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Diet Shift and Prey Selection of the Native European Catfish, *Silurus glanis*, in a Turkish Reservoir

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ABSTRACT

Diet and prey selection of European catfish were studied in Menzelet Reservoir in Turkey. Diet of European catfish composed of 6 prey fish species, 1 crab (*Potamon* sp.) and 1 leech (*Hirudo* sp.). Diet composition was dominated by fish, including *Alburnus kotsychyi*, *Capoeta angorae*, *Capoeta erhani*, *Luciobarbus pectoralis*, *Silurus glanis* and the most important prey item was *A. kotsychyi*. The diet of European catfish was constituted solely by fish in winter and autumn while crab and leech contributed to a small part of the diet in spring and summer. Therefore, feeding was more heterogeneous in spring and summer than winter and autumn. The values of X^2 and G statistics indicated a significant difference (P<0.05) in the seasonal proportions of prey types consumed and main source of variation comes from *C. angorae* in winter. Prey size did not change according to the predator size. According to the prey selection indices (V), European catfish did not show prey selectivity. *A. kotsychyi* was the most preferred prey, but its selection index was not statistically significant (V=-0.112, X^2=2.509 and P>0.05).

Keywords: European catfish, *Silurus glanis*, diet, prey selection, Menzelet Reservoir

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Türkiye'deki Bir Baraj Gölünde Doğal Olarak Bulunan Yayın Balıklarının (*Silurus glanis*) Besin Değişimi ve Av Seçiciliği

Öz: Bu çalışmada Menzelet Baraj Gölü'ndeki (Türkiye) yayın balıklarının besin değişimleri ve av seçicilikleri çalışılmıştır. Yayın balığının beslenme diyeti 6 balık türü, 1 yengeç (*Potamon* sp.) ve 1 sülük (*Hirudo* sp.)'ten oluşmuştur. Besin kompozisyonunu ağırlıklı olarak *Alburnus kotsychyi*, *Capoeta angorae*, *Capoeta erhani*, *Luciobarbus pectoralis* ve *Silurus glanis*'i içeren balıklar oluşturmuş ve en önemli besinsel av ise *A. kotsychyi* olmuştur. Yayın balıklarının besin kompozisyonu kış ve sonbaharda sadece balıklardan oluşurken, bahar ve yaz döneminde diyette çok küçük bir oranda yengeç ve sülük bulunmuştur. Bu nedenle, bahar ve yaz döneminde besleneme kış ve sonbahara göre daha heterojendir. X^2 ve G istatistik değerlerine göre av çeşitleri mevsimsel olarak değişiklik göstermiş (P<0,05) ve bu varyasyonun kaynağı özellikle kış sezonundan ve *C. angorae*'dan kaynaklanmıştır. Av boyu avcı boyuna göre değişmemiştir. Besin seçicilik indeksine (V) göre, yayın balıkları besinsel seçicilik göstermemişlerdir. En çok tercih edilen besinsel av *A. kotsychyi*'dür ancak bu avın da seçicilik indeksi istatistiki açıdan önemsiz bulunmuştur (V=-0,112, X^2=2,509 ve P>0,05).

Anahtar kelimeler: Yayın balığı, *Silurus glanis*, diyet, besin seçiciliği, Menzelet Baraj Gölü

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Introduction

Silurus genus commonly known as catfish or sheatfish consists of 14 species and the majority of them inhabit Asian freshwaters (Froese and Pauly 2016). Two species of *Silurus* genus, *Silurus glanis* (Linnaeus, 1758) and *Silurus aristotelis* (Garman 1890), inhabit European freshwaters and *S. aristotelis* is an endemic species to Greece while *S. glanis* is native to eastern Europe and western Asia. European catfish is one of the biggest fish species in the freshwaters and inhabits European and Asian rivers, lakes and reservoirs. It has also been introduced to many European countries, including France, Italy, the Netherlands, Spain and the UK due to its popularity among anglers (Banarescu 1989; Krieg et al. 2000; Britton and Pegg 2007; Carol 2007; Carol et al. 2009; Copp et al. 2009). It was also reported in Brazil, South America by Cunico and Vitule (2014). In Turkish inland waters, two *Silurus* species, *S. glanis* and *Silurus triostegus* (Heckel, 1843), inhabit and the latter being endemic to Tigris-Euphrates basin (Ünlü and Bozkurt 1996; Alp et al. 2004; Alp et al. 2011).

Because of the commercial and ecological importance, *S. glanis* has always attracted interest as a potential species for aquaculturists and recreational fishery managers. Therefore a number of studies have been carried out about its artificial reproduction (Haffray et al. 1998; Adamek et al. 1999; Brzuska and Adamek 1999; Linhart et al. 2002; Czarnecki et al. 2003), reproduction characteristics (Alp et al. 2004), growth parameters (Harka 1984; Alp et al. 2011; Saylar 2014), feeding behavior (Doğan Bora and Gül 2004; Wysujack and Mehner 2005; Carol et al. 2009; Moreno- Valcárcel et al. 2013; Pavlovic et al. 2015) and habitat usage (Carol 2007; Slavik et al. 2007). The ecology of its wild populations is poorly known, probably because of the difficulty of sampling such a large species in large rivers or lentic ecosystems (Carol 2007; Copp et al. 2009) and therefore the studies were generally carried out for introduced populations or aquaculture purposes.

It is important to know diet compostion and prey selection of the piscivorous fish in their natural habitats in order to be aware of their interaction with other organisms. Predatory fishes do not only deplete prey supply in the habitat but they may also cause the change in the aquatic food web (Liao et al. 2002). Introduced predatory fish species can also have important implications for native species (Vander Zanden et al. 1999).

Unless we have a well understanding of the relationship between prey and predator, it can not be benefited from the stocks economically and this results in destruction on ecology. In the aquatic environment, one of the most important factor limiting or regulating the small prey fish abundance is the predator fish species and their abundance in the ecosystems. European catfish can play an important role as the main regulator of abundance and of other prey fish in aquatic ecosystems. Therefore, in order to apply an effective fisheries management and biological conservation, we need to know the feeding and food habits of native European catfish and its relations with their preys.

In this study the diet dynamics including; seasonal diet composition, prey selectivity and the prey-predator relations, were studied in order to obtain feeding data of a native European catfish as predator and the rest of fishes, constituting the prey population. The results of this study may be used to design commercial fisheries management strategies and biological conservation. The aims of this study were to 1. describe ontogenetic and seasonal diet changes of European catfish, 2. investigate between predator and prey relations by size, 3. investigate prey selection by a native European catfish in a reservoir, and 4. compare the results with the data of introduced European catfish populations and with data from other habitats.

Materials and Methods

Biological material in the study was collected in 2007, monthly from Menzelet Reservoir located at the eastern Mediterranean region of Turkey. The reservoir has a surface area of 4200 ha and its maximum depth is about 100 m. Total annual commercial catch of the reservoir is 30-40 tonnes, 10-12 of which were of European catfish (Alp et al. 2003). The main fish species in the reservoir are *S.glanis, Capoeta angorae* (Hanko, 1925), *Capoeta erhani* (Turan, Kottelat & Ekmekçi, 2008), *Luciobarbus pectoralis* (Heckel, 1843), *Cyprinus carpio* (Linnaeus, 1758) and *Alburnus kotschyi* (Steindachner, 1863).

Fish samples were collected using by trammel nets and hooklines from the commercial fisheries. Each trammel net and hookline was 100 m in length and a total of 10 trammel nets with between 20 and 120 mm streched mesh size were used. The fishing gears were set during afternoon hours and raised the following mornings. The commercial fishermen also supported the study in terms of providing fish samples. All procedures involving fish were approved by the University of Kahramanmaraş Animal Care and Use Committee. In order to estimate prey fish abundancy in the reservoir, fish species from catches with trammel nets were identified, counted and weighed according to species. The percentage composition of the prey fish were determined. Total lengths (TL, cm) and total weights (W, g) of the each European catfish were measured (±0.1 cm and ±1.0 g accuracy) and they were dissected and then their stomachs were obtained in the fishermen building. Stomachs of each European catfish were cut open and the contents flushed onto a plastic plate. Prey organisms found in the stomachs were identified to species and their wet weights and total lengths were recorded.

In order to express prey importance, the percentage of relative importance index *(%IRI*) (Pinkas et al. 1971; Cortes 1997; Liao et al. 2002) and three-dimensional graphical representation (Cortes 1997) were used. The percentages and relative importance index *(IRI*) were calculated following equations;

$$\%N_i = \frac{100 * Ni}{\sum_{i=1}^{n} Ni}$$

$$\%FO_i = \frac{100 * FOi}{\sum_{i=1}^{n} FOi}$$

$$\%W_i = \frac{100 * Wi}{\sum_{i=1}^{n} Wi}$$

$$IRI_i = (Ni\% + Wi\%) * FOi\%$$

$$\%IRI_i = \frac{100 * IRIi}{\sum_{i=1}^{n} IRIi}$$

where n is the total number of prey in the examined stomach and Wi and Ni are the the total wet weight and number of prey. FOi is the number of European catfish stomachs containing prey organism "i". Three-dimensional graph representations were made with *%N*, *%W* and *%FO*. This provides a good depiction of prey importance (dominant or rare), predator feeding strategy (specialized or generalized) and degree of feeding homogenity in the predator population (Cortes 1997). Each point on the graph represents the percent of occurrence and abundance (in weight and number) for the prey category. Any point located at 100% *FO*, 100% *W* and 100% *N* is the dominant prey taxon. Conversely, points located near the origin of the three axes represent rare prey types. A cluster of points located close to 100% *FO* and the origin of the other two axes (*W%* and *N%*) would indicate a generalized diet. In contrast, a point close to 1% *FO*, 100% *W* and 100% *N* would indicate a specialized diet (Cortes 1997; Alp et al. 2008).

The prey selection index V was calculated to estimate prey preference by European catfish with the following equation (Pearre 1982);

$$V_a = \frac{(a_d * b_e) - (a_e * b_d)}{\sqrt{(a * b * d * e)}}$$

where V_a is Pearre's index for European catfish selection of species a, a_d is relative abundance of species a in diet, b_e is relative abundance of all other species in the environment, a_e is relative abundance of species a in the environment, and b_d is relative abundance of all other species in the diet. Values without subscripts are expressed as follows: $a = a_d + a_e$, $b = b_d + b_e$, $d = a_d + b_d$, $e = a_e + b_e$. Selection index (V_a) is statistically tested using the Chi-square test: $X^2 = n * V^2$. Where, $n = a_d + a_e + b_d + b_e$. This index ranges between 1 (strong positive selection) and -1 (strong negative selection), with a value of zero indicating neutral selection (Pearre 1982).

In order to test for independence between prey types and season, two-way contingency table analysis were employed and the source of variations was identified with the X^2 and G statistics (Cortes 1997; Oh et al. 2001). Some prey categories (<5) were ignored in the test, because the cells having frequencies lower than 5 should be ignored or pooled into a larger category in this test (Sokal and Rohlf 1995).

Results

Size composition

A total of 244 European catfish individuals were used for the study. Total lengths±SD of the fish were 97.3±26.9 cm in winter (N=87), 82.3±36.59 cm in spring (N=80), 74.1±43.9 cm in summer (N=38) and 78.3±51.44 cm in autumn (N=39) (Figure 1). According to Kolmogorov-Smirnov 2-sample test, there was no significant differences in size distribution between summer and autumn ($P>0.05$), however they were significant among the other seasons ($P<0.05$).

Prey composition

The stomach contents of 244 European catfish were examined, 124 fish (50.8%) had empty stomachs and 120 contained prey (49.2%). Percentage of European catfish containing prey was lowest in spring (40.0%) and above 50.0% in other seasons (51.7% in winter, 58.0% in summer and 53.8% in autumn).

Cyprinids (mainly *A. kotschyi*, *C. angorae* and *C. erhani*) were found to be the most important prey group for European catfish population in Menzelet Reservoir; both when looking at their abundances in the stomachs examined, and at their percentages among the total prey population. The other prey categories contributed only small proportions to the diet (Table 1).

A. kotschyi were found in the stomachs of 48 European catfish (40.0%) while *C. angorae* were found in 26 stomachs (21.7%), *C. erhani* in 8 stomachs (6.7%), *L. paectoralis* in 13 stomachs (10.8%) and *S. glanis* in 9 stomachs (7.5%). In addition, *C. carpio* were only found in 1 stomach (0.8%). Crab (*Potamon* sp.) (in 2 stomachs) and leech (*Hirudo* sp.) (in 1 stomach) were also represented in the diet of European catfish.

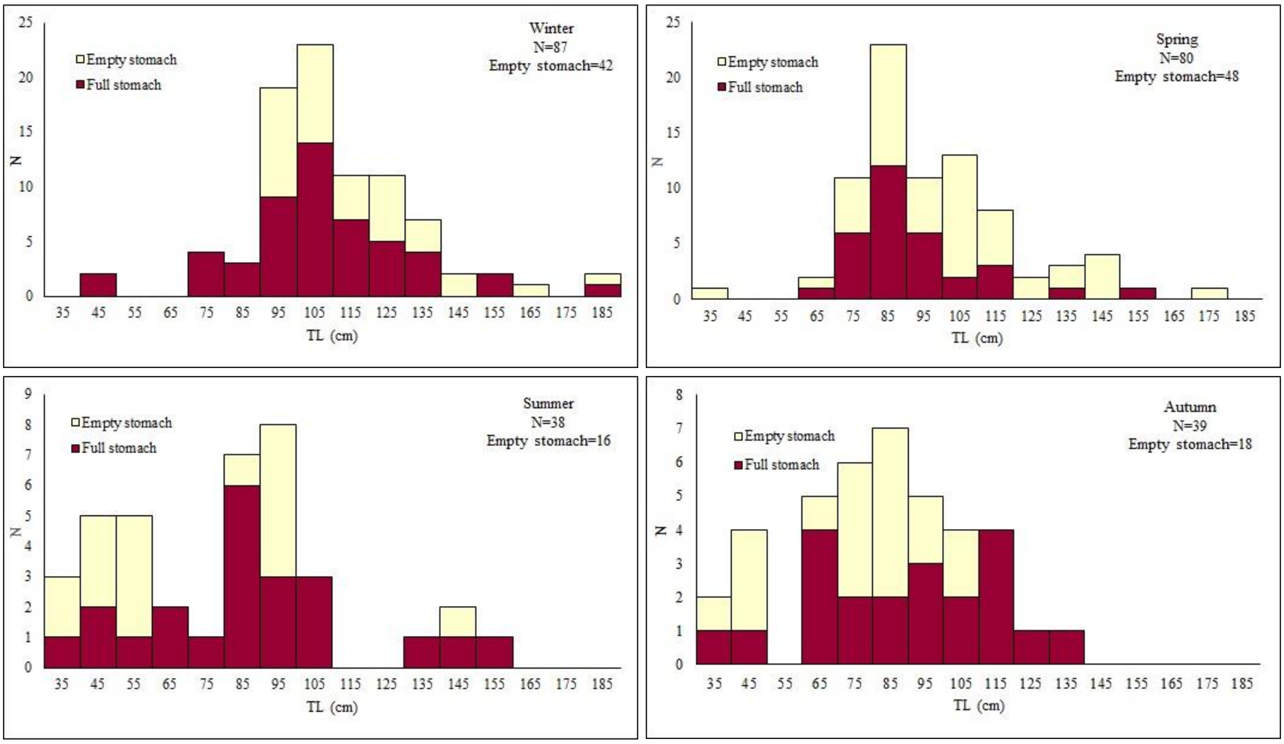

Figure 1. Seasonal size structure of individuals examined for stomach content analysis. (Winter: January, February and March; Spring: April, May and June; Summer: July, August and September; Autumn: October, November and December).

Table 1. Prey composition of European catfish in Menzelet Reservoir. N: Prey number, FO: Frequency of occurrence (*%FO* values were estimated from 120 fish contained preys), W: prey weight and IRI: Relative importance index.

	N	*%N*	FO	*%FO*	W	*%W*	IRI	*%IRI*
Fish skeleton	105	21.7	45	37.5	2325.4	12.3	1275.0	22.7
Alburnus kotschyi	258	53.3	48	40.0	6117.0	32.4	3328.0	59.1
Capoeta angorae	41	8.5	26	21.7	3705.9	19.6	609.8	10.8
Capoeta erhani	23	4.8	8	6.7	1081.3	5.7	70.4	1.3
Luciobarbus pectoralis	27	5.6	13	10.8	3257.1	17.2	246.2	4.4
Silurus glanis	13	2.7	9	7.5	1754.0	9.3	90.0	1.6
Cyprinus carpio	2	0.4	1	0.8	528.0	2.8	2.6	0.0
Crab (*Potamon* sp.)	7	1.4	2	1.7	111.8	0.6	3.4	0.1
Leech (*Hirudo* sp.)	8	1.6	1	0.8	12.0	0.1	1.4	0.0
	484	100.0			18892.5	100.0	5626.8	100.0

The diet of 120 European catfish contained 484 prey items, including 105 undefined fish skeletons, 258 *A. kotschyi*, 41 *C. angorae*, 23 *C. erhani*, 27 *L. pectoralis*, 13 *S. glanis*, 2 *C. carpio*, 7 crabs (*Potamon* sp.) and 8 leeches (*Hirudo* sp.). Total wet weight of 484 prey items was 18892.5 g and in terms of weight, *A. kotsvhyi* constituted 32.4%, *C. angorae* 19.6%, *C. erhani* 5.7%, *L. pectoralis* 17.2%, *S. glanis* 9.3% and *C. carpio* 2.8%.

The relative importance index *(%IRI*) indicated that *A. kotschyi* had a larger importance *(%IRI*=59.1) than other prey items.

Difference of diet by season and size class

The diet of European catfish in Menzelet Reservoir was dominated by *A. kotschyi* and *C. angorae* in all season. *A. kotschyi* accounted for >30% of the diet according to abundance, occurrence and weight (Figure 2). Diet composition of European catfish in spring and summer indicated more diversity than those of winter and autumn. The diet was constituted by only prey fish in winter and autumn, however, crab (*Potamon* sp.) and leech (*Hirudo* sp.) constituted a small part of the diet in spring and summer.

According to the two-way contingency analysis, the grand total X^2- and *G*-values indicate a significant difference (P<0.05) in the seasonal proportions of prey organisms consumed (Table 2). The main source of variation comes from *C. angorae* among prey organisms especially in winter season.

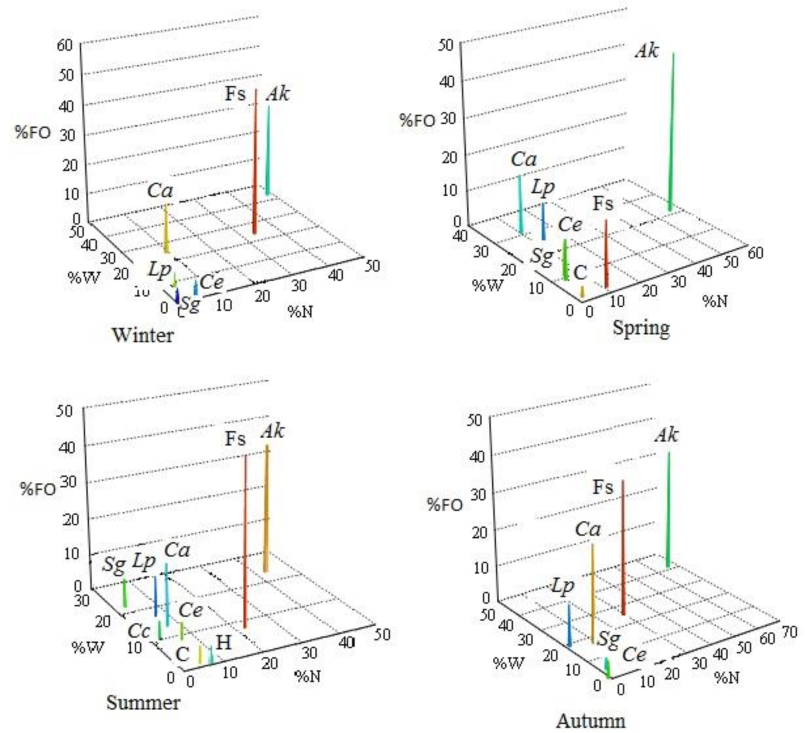

Figure 2. Three-dimensional representation of seasonal stomach contents of European catfish in Menzelet Reservoir. *Ak*: *A. kotschyi*, *Ca*: *C. angorae*, *Ce*: *C. erhani*, *Lp*: *L. pectoralis*, *Cc*: *C. carpio*, *Sg*: *S. glanis*, Fs: Fish skeleton, C: Crab (*Potamon* sp.) and H: Leech (*Hirudo* sp.).

Table 2. Contingency table analysis of the seasonal variations of 4 different categories of prey found in the stomachs. Values are total number of prey observed in each season, with expected values given in the parentheses. The bold values of X^2 and *G* statistics indicate highly significant (P<0.05).

	Winter	Spring	Summer	Autumn	N_i	χ^2	G_i
Alburnus kotschyi	21 (35)	60 (59)	82 (78)	95(86)	258 (258)	6.76	7.67
Capoeta angorae	15 (5)	7 (10)	9 (12)	10 (14)	41 (41)	22.79	16.06
Capoeta erhani	5 (3)	5 (5)	6 (7)	7 (8)	23 (23)	1.61	1.39
Luciobarbus pectoralis	6 (4)	8 (6)	8 (8)	5 (9)	27(27)	3.44	3.59
N_i	47 (47)	80 (80)	105 (105)	117 (117)	349 (349)		
χ^2	27.93	1.58	1.10	3.99		34.60	
G_i	21.48	1.63	1.17	4.43			28.71

$\chi^2_{(0.05)}$ (df: 3)= 7.815; $\chi^2_{(0.05)}$ (df: 9)= 16.919

More consumption of *C. angorae* by European catfish in winter season may be due to more intensive *C. angorae* stock in the reservoir.

Relationship between predator size and prey size

The prey fish size in the diet of European catfish varied from 4.8 to 39.4 cm in total length (the mean length±SD 13.9±2.1 cm) (Figure 3) while the predator size varied from 30.9 to 187.0 cm in total length (mean length±SD 85.7±20.3).

Prey size did not change according to the predator size. The coefficient of determination (R^2) was very small thus implying almost no relationship between predator and prey sizes. This also indicates that European catfish did not select their prey based on the prey size, just preyed upon fish of all size.

Prey selection

In order to estimate prey fish abundance in the reservoir, a total of 15028 fish specimens were caught. From these, 11454 were *A. kotschyi* (79.8%), 1364 *C. angorae* (9.5%), 876 *C. erhani* (6.1%), 832 *L. pectoralis* (5.8%), 258 *C. carpio* (1.8%) and 244 *S. glanis* (1.7%). Similar results of prey fish abundance were estimated in the diet of European catfish. A total of 364 prey fish were determined in the diet and from these, 258 were *A. kotschyi* (70.9%), 41 *C. angorae* (11.3%), 23 *C. erhani* (6.3%), 27 *L. pectoralis* (7.4%), 2 *C. carpio* (0.5%) and 13 *S. glanis* (3.6%).

According to the prey selection indices (*V*), European catfish in Menzelet Reservoir did not show prey selectivity. Estimated prey selection indices of the prey fish were statistically insignificant (P>0.05)

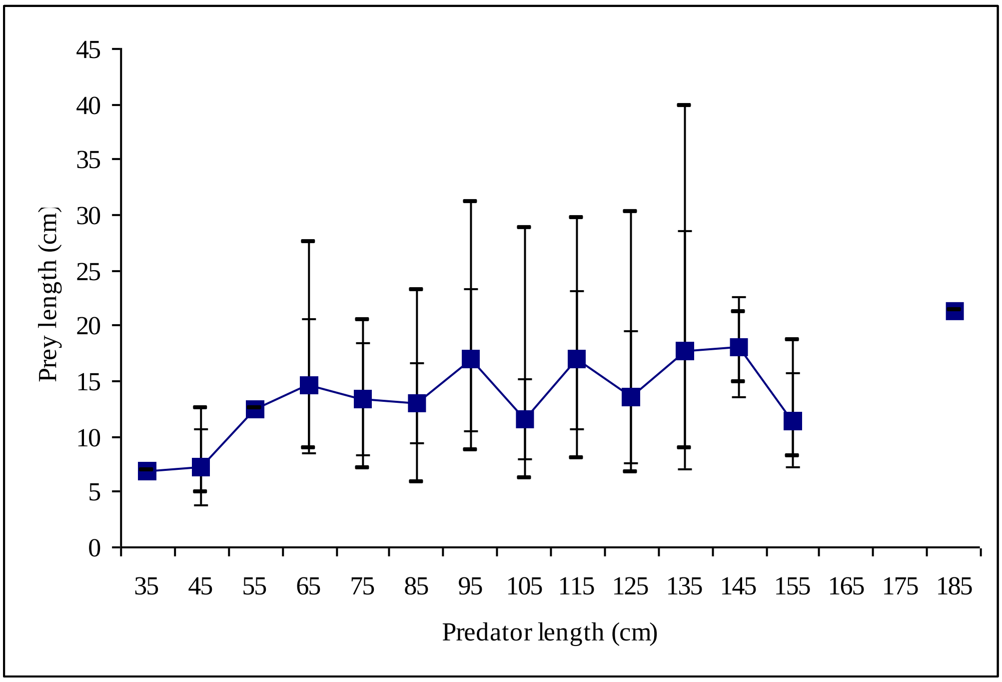

Figure 3. Relationship between prey and predator size of the European catfish in Menzelet Reservoir. Vertical lines indicate minimum, maximum and ±SD while solid squares indicate the mean prey lengths value.

(Figure 4). *A. kotschyi* was the most preferred prey, its selection index was not significant (V=-0.112, X^2=2.509 and P>0.05).

Discussion

The diet of European catfish in Menzelet Reservoir was based on 6 fish species (*A. kotschyi*, *C. angorae*, *C. erhani*, *L. pectoralis*, *C. carpio* and *S. glanis*) mostly cyprinid fishes. In addition, 1 predator (30.9 cm in length) consumed 8 leeches while 2 predators (54.9 cm and 62.3 cm in length) consumed 7 crabs. In the present study minimum size of the catfish was 30.9 cm in total length. If there were smaller catfish in the sample, it might be possible to find a more vertebrae in the stomach contents. European catfish larvae of 10-12 cm in total length are fed by invertebrate such as *Copepoda*, *Cladocera*, and *Tendipedidae* (Copp et al. 2009) and the individuals less than 30 cm in total length consume mainly invertebrate and then shifting to prey upon cyprinids at larger sizes (Rossi et al. 1991; Carol et al. 2009) and crayfish (Carol et al. 2009). Based on the previous studies, European catfish has a large dietary variation and mostly feed on fish species in addition to vertebrates such as frogs, birds and rodents (Carol et al. 2009; Orlova and Popova 1976; Omarov and Popova 1985; Adamek et al. 1999; Czarnecki et al. 2003; Doğan Bora and Gül 2004; Wysujack and Mehner 2005). European catfish diets were dominated by cyprinid fishes in some previous studies but also by other prey fish species such as percids, stickleback, shads, northern pike, Euroepan catfish, syngnathids, sandsmelts, lampreys, sturgeons, mullets, European eels and rainbow trout (Abdurakhmanov 1962; Bekbergenov and Sagitov 1984; Czarnecki et al. 2003; Doğan Bora and Gül 2004; Mamedov and Abbasov 1990; Omarov and Popova 1985; Orlova and Popova 1976; Orlova and Popova 1987; Pouyet 1987; Mukhamediyeva and Sal'nikov 1980; Stolyarov 1985; Wysujack and Mehner 2005; Rossi et al. 1991; Bruyenko 1971; Carol et al. 2009; Pavlovic et al. 2015). A total of 47 fish species in the studies of diet on European catfish was listed by Copp et al. (2009). In the present study, this table was updated with the new studies and a total of 60 fish species were identified in the diet of European catfish (Table 3). From these, 4 fish species (*A. kotschyi*, *C. angorae*, *C. erhani* and *L. pectoralis*) were first reported with the present study in the diet of European catfish. The diet was based mostly on cyprinid fishes and 33 species from 60 prey fish species were constituted by the members of Cyprinidae (Table 3). The identification of cyprinids of the most important prey for European catfish in the present study is consistent with the previous studies. Some European catfish populations from Spain were reported to mostly feed on swamp crayfish and birds (Carol 2007). However, in the present study any birds, rodents and frogs were not found in the stomachs of European catfish. In the present study, diet of European catfish showed seasonal variation. Diet composition in spring and summer indicated more diversity than that of the winter and autumn. In the contingency table, the main source of variation was due to winter season and *C. angorae*.

Table 3. Natural diet of *S. glanis* and comparison with the results of the present study.

Prey	Reference	Prey	Reference
Acipenser gueldenstaedtii	11	*Hemiculter sp.*	10
Acipenser stellatus	11	*Leuciscus cephalus*	13
Huso huso	11	*Liza sp.*	15
Anguilla anguilla	12	*Luciobarbus pectoralis*	P
Atherina boyeri	5, 11	*Luciobarbus graellsii*	15
Alosa sp.	5,7,8	*Pelecus cultratus*	7
Clupeonelladelicatula	11	*Rhodeus amarus*	5,9
Cobitis sp.	1,5,8,11	*Rutilus aula*	13
Misgumus fossilis	14	*Rutilus frisii kutum*	6
Cobitis taenia	14	*Rutilus rutilus*	2,3,5,11,14,15,16
Abramis brama	5,7,9,11,12,14	*Scardinus erythrophthalmus*	5,9,11,12,14
Alburnus alburnus	1,3,5,9,13,14,15,16	*Vimba vimba*	14
Alburnus kotschyi	P	*Vimba vimba persa*	6
Alburnoides bipunctatus	14	*Esox lucius*	6,8,14,15
Aspius aspius	5,7,14	*Pungitius platygaster*	5,6,8
Barbus brachycephalus	2,5	*Gasterosteus aculeatus*	14
Barbus capito	1	*Lepomus gibbosus*	9,14
Barbus lacerta	1	*Neogobius sp.*	5,8,11,14
Barbus borysthenicus	14	*Gymnocephalus cemuus*	3,12,14
Blicca bjoerkna	1,5,7,9,12,14	*Perca fluviatilis*	3,6,9,11,12,14
Capoeta angorae	P	*Sander lucioperca*	4,5,7,8,11,12,14,16
Capoeta capoeta	1	*Caspiomyzon wagneri*	1,5
Capoeta erhani	P	*Platichthys flesus*	13
Capoetabrama kuschkewitschi	2	*Oncorhynchus mykiss*	9
Carassius carassius	6,10,13,14	*Ameiurus melas*	9
Chalcalburnus chalcoides	1,5	*Silurus glanis*	4,5,7,14, P
Chondrostoma oxyrhynchum	1	*Syngnathus nigrolineatus*	11
Chondrostoma soetta	13	*Nerophis ophidion*	14
Cyprinus carpio	5,8,10,11,15,P	*Birds*	15
Gammarus holbrooki	15	*Procambarus clarkii*	15
Gobio gobio	1,9	*Crab*	P
Tinca tinca	4,8	Leech	P

(1) Abdurakhmanov (1962); (2) Bekbergenov and Sagitov (1984); (3) Czarnecki et al. (2003); (4) Doğan Bora and Gül (2004); (5) Mamedov and Abbasov (1990); (6) Omarov and Popova (1985); (7) Orlova and Popova (1976); (8) Orlova and Popova (1987); (9) Pouyet (1987); (10) Mukhamediyeva and Sal'nikov (1980); (11) Stolyarov (1985); (12) Wysujack and Mehner (2005); (13) Rossi et al. (1991) and (14) Bruyenko (1971); (15) Carol et al. (2009); (16) Pavlovic et al. (2015) P: Present study.

Because, *C. angorae* is a potamodrom species and migrate to the upstream especially in spring and summer seasons (Alp et al. 2015). Therefore, it constitutes a smaller stock in the reservoir in spring and summer season. In these seasons European catfish will find less prey of *C. angore* in the reservoir. Additionally, another reason could be resulted from the seasonal size differentiation of the examined European catfish.

According to the prey selection indices, European catfish in Menzelet Reservoir can be considered as a non-selective predator. Because, selection indices of the preys were not statistically significant (P>0.05) and food of the European catfish strongly influenced by prey availability in the habitat. *A. kotschyi*, which are highly abundant in Menzelet Reservoir were invariably the most important prey category for all seasons and size groups. In the previous studies, European catfish was reported as an opportunistic predator (Stolyarov 1985; Carol et al. 2009; Copp et al. 2009). Spatial and temporal availability of prey is considered the most important factor affecting the diet of European catfish and the predominant prey type reflects the most abundant fish species of suitable size (Omarov and Popova 1985; Copp et al. 2009).

In the present study, the maximum length of the prey consumed by European catfish was 39 cm and prey size did not change according to the predator size. According to the optimal foraging concept, consumers attempt to maximize energy acquisition while minimizing the energetic cost of food uptake by targeting the most abundant, profitable and easily captured prey (Pyke et al. 1977; Akin and Winemiller 2008). In this concept, European catfish in Menzelet Reservoir has preferred the most suitable and most abundant fish, *A. kotschyi*, that it could get by less energy spend.

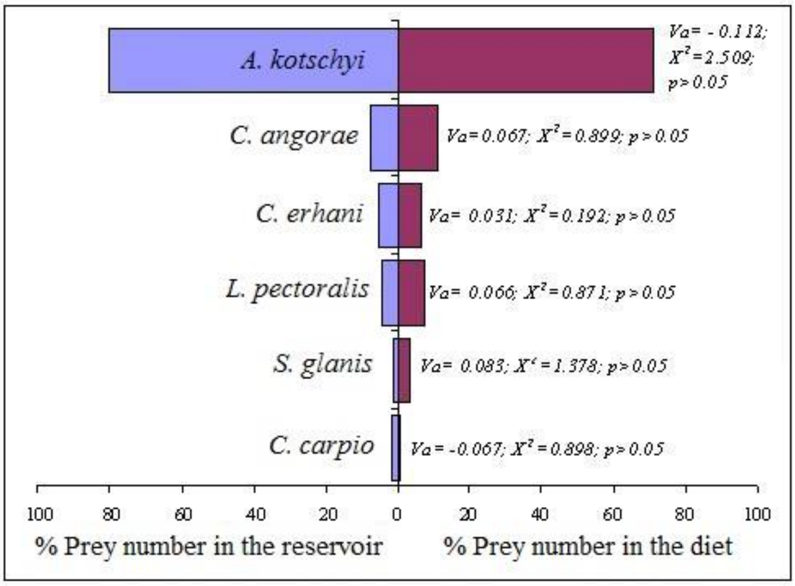

Figure 4. Percentage of different fish species in reservoir (left) and diet (right) of European catfish in Menzelet Reservoir. Values on column indicate Pearres *V* selectivity indices.

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