teleost prey category by *L. johnii* and *C. malabaricus* (Fig. 4).

Overall, *P. dussumieri* and *L. johnii* occupied an intermediate trophic level.

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The values were 3.75 and 3.66, respectively. On the other hand, three species, *N. thalassina*, *O. ruber* and *C. malabaricus* occupied high trophic levels, placing them as top predators in the food web. Values were 4.24, 4.43 and 4.48, respectively.

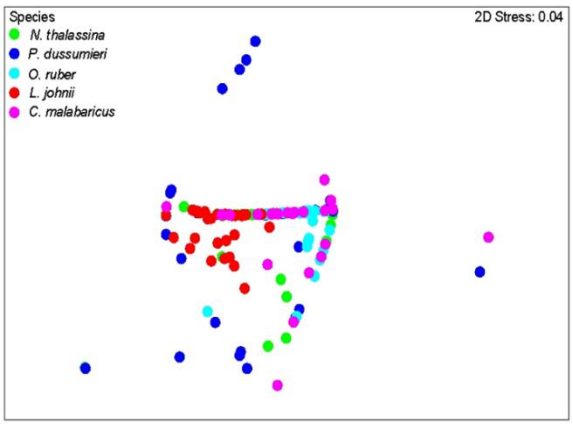

Figure 3: Non-metric multidimensional scaling (nMDS) analysis of the stomach contents of 5 teleost species sampled in the northern Oman Sea.

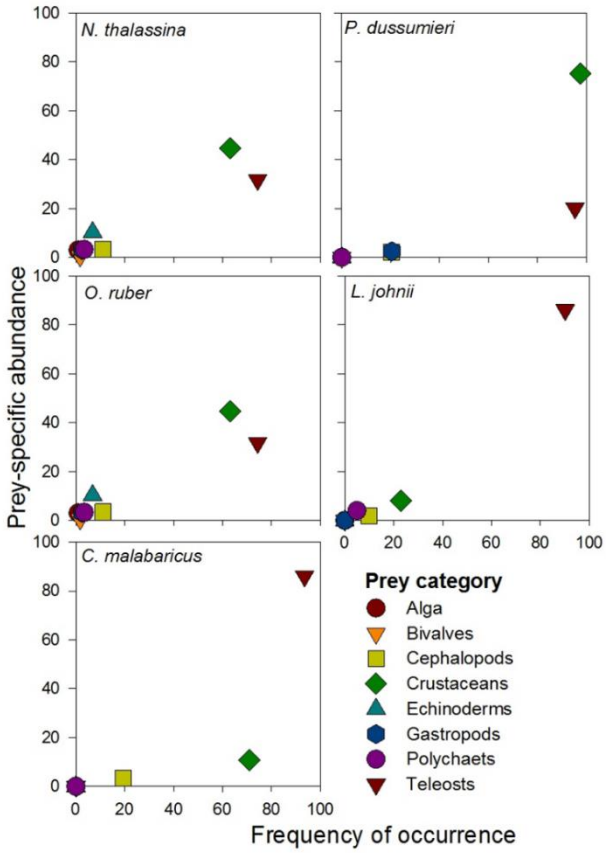

Figure 4: Graphical representation of the feeding strategy of five species sampled on the method proposed by Amundsen *et al*. (1996).

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Table 2: Analysis of similarity pairwise tests to compare the diet of five teleost species from the northern Oman Sea.

Species × Species	R significance	
	R	*P*
N. thalassina × *P. dussumieri*	0.124	>0.05
N. thalassina × *O. ruber*	0.014	>0.05
N. thalassina × *L. johnii*	0.013	>0.05
N. thalassina × *C. malabaricus*	-0.027	>0.05
P. dussumieri × *O. ruber*	0.29	>0.05
P. dussumieri × *L. johnii*	-0.007	>0.05
P. dussumieri × *C. malabaricus*	0.33	>0.05
O. ruber × *L. johnii*	0.39	>0.05
O. ruber × *C. malabaricus*	-0.016	>0.05
L. johnii × *C. malabaricus*	0.597	>0.05

Discussion

In the present study, we investigated the feeding ecology and comparative feeds of five sympatric teleost species in the northern Oman Sea using the direct stomach content analysis, which is a well-known method for researching the trophic ecology of teleosts and offers a qualitative and quantitative snapshot of the diet (Hyslop, 1980). It is suggested that the results obtained from this study may provide general baseline information, especially for the species whose diets have been poorly studied in the area. Moreover, this study is the first to analyze comparative dietary data of the sympatric teleost species in the northern Oman Sea to shed new light on what might allow these species to coexist.

The results from this study indicated that *N. thalassina* feed primarily on teleosts (74.35%), followed by crustaceans (63.24%) and this is in agreement with the results of the studies conducted in the same waters by Karimi *et al*. (2012) and Pourbabaie *et al*. (2013). Teleosts were also the most commonly occurring identifiable prey in *O. ruber* (93.54%), similar to other studies (Nair, 1980; Euzen, 1987; Bandani *et al*., 2006; Azhir, 2008; Sadeghi *et al*., 2014; Vahabnezhad, 2015; Taghavi Motlagh *et al*., 2015; Ghorbani Ranjbari *et al*., 2016; Hashemipour *et al*., 2019). However, Pillai (1983) and Abdel-Aziz *et al*. (1993), who studied the feeding habit of juvenile *O. ruber* declared that younger forms of all sciaenids take prawns (crustaceans) as the main feed and the percentage of their fish feed goes on slowly increasing as they grow in size, thus it can be concluded that *O. ruber* is a highly carnivorous fish exhibiting a selectivity of feeding within various size groups. *P. dussumieri* mainly consumed crustaceans (62.36%) and this finding supplements the works done by other researchers (Cheraghi *et al*., 2013; Abdi and Ghazi zadeh, 2019). *L. johnii* feeds mainly on crustaceans, especially crabs (75.19%). These results are consistent with previous literature (Kamali and Valinassab, 2003; Behzadi, 2016). Kiso and Mahyam (2003), who worked on the feeding habit of *L. johnii* in a mangrove estuary in Malaysia noted that the most

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occurring prey in *L. johnii* were crustaceans, especially prawns, and the large prawn biomass causes it in this estuary (Kiso and Mahyam, 2003). The most preferred food item of *C. malabaricus* were teleosts (90.16%). Similar results have been reported in *C. malabaricus* (Sadeghi *et al*., 2014, Kamali *et al*., 2016; Hashemipour *et al*., 2019). Conversely, Ibrahim *et al*. (2003), who worked on *C. malabaricus* in the south China Sea, found *Penaeus* sp. (Crustaceans) to be the most frequent and numerically dominant prey of *C. malabaricus*. This can be described as an adjustment to the available feed without the preferred prey (Sivakami, 1996). Generally, it is assumed that these differences are due to differences in the environment, including the density and composition of prey groups between different habitats.

Sympatric species are likely to consume slightly different prey to minimize niche overlap (Schoener, 1974). For instance, in the current study *L. johnii* and *P. dussumieri* are both benthophagous feeders, but to reduce the niche overlap the former has a fish-based diet and the latter has a crustacean-based diet, although the importance of teleosts and crustaceans as prey is not negligible in the study area (Fig. 4). Competition for food can affect habitat selection patterns, and niche overlap (Hilderbrand and Kershner, 2004; David *et al*., 2007). When food resources are shared, it has been proposed that the coexistence of fish species is related to differential use of space and resources over time (Amarasekare, 2003; Sandlund *et al*., 2010). In the present study, competition for resources was observed among all five studied species. The high abundance of some prey in the study area may affect the significant diet overlap. Crowder and Cooper (1982) suggested that due to high catch rates when prey is plentiful, the feeding niche breadth of a predator will be narrowest when food in a particular site is abundant. While fish species included more than one type of food in their diet, the highest predominance of a single food item implies an abundance of food in the environment, besides may indicate active food selection (Novakowski *et al*., 2008).

Even though new methods have been developed to determine trophic levels for marine species, such as stable isotope approaches, the trophic level estimates are generally extracted from the analysis of stomach content (Stergiou and Polunin, 2000). In marine ecosystems, trophic levels ranged from 2 for detritivorous/herbivorous species to 5 for carnivorous/piscivorous species (Pauly *et al*., 1998). In the present study, the estimated trophic level of *P. dussumieri* and *L. johnii* (3.5<TL<4.0) suggested that these species are potentially important mesopredators within the Oman Sea food web. The estimated trophic level of *N. thalassina*, *O. ruber* and *C. malabaricus* (4<TL<4.5) indicated that these species are top-level predators in this ecosystem and have a high degree of food consumption. The estimated trophic levels in different studies (Table 1) may vary due to changes in prey availability

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and geographical variations (Arendt *et al*., 2001). Moreover, it may happen due to differences in feeding intensity (Hassler and Rainville, 1975). Pauly (2010) also noted that most fish have a lower trophic level when they are smaller and younger than when large and mature. Therefore, it can be concluded that the trophic level may change with the size and age of the fish. (Pauly and Watson, 2005). Rastgoo and Navarro (2017) also indicated a positive correlation between trophic levels estimated from data on stomach content and the fish size in their literature. In the present study, T.L has not been compared for different age groups. However, this index is likely to vary based on changes in feeding habitats associated with the transition from the larval to the more mature stage (Table 3).

Table 3: Studied species, the trophic level calculated in the present study the northern Oman Sea and the trophic level of these species from other studies.

Species	Trophic level (Present study)	Trophic level (Other studies)	References	Study Areas
N. thalassina	4.24	3.40	Nasir, 2000	Northwest Persian Gulf
	-	4.07	Taghavi Motlagh *et al*., 2015	Persian Gulf
	-	4.31	Mohseni, 2019	Persian Gulf and Oman Sea
P. dussumieri	3.75	3.99	Rastgoo and Navarro, 2017	Persian Gulf and Oman Sea
	-	4.39	Mohseni, 2019	Persian Gulf and Oman Sea
O. ruber	4.43	3.60	Nasir, 2000	Northwest Persian Gulf
	-	3.64	Vahabnezhad, 2015	Persian Gulf
	-	3.66	Taghavi Motlagh *et al*., 2015	Persian Gulf
	-	3.39	Rastgoo and Navarro, 2017	Persian Gulf and Oman Sea
L. johnii	3.66	3.59	Vahabnezhad, 2015	Persian Gulf
	-	3.72	Taghavi Motlagh *et al*., 2015	Persian Gulf
	-	4.20	Moniri *et al*., 2015	Persian Gulf and Oman Sea
	-	4.00	Behzadi, 2016	Persian Gulf and Oman Sea
	-	3.93	Rastgoo and Navarro, 2017	Persian Gulf and Oman Sea
C. malabaricus	4.48	4.40	Salini *et al*., 1994	Gulf of Carpentaria, Australia

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The study of feeding habits and the sharing of resources is closely related to fish species can be very useful for understanding energy flows across the food web and provides important insights into the trophic flexibility of the sympatric species (Darnaude *et al*., 2001; Platell *et al*., 2006; Russo *et al*., 2008). However, such findings need to be coupled with analyses of the benthic community composition and abundance of key species to find out detailed information of the prey-predator relations to help develop appropriate conservation and ecosystem-based management plans for the commercial fisheries that operate there.

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