

FEEDING PROPERTIES OF COMMON CARP (*Cyprinus carpio* L.,1758) LIVING IN HIRFANLI DAM LAKE

Ali GÜL, Mehmet YILMAZ, Ayşe KUŞÇU, Semra BENZER

Gazi University, Gazi Education Faculty, 06500 Teknikokullar, Ankara, Türkiye.

Abstract

*This study deals with the investigation of the digestive track content and the feeding habits of *Cyprinus carpio* living in Hirfanlı Dam Lake. The study was carried out between August 1996 and July 1997 on 206 *Cyprinus carpio* samples. There were zooplanktonic (*Cladocera*, *Copepoda*, *Ostracoda*, *Rotifera*), benthic (*Diptera*, *Gastropoda*) and phytoplanktonic (*Euglenophyta*, *Cyanophyta*, *Pyrrophyta*, *Chlorophyta*) organisms, plant residues and detritus in the digestive tract of the fish.*

Key words: *Cyprinus carpio, Common carp, Feeding, Hirfanlı Dam Lake*

HIRFANLI BARAJ GÖLÜ'NDE YAŞAYAN SAZAN BALIĞI (*Cyprinus carpio* L.,1758)'NIN BESLENME ÖZELLİKLERİ

Özet

*Bu araştırmada Hirfanlı Baraj Gölü'nde yaşayan *Cyprinus carpio*'nun sindirim kanalı muhteviyatı ve beslenme özellikleri incelenmiştir. Ağustos 1996-Temmuz 1997 arasında yapılan bu çalışmada 206 adet Sazan avlanmıştır. Sindirim kanalı içeriklerinde zooplanktonik (*Cladocera*, *Copepoda*, *Ostracoda*, *Rotifera*), bentik (*Diptera*, *Gastropoda*) ve fitoplanktonik (*Euglenophyta*, *Cyanophyta*, *Pyrrophyta*, *Chlorophyta*) organizmalar, bitki parçaları ve detritus-çamur bulunmuştur.*

Anahtar Sözcükler: *Cyprinus carpio, Sazan, Beslenme, Hirfanlı Baraj Gölü*

1. Introduction

The intensive use of natural sources caused incredible pressure on the food supplies. The importance of plant and animal based protein in balanced nutrition is an undeniable fact. However the shortage of animal based protein causes problems to meet this ever increasing demand and there is an urgent need for the development of alternative production methods. Since fish is rich in protein the proper utilization of water sources is of paramount importance.

Common carp (*Cyprinus carpio* L., 1758) has a very important place among the fish species living in inland waters of the country as regards to its economic value and bre-

eding features. The common carp prefers natural lakes, ponds and deep and slow flowing rivers with detritus bottom and abundant vegetation. The young fish generally live in shallow parts while the elder ones prefer deep waters. They prefer warm waters and they are not very common in high altitude lakes and they have a considerable tolerance against the lack of oxygen. It has an important place among cultured species due to its omnivore nature, rapid growth, ease of keeping in closed regions and it relatively tasty meat. They reach to sexually maturity at 3-4 years of age and spawn their eggs between April and June. They can reach to a length of 1 m and the weight of 40 kg (1).

Although there been numerous studies related to *Cyprinus carpio* in Turkey the studies related to its feeding biology and environmental adaption are highly limited. Some of the studies related to the feeding habits of *Cyprinus carpio* are the following:

Tanyolaç and Karabatak (2) investigated the digestive content of *Cyprinus carpio* in Mogan Lake while Atasagun (3) concentrated on the food types and their seasonal variations. Karaca (4), investigated the growth and feeding behavior of the common carp in Hirfanlı Dam Lake, Çetinkaya (5) examined its breeding and feeding behaviors in Akşehir Lake, Pala et al. (6) investigated the digestive content of *Cyprinus carpio* in Keban Dam Lake, Çetinkaya et al. (7) and Kırankaya and Ekmekçi (8) examined the growth properties of *Cyprinus carpio* in Beyşehir Lake and Gelingüllü Dam Lake.

Mc. Crimmon (9) investigated the feeding habits of *Cyprinus carpio* in Canada, Summerfelt et al. (10) in Oklahoma and Cherry and Guthrie (11) in Canada and Hana and Manal (12) Iraq. Saikia and Das (13) examined its feeding ecology in India.

The determination of the feeding biology of *Cyprinus carpio*, which has an important economic value and consumption potential for Turkey, is very important for the proper utilization of Hirfanlı Dam Lake which has a considerable water capacity.

2. Material and Method

Hirfanlı Dam Lake was constructed on Kızılırmak River 70 km south of Kırıkkale province, with an altitude of 856 m, volume 7.63×10^9 m³ and a maximum reservoir of 320 km² (Figure 1). The Dam Lake was started to operate in 1959 (14). The zooplankton and phytoplankton in the lake which are amongst the basic food of fish are listed in Table 1 (14). Annelida and Diptera larvae (*Chironomus*) constitute the majority of the benthic fauna of the dam lake (14).

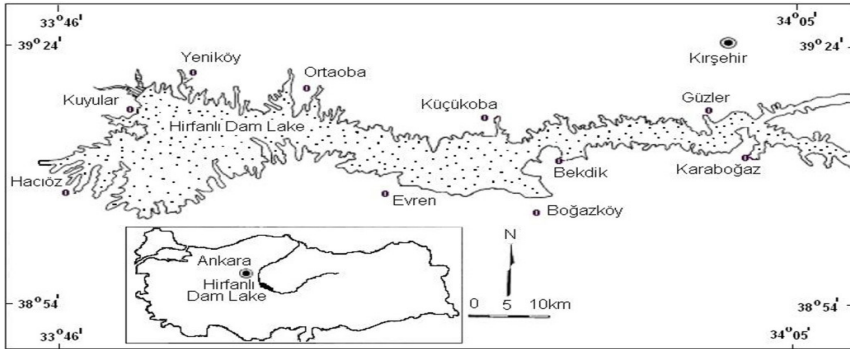


Figure 1. Hirfanlı Dam Lake

Tablo 1. Zooplankton and phytoplankton in Hirfanlı Dam Lake

ZOOPLANKTON		PHYTOPLANKTON	
Copepoda	<i>Diaptomus</i> sp.	Cyanophyceae	<i>Gleocapsa</i> sp.
	<i>Nauplius</i> (larva)		<i>Oscillatoria</i> sp.
	<i>Cyclops</i> sp.		<i>Aphanizomenon</i> sp.
Cladocera	<i>Daphnia</i> sp.		<i>Microcystis</i> sp.
	<i>Diaphanosoma</i> sp.		<i>Merismopedia</i> sp.
	<i>Chydorus</i> sp.	Chlorophyceae	<i>Ankistrodesmus</i> sp.
	<i>Macrothrix</i> sp.		<i>Phormidium</i> sp.
	<i>Alona</i> sp.		<i>Pediastrum</i> sp.
	<i>Moina</i> sp.		<i>Closterium</i> sp.
	<i>Bosmina</i> sp.		<i>Oocystis</i> sp.
Rotifera	<i>Keratella</i> sp.	Bacillariophyceae	<i>Diatom</i> sp.
	<i>Trichocerca</i> sp.		<i>Surirella</i> sp.
	<i>Polyarthra</i> sp.		<i>Gyrosigma</i> sp.
	<i>Synchaeta</i> sp.		<i>Cymatopleura</i> sp.
	<i>Hexarthra</i> sp.		<i>Synedra</i> sp.
	<i>Asplanchna</i> sp.		<i>Nitzschia</i> sp.
	<i>Lepadella</i> sp.		<i>Cymbella</i> sp.
	<i>Filinia</i> sp.		<i>Cyclotella</i> sp.
			<i>Navicula</i> sp.
			<i>Ceratium</i> sp.
	Dinophyceae		

There were 206 *Cyprinus carpio* caught monthly between August 1996 and July 1997. The fish caught with nets with different mesh sizes were kept in 4% formaldehyde. The fork lengths of the samples were measured and the weights were determined by the use of scales with accuracy 0.1g. The ages of the samples were determined by the use of scales (15). The genders were determined from the gonads. The

digestive tracks of the fish were taken out. The residual tissues around the digestive tracks were cleaned out and their length was measured in mm. They were latter kept in 4% formaldehyde. The digestive tracks were opened and the ones which contain organisms, detritus and plant pieces were regarded as “full” and the ones which do not contain any of these were regarded as “empty”. The track contents were put in glass measuring cylinders, kept there for 24 hours and their volumes were determined in cm^3 . Using these volumes the monthly averages of the track contents were determined. The volume of each track content were summed up and divided to the samples caught at each month to determine the food content for each sample in cm^3 . The types of food taken according to the seasons and the percentages were qualitatively and quantitatively determined under microscope. The animal and plant base organisms were accurately counted (15).

Based on these monthly analyses the average monthly % composition of each organism and the average number of monthly organisms consumed by each *Cyprinus carpio* species were determined. The seasonal variations in the types, compositions and relative abundance of the food preferred by *Cyprinus carpio* were also calculated .

3. Results

Digestive track contents and the food types

The type and % composition of the zooplanktonic and benthic organisms determined after the analyses of the digestive track contents of the *Cyprinus carpio* species caught monthly in Hirfanlı Dam Lake are tabulated in Table 1 the relative abundance of phytoplankton and other residues are listed in Table 3. The digestive track contents of 127 common carp out of 206 were determined and there were phytoplanktonic, zooplanktonic and benthic organisms, mud, detritus and plant residues in their digestive track. The analyses revealed the presence of 38 492 animal based organisms. 63.94% of these organisms were classified as zooplanktonic and 36.06% as benthic.

Among the zooplanktonic organisms consumed 40.28% was Cladocera, 12.04% was Copepoda, 7.67% was Rotifera and 3.95% was Ostracoda. Cladocera group was constituted by *Daphnia* (19.26%), *Ceriodaphnia* (9.11%), *Diaphanosoma* (5.88%), *Chydorus* (4.29%) and *Alona* (1.74%); Copepoda group included *Diaptomus* (9.51%) and *Cyclops* (2.53%); Rotifera was formed by *Filinia* (4.16%), *Hexartha* (2.01%) and *Keratella* (1.5%) and Ostracoda contained *Cypris* (3.95%) (Table 3).

There were *Chironomus* (23.83%), *Corethra* (9.69%) and *Oligochaeta* (2.54%) species in Diptera group which contains all of the benthic organisms encountered. Apart from that there were Gastropoda species occasionally observed in March, April and May (Table 2).

Among the phytoplanktonic organisms observed in digestive tract content were

Cyanophyta, Euglenophyta, Chrysophyta and Chlorophyta (Table 3). The monthly analyses of digestive content are listed in Table 2 and Table 3. Phytoplanktonic organisms were mostly observed in August, September, October and April. The number of species and their abundance are tabulated in Table 3. The species belonging to Cladocera from zooplankton were observed almost in every month. Among them *Daphnia* was mostly observed in October and February, *Ceriodaphnia* in September and May, *Diaphanosoma* in June, *Chydorus* in November and *Alona* in April. Among the Copepoda group *Diaptomus* was most frequently observed in December and April and *Cyclops* in June. *Cypris* from Ostracoda was most frequent in August. When we come to Rotifera group *Keratella* was most abundant in August, *Hexarthra* in March and *Filinia* in April. Among the benthic organisms *Chironomus* from Diptera was observed almost every month but mostly in October and November, *Corethra* in November and *Oligochaeta* in July (Table 2). The organisms which could not be defined, detritus and mud were most frequently observed in June, August, September and October (Table 3).

Table 2. The zooplanktonic and benthic organisms observed in the tract contents of *Cyprinus carpio* living in Hirfanlı Dam Lake.

MONTHS	Number of fish caught		ZOOPLANKTONIC ORGANISMS										BENTHIC ORGANISMS					TOTAL ORGANISMS NUMBER	TOTAL % N									
	Number of fish with filled tracts	Number of fish with empty tracts	CLADOCERA			COPEPODA			ROTIFERA				DIPTERA															
			<i>Daphnia</i>	<i>Ceriodaphnia</i>	<i>Daphanosoma</i>	<i>Chydorus</i>	<i>Alona</i>	TOTAL	<i>Diaptomus</i>	<i>Cyclops</i>	TOTAL	<i>Filinia</i>	<i>Hexarthra</i>	<i>Keratella</i>	<i>Chironomus</i>	<i>Corethra</i>	<i>Oligochaeta</i>			TOTAL % N								
August	22	18	4	4	4.72	6.96	8.46	5.92	4.16	30.22	13.42	4.95	18.37	10.71	4.61	3.23	2.97	10.81	70.11	20.44	5.52	3.93	1.8	11.96	1065627.68	9.18		
September	14	14	-	-	41.91	19.86	7.11	4.09	-	72.97	6.52	0.5	7.02	2.53	2.16	1.37	1.99	5.52	88.04	8.56	1.6	1.8	-	-	-	-	-	
October	13	9	4	4	17.17	9.09	8.62	-	5.33	40.21	6.34	-	6.34	3.66	1.77	4.56	3.92	10.25	60.46	30.59	6.54	2.41	-	-	-	-	-	
November	13	8	5	-	1.52	-	7.91	0.57	10.00	4.16	-	4.16	0.97	1.12	1.58	2.7	1.58	2.7	17.83	49.7	30.46	2.01	-	-	-	-	-	
December	16	7	9	31	26	-	-	-	-	31.26	30.19	-	30.19	7.02	-	-	-	-	68.47	21.85	9.68	-	-	-	-	-	-	
January	17	7	10	39	83	-	-	-	-	39.83	19.15	-	19.15	-	5.95	-	-	5.93	64.91	28.48	6.61	-	-	-	-	-	-	
February	20	9	11	50	32	-	-	-	2.6	52.92	16.18	-	18.18	7.47	-	-	-	-	78.57	21.43	-	-	-	-	-	-	-	
March	33	24	9	27	52	4.81	7.55	-	-	39.98	25.37	-	25.37	8.2	10.21	11.33	21.54	94.99	5.01	-	-	-	-	-	-	-	-	
April	23	11	12	-	4.73	-	5.53	9.83	20.09	28.07	4.11	32.18	6.2	3.56	26.66	30.22	88.69	9.71	1.6	-	-	-	-	-	-	-	-	
May	14	10	4	19	51	10.14	8.7	2.51	1.87	42.73	10.91	2.55	13.46	3.82	4.3	6.27	10.57	70.63	20.9	5.8	2.67	-	-	-	-	-	-	
June	11	7	4	9	73	7.32	16.93	4.52	2.51	41.01	5.60	16.07	22.27	5.95	-	-	3.56	3.56	72.79	19.5	5.91	5.8	-	-	-	-	-	
July	10	3	7	1.62	4.58	3.4	-	-	-	9.60	-	10.49	10.49	2.51	-	-	15.95	15.95	38.55	20.13	12.11	19.21	-	-	-	-	-	
TOTAL	206	127	79	7414	3506	2265	1650	671	15506	3662	4634	4634	152	578	770	1602	2950	24611	9173	3731	977	-	-	-	-	-	-	-
%N	-	61.65	38.35	19.26	9.11	5.58	4.29	1.74	40.28	9.51	12.04	12.04	3.95	1.5	2.01	4.16	7.67	63.941	23.83	9.69	2.54	-	-	-	-	-	-	-

Monthly variations in feeding ratio and feeding rate

It was observed that the feeding ratio and the feeding rate of the common carp were varied according to months (Table 4). The highest and the lowest ratios of the fish with full tracks were observed in September (100%) and July (30%). It was observed that the fish with empty tracks were dominant in December, January and February and the number of the fish with full tracks were dominant August, September, October, March and April. The largest tract volume was observed in September with 7.74 cm³. The lowest volumes were found in January with 1.35 cm³, in February with 1.92cm³, in April with 1.48 cm³ and in July with 1.7 cm³. The monthly mean fork length of the *Cyprinus carpio* individuals hunted varied between 183.95 mm and 366.27 mm. This value were found to be between 188.50 mm and 357.71 mm for the individuals with full tracts. The tract lengths of the fish were between 285.04 mm and 578.18 mm according to months. These values changed between 273.75 mm and 586.42 mm for the fish with full tracts (Table 4).

Table 4. The mean fork lengths, mean digestive tract lengths and volume of food per individual for *Cyprinus carpio* with full tracts living in Hirfanlı Dam Lake.

MONTHS	N	Fish with filled tracts % N	Fish with empty tracts % N	Average fork lengths of the fish caught (mm) (Min-Max)	Average fork lengths of the fish with filled tracts (mm) (Min-Max)	Average length of the digestive tracts of the fish (mm) (Min-Max)	Average length of the digestive tracts of the fish with filled tracts (mm) (Min-Max)	The volume of the food content Per fish (cm ³) (Min-Max)
AUGUST	22	81.82	18.18	183.95 (127-226)	188.5 (138-226)	285.04 (240-360)	290.05 (240-360)	5.01 (0-12)
SEPTEMBER	14	100	-	233.14 (169-362)	233.14 (169-362)	341.92 (230-595)	341.92 (230-595)	7.74 (0-15)
OCTOBER	13	69.23	30.77	247.15 (207-380)	252.88 (225-340)	355.23 (270-500)	361.55 (270-500)	5.23 (0-12)
NOVEMBER	13	61.54	38.46	191.3 (139-225)	190.75 (139-223)	285.53 (236-370)	273.55 (236.350)	4.05 (0-10)
DECEMBER	16	43.75	56.25	245.68 (185-280)	253.85 (220-280)	299.75 (250-380)	309.85 (250-380)	2.5 (0-11.7)
JANUARY	17	41.18	58.82	219.88 (186-252)	219.57 (186-260)	300.76 (237-396)	295.57 (237-396)	1.35 (0-6.3)
FEBRUARY	20	45	55	216.9 (154-270)	211.11 (154-254)	286.7 (196-489)	284.11 (196-430)	1.92 (0-6.5)
MARCH	33	72.73	27.27	224.33 (152-272)	227.79 (152-272)	327.6 (205-482)	335.45 (209-482)	3.07 (0-10)
APRIL	23	47.83	32.17	263.86 (170-312)	261.27 (170-312)	477.97 (236-609)	476.96 (236-600)	1.48 (0-6)
MAY	14	71.43	28.57	279.85 (231-387)	278.9 (231-387)	460.85 (303-760)	444.1 (303-760)	4.12 (0-9)
HAZIRAN	11	63.64	38.36	366.27 (260-400)	357.71 (260-389)	578.18 (400-850)	586.42 (400-799)	6.09 (0-15)
JULY	10	30	70	248.8 (132-369)	236.6 (168-380)	404.7 (221-705)	485.3 (255-705)	1.7 (0-7)

4. Discussion

Cyprinus carpio living in Hirfanlı Dam lake was found to be between I-V years of age. The monthly investigation of the digestive tracts of the fish showed animal and plantation based organisms, mud and detritus. Although the type organisms consumed showed difference zooplanktonic and benthic organisms, detritus and mud were present throughout the year.

The fact that feeding condition of common carp showed difference according to months and the type of organisms it consumed exhibited seasonal variations may be attributed to the fact that it changes its location in certain periods. However the presence of benthic organisms, detritus and mud in its digestive tract throughout the year indicates that the fish feed at the bottom of the lake. The digestive tract content of *Cyprinus carpio* living in Hirfanlı Dam Lake found in this study show certain similarities with some other studies in literature.

Numann (16) reported that *Cyprinus carpio* mainly feed on plankton (*Cyclops*, *Bosmina* and *Alona*) insects (*Chironomid* larvae). Summerfelt et.al (10), Cherry and Guthrie (11) stated that detritus and zooplanktonic organisms such as Cladocera, Copepoda and Diptera constituted the large part of the monthly and annual food of *Cyprinus carpio* in waters they investigated. Tanyolaç and Karabatak (2) the digestive tract content of the common carp in Mogan Lake largely contained algae, zooplankton (Cladocera, Copepoda, Rotifera, Ostracoda), benthic organisms (Diptera mainly *Chironomus*), plant residues and mud. Atasagun (3), found zooplanktonic and phytoplanktonic organisms, detritus and mud in the digestive tract of common carp in Mogan Lake. They observed that among the animal based organisms 67.58% was zooplanktonic and 32.42% benthic organisms. The most common zooplanktonic organisms observed in the digestive tract of the fish were Cladocera (35.65%), Copepoda (23.80%), Rotifera (4.34%) and Ostracoda (3.78%). The most frequently observed benthic organisms in the digestive tracts were Diptera with 29.02% and *Oligochaeta* with 2.82%. There were also phytoplanktonic organisms such as Cyanophyta, Chlorophyta, Chrysophyta and Euglenophyta and water plants. Karaca (4) reported zooplanktonic and benthic organisms and algae in the digestive tracts of *Cyprinus carpio* in his study he carried out in Hirfanlı Dam Lake. They reported that the majority of the food found in the digestive tracts was constituted by Chrysophyta from algae with 55.46% followed by benthic organisms with 16.17 % and Copepoda from zooplankton with 8.49 %. Among the animal based organisms which constitutes 33.77 % of the total food consumed 56.72 % was zooplanktonic and 43.28 % was benthic organisms.

There are some differences between the studies related to the digestive tract contents of common carp in literature. Mc. Crimmon (9) reports that common carp consumes Mollusc, Annelida, Crustacea, Insecta and Detritus, water plants and phytoplanktonic organisms. They also state that when animal based food is limited the carp

eats the seeds of water grown plants such as rice and the seeds of wheat, oath and maize. Hana and Manal (12) found eggs of other fish and small fish in the digestive tract of common carp. Çetinkaya (5) reports that although plant based feeding rate is high in Akşehir Lake they observed 1-5 fish in the digestive tract of 17 common carps and the *Chironomid* larvae were seldom seen. Geldiay and Balık (1) states that the natural food of common carp are water fleas, Dipter larvae, small Molluscs, plants and algae.

There were animal and plant based organisms and detritus were present in the digestive tract contents of *Cyprinus carpio* throughout the year. Cladocera and Copepoda from zooplankton and Diptera from benthic organisms were observed in every month. In addition Rotifera (except December-February) and Ostracoda species (except January) were constantly present (Table 2). Cladocera, Copepoda and Rotifera species were less common in December, January and February when benthic organisms especially *Chironomus* from Diptera were consumed. Daphnia from Cladocera and *Diaptomus* from Copepoda were much more common in December, January and February (Table 2). Phytoplanktonic organisms were observed in all the months but mostly in August, September and October (Table 3). Tanyolaç and Karabatak (2) reported that *Chironomus* dominated the digestive tract contents of common carp at the beginning of fall and spring while zooplanktons were dominant between April and September. Atasagun (3) reported that the food content of common carp contains in small amounts of Cladocera (*Ceriodaphnia*) Copepoda (*Diaptomus*), Diptera (*Chironomus*), other species of Copepoda, and Rotifera and Ostracoda (except April and December). Also the consumption of Rotifera and Copepoda was observed to decrease and the consumption of Cladocera was observed to increase in summer months and at the beginning of fall and spring. They also reported that the consumption of benthic organisms (especially *Chironomus*) was observed to increase in spring, fall and winter months and in July. Mc.Crimmon (9) found that, *Oligochaeta* was immediately digested. That was why it was rarely observed in the digestive tract contents. In this study and in Atasagun's (3) study in Mogan Lake there were small amounts of *Oligochaeta* in the digestive contents of the common carp. According to Karaca (4) the highest and the lowest amounts of organisms were observed in October and July with 22.8% and 0.24 %.

The zooplankton, phytoplankton, water plants and detritus constitute the major diet of the *Cyprinus carpio* living in Hirfanlı Dam Lake. These organisms also constitute the main food of *Tinca tinca* living in the lake. These two omnivorous fish are in competition for food. In spite of this the organisms in the lake seem to be abundant enough for both fish. Therefore it can conveniently be claimed the ecological balance of Hirfanlı Dam Lake is adequate enough as regards to planktonic and benthic organisms. Therefore there are no feeding problems for the fish living in the lake.

5. References

1. Geldiay, R., Balık S., (1988). Türkiye Tatlısu Balıkları, Ege Üniversitesi Fen Fakültesi Kitaplar Serisi No: 97,519 s, Bornova, İzmir.
2. Tanyolaç, J., Karatabak, M., (1974). Mogan Gölü'nün Biyolojik ve Hidrolojik Özelliklerinin Tespiti, TÜBİTAK VHAG Yayınlan, No: 255.
3. Atasagun, S., (1991). Mogan Gölü'ndeki Sazan (*Cyprinus carpio* L.,1758) ve Kadife (*Tinca tinca* L., 1758) Balıklarının Besin Tipleri ve Beslenmelerinde Mevsimsel Değişimler, Ankara Üniv, Fen Bilimleri Enstitüsü Yüksek Lisans Tezi, Ankara.
4. Karaca, İ., (1995). Hirfanlı Baraj Gölü (Kırşehir)'nde Yaşayan Sazan (*Cyprinus carpio* L., 1758)'in Büyüme ve Beslenme Özellikleri, Gazi Üniv. Fen Bilimleri Enstitüsü, Yüksek Lisans Tezi, Ankara.
5. Çetinkaya, O., (1992). Akşehir Gölü Sazan Populasyonu (*Cyprinus carpio* L. 1758) Üzerine Araştırmalar I. Büyüme, Boy, Ağırlık İlişkisi ve Kondüsyon, Doğa Türk Zool Derg., Sayı 16,13-29.
6. Pala, G., Tellioglu A., Şen, D., (2003). Keban Baraj Gölü'nde Yaşayan *Cyprinus carpio* (Linnaeus, 1758)'nun Sindirim Sistemi İçeriği, F. Ü. Fen ve Mühendislik Bilimleri Dergisi, 15(2), 135-142.
7. Çetinkaya, S., Çınar, Ş., Özkök, R. ve Erol, K.G. (2006). Beyşehir Gölü'ndeki Sazan Populasyonu (*Cyprinus carpio* L., 1758)'nun Büyüme Özellikleri, I. Uluslararası Beyşehir ve Yöresi Sempozyumu. Beyşehir/Konya 11-13 May 2006, 697-704.
8. Kırankaya, Ş.G., Ekmekçi, F.G., (2004). Gelingüllü Baraj Gölü'nde Yaşayan Aynalı Sazan (*cyprinus carpio* L., 1758)'in Büyüme Özellikleri. Turkish Journal of Veterinary and Animal Sciences, 28, 1057-1064.
9. Mc Crimmon, R.H., (1968). Carp in Canada Fisheries Research Board of Canada, Ottawa, Bulletin 165.
10. Summerfelt, R. C, Mauck, P.E., Mesinger, I., (1971). Food Habits of Carp, *Cyprinus carpio* L., in five Oklahoma Reservoirs, Proc, Annu. Conf. Southeast, Assoc. Game Fish Comm. 24 (1970). 352-377.
11. Cherry D. S., Guthrie, R. K., (1975). Significance of detritus or detritus associated invertebrates to fish production in a new impoundment, J. Fish, Res. Board Con., Vol. 32 (10), 1799-1805.
12. Hana, H. M., Manal, M.A., (1988). Limnological investigation on the Al-Iatifyah common carp (*Cyprinus carpio*) pond (Baghdad-Iraq), ii, food and feeding habits of *Cyprinus capio* L., 1758, Environ, Scr. Health, A, 23 (6), 513-524.
13. Saikia, S. K., Das, D. N., (2008). Feeding ecology of common carp (*Cyprinus carpio* L.) in a rice-fish culture system of the apatani plateau (Arunachal Pradesh, India), Aquatic Ecology, 10.1007/s10452-008-9174-y.
14. DSİ, (1968). Hirfanlı Baraj Gölü Limnolojik Etüd Raporu, Ankara.

15. Lagler, K. F., (1956). Freshwater Fishery Biology, W.M.C. Brown Company Publishers, Dubuque, Iowa, 421.
16. Numann, W., (1958). Anadolu'nun Muhtelif Göllerinde Limnolojik ve Balıkçılık İlmi Bakımından Araştırmalar ve Bu Göllerde Yaşayan Sazanlar Hakkında Özel Bir Etüd, İst. Üniv., Fen Fak. Hidrobiyoloji Monograf: 7,114 s.