

## **The Feeding Biology of *Tinca tinca* L., 1758 Living in Hirfanlı Dam Lake**

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Received: 11.07.2007, Accepted: 15.06.2007

**Abstract:** In this study the feeding characteristics and digestive track content of *Tinca tinca* living in Hirfanlı Dam Lake are investigated. The study was carried out between August 1996 and July 1997 on 241 *Tinca tinca* samples. Among the contents of the digestive tract zooplanktonic (Cladocera, Copepoda, Rotatoria, Ostracoda) bentic (Diptera, Oligochaeta, Gastropoda) and phitoplanktonic organism (Cyanophyta, Chlorophyta, Bacillariophyta, Euglenophyta), plant fragment , various pollens and detritus mud have been identified. The digestive tract contents were dominated zooplanktonic organisms in spring, summer and winter months while bentic organisms were particularly dominant in winter and summer months. It was also observed that the phthoplanktonic organisms were more numerous in August, September, October and November compared to other months. It was also found that the number of individuals with filled digestive tracts was higher in fall and summer months and the filling ratio was observed to be 100% in September.

**Key words:** Hirfanlı Dam Lake, *Tinca tinca*, tench, feeding

## **Hirfanlı Baraj Gölü'nde Yaşayan *Tinca tinca* L., 1758'nin Beslenme Biyolojisi**

**Özet:** Bu araştırmada Hirfanlı Baraj Gölü'nde yaşayan *Tinca tinca*'nın sindirim kanalı içeriği ve beslenme özellikleri incelenmiştir. Ağustos 1996-Temmuz 1997 tarihleri arasında 241 adet kadife balığı

örneği yakalanmıştır. Sindirim kanalı içeriklerinde zooplanktonik (Cladocera, Copepoda, Rotatoria, Ostracoda), bentik (Diptera, Oligochaeta, Gastropoda) ve fitoplanktonik (Cyanophyta, Chlorophyta, Bacillariophyta, Euglenophyta) organizmalar, bitki parçaları, çeşitli polenler ve detritus-çamur saptanmıştır. Sindirim kanalı içeriklerinde zooplanktonik organizmaların sırasıyla ilkbahar, yaz ve kış aylarında, bentik organizmaların ise kış ve yaz aylarında çoğunlukta olduğu saptanmıştır. Fitoplanktonik organizmaların Ağustos, Eylül, Ekim ve Kasım aylarında diğer aylara göre fazla olduğu belirlenmiştir. Sindirim kanalı dolu birey sayısının sonbahar ve yaz aylarında daha fazla, Eylül ayında doluluk oranının %100 olduğu bulunmuştur.

**Anahtar Kelimeler:** Hirfanlı Baraj Gölü, *Tinca tinca*, kadife, beslenme

## Introduction

It is not possible to meet the food demand solely on plant sources. One needs animal based food and protein. One of the major sources of animal based food is water products and especially fish. The nutritious content of the fish is dependent upon whether they are feed in regular and balanced way. Since the growth phenomenon is a result of feeding behavior the importance of the investigation of the feeding behavior becomes much more apparent.

*Tinca tinca* has economic importance and shows a wide range of distribution in the internal waters of Turkey [1, 2]. Bircan [3], Atasagun [4] carried out comprehensive studies on the feeding behavior of *Tinca tinca* in different aqueous systems. Also Petridis and O'hara [5], Petridis [6], Giles et al. [7] also studied the feeding behavior of *Tinca tinca* in different countries. This study is concerned with the investigation of the digestive tract content of *Tinca tinca* living in Hirfanlı Dam Lake in order to elucidate its feeding habits.

## Material and Method

The study was carried out in Hirfanlı Dam Lake constructed in 1959. It is located at 856 m altitude with a capacity of  $7.63 \times 10^9$  m<sup>3</sup> and an area of 320 km<sup>2</sup> [8]. It is 24 km from Ankara-Kırşehir Highway and 30 km from Ankara-Adana highway. There is comprehensive agricultural activity around the lake and Mid-Anatolian land type climate prevails in the region [8]. The lake contains economically important fish such as *Tinca tinca*, *Cyprinus carpio*, *Sander lucioperca* and *Silurus glanis*.

There were 241 *Tinca tinca* caught in the lake between August 1996 and July 1997. Their digestive tracts were removed, measured in mm and kept in 4% formaldehyde [7]. The digestive tract contents were evaluated in accordance to Lagler method [9] and the volume of the tract was measured in  $\text{cm}^3$ . The types of food were determined as total and percentage ratios. The phytoplanktons were counted with the use of plankton counting method [10]. The organisms were identified by the use of various sources [10-22]. The food analysis performed on monthly basis and the average percentage composition of the digestive tract content of the fish was computed according to months. The average number of monthly food consumed by each individual was also determined. The fork lengths, average tract lengths and food contents of all *Tinca tinca* individuals and the ones with the filled digestive tracks were measured according to months.

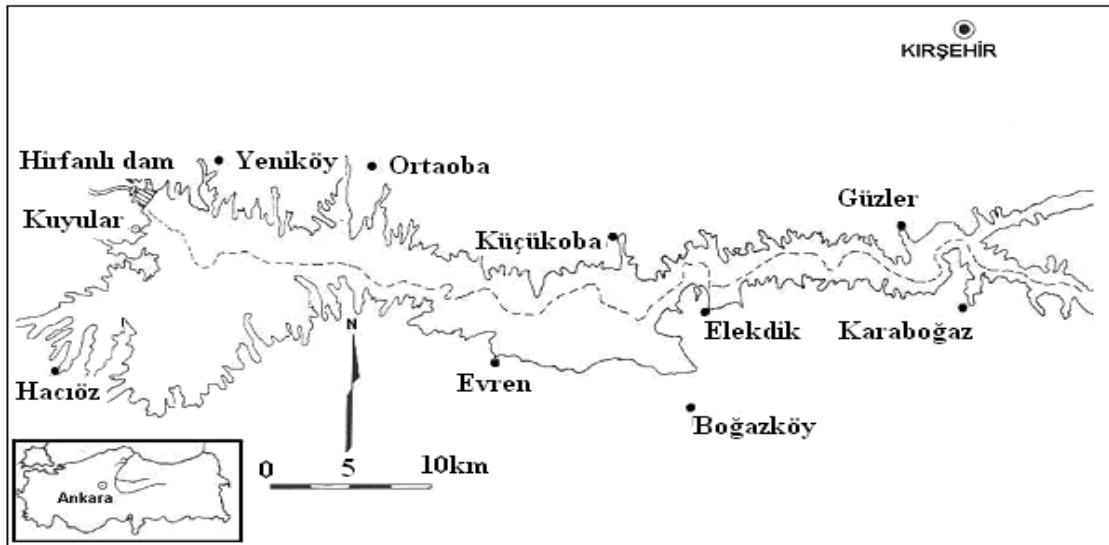


Figure 1. Hirfanlı Dam Lake

## Results

There were only 145 fishes with digestive tract containing food among 241 individual caught throughout the study. The digestive tract content of the fish included phytoplanktonic, zooplanktonic and benthic organisms, plants, various pollens and detritus-mud (Table 1 and 2). In 45695 animal based organisms 63.22% was zooplanktons and 36.78% was benthic organisms. The most widely consumed Zooplanktonic organisms were Cladocera (44.98%), Copepoda (8.36%), Ostracoda

(3.56%) and Rotatoria (6.31%). *Daphnia* (26.75%) was the most consumed and *Alona* (1.73%) and *Bosmina* (+) were the least consumed organisms in Cladocera group. According to Table 1 most of the organisms belonging to Copepoda group (8.36%) was constituted by *Diaptomus* (5.67%). There was only *Cypris* encountered from Ostracoda (3.56%) group. *Triarthra* (3.56%) dominated the organisms belonging to Rotatoria group (6.31%) while there was a small amount of *Keratella* with 0.796%. Among the benthic organisms the most abundant one was *Chironomus* (23.68%) followed by *Corethra* (10.78%), *Oligochaeta* (2.32%) and *Gastropoda* (+).

Among the Zooplanktons different species of Cladocera were encountered almost in every month of the year. *Diaptomus* and *Cyclops* among the Copepoda were most frequently observed in April and June respectively. Among the Ostracoda, *Cypris* was dominant in August. While *Keratella*, *Hexarthra* and *Triarthra* in Rotatoria were frequent in January, March and April respectively. Among the benthic organisms investigated *Chironomus* was seen almost in every month. *Chironomus* and *Corethra* were most frequently observed in November and July respectively. *Gastropoda* was only encountered in March and April.

If the digestive tract contents are examined according to months it is seen that zooplanktonic organisms dominate in spring, summer and winter. The benthic organisms on the other hands have an important share in fall, winter and summer months. The major portion of the food in fall months is constituted by phytoplanktonic organisms.

Table 2 shows the distribution of the phytoplanktonic organisms observed in the digestive contents of the fish. It was observed that they were much more dominant in August, September, October and November. Table 3 shows the number and % ratio of the *Tinca tinca* individuals with filled and empty digestive tract show variation according to months. The number of *Tinca tinca* individuals with filled digestive tract is higher in fall and summer months. In September the ratio of the individuals with filled digestive tract is 100 %. This ratio is the lowest with 16.67 % in July compared with other months. The volume of the digestive tract shows variation according to the months as well (Table 3).

The average fork length of *Tinca tinca* individuals ranged between 202.61 mm and 284.50 mm. These values varied between 202.00 mm and 323.33 mm for the *Tinca*

*tinca* individuals with filled tracts. The length of the digestive tract of *Tinca tinca* individuals was between 222.85 and 351.17 mm. These values ranged between 224.28 mm and 305.26 mm for the individuals with filled digestive tracts (Table 3).

**Table 1.** The % ratios zooplanktonic and benthic organisms found in the digestive tract of the *Tinca tinca* individuals living Hirfanlı Dam Lake.

MONTHS	Number of fish caught	Number of fish with filled tracts	Number of fish with empty tracts	ZOOPLANKTONIC ORGANISMS															GENERAL TOTAL N %	BENTIC ORGANISMS				TOTAL N %	TOTAL NUMBER OF ORGANISMS	N %	AVERAGE NUMBER OF ORGANISMS
				CLADOCERA						TOTAL	COPEPODA		TOTAL	OSTRACODA	ROTATORIA			TOTAL		Chironomus	Coratbra	Oligochoeta	Gastropoda				
				<i>Diaphanosoma</i>	<i>Daphnia</i>	<i>Ceriodaphnia</i>	<i>Clydorus</i>	<i>Alona</i>	<i>Bosmina</i>		<i>Diaptomus</i>	<i>Cyclops</i>		<i>Cypris</i>	<i>Keratella</i>	<i>Hexarthra</i>	<i>Triarthra</i>										
August	24	18	6	6.20	2.31	7.76	8.53	5.43	-	30.23	15.51	3.10	18.61	9.32	3.86	3.86	3.10	10.82	68.98	19.40	7.76	3.86	-	31.02	4293	9.39	238.5
September	21	20	1	6.40	57.89	17.87	2.13	-	-	84.29	1.60	-	1.60	1.60	0.53	0.53	1.60	2.66	90.15	6.67	2.12	1.06	-	9.85	12495	27.34	624.75
October	21	13	8	-	-	4.12	-	3.07	-	52.63	3.07	-	3.07	3.11	1.02	3.07	4.09	8.18	66.99	26.84	4.12	2.05	-	33.01	3226	7.05	248.15
November	20	15	5	-	-	0.94	5.36	0.94	-	8.49	1.88	-	1.88	0.63	0.63	0.31	-	0.94	11.94	53.65	33.15	1.26	-	88.06	10599	23.19	703.90
December	16	7	9	-	36.78	-	-	-	+	36.78	22.55	-	22.55	6.41	-	-	-	-	63.74	19.34	12.92	-	-	23.26	1029	2.25	1470
January	22	9	13	-	45.62	-	-	-	-	45.62	13.56	-	13.56	-	4.52	-	-	4.52	63.70	31.78	4.52	-	-	36.30	730	1.59	81.10
February	19	8	11	-	48.39	-	-	3.43	+	51.82	13.71	-	13.71	6.85	-	-	-	-	72.38	27.62	-	-	-	27.62	963	2.10	120.98
March	21	15	6	6.90	31.07	3.42	-	-	-	41.39	20.70	-	20.70	10.32	-	8.61	15.56	24.17	96.58	3.42	-	-	+	3.42	1928	4.21	128.50
April	18	10	8	-	-	5.24	7.86	10.48	-	23.58	23.81	5.24	29.05	5.24	-	5.24	21.1	26.34	84.21	13.17	2.62	-	+	15.79	1260	2.75	126.00
May	20	13	7	10.49	26.45	7.92	3.49	2.65	-	51.00	7.04	-	7.04	2.65	-	5.24	7.86	13.10	73.29	18.35	5.24	2.62	-	26.71	3777	8.26	290.50
June	22	14	8	14.34	11.95	4.78	9.56	2.39	-	43.02	-	22.53	22.53	8.76	-	-	2.41	2.41	76.72	16.88	2.39	4.01	-	23.78	4142	9.06	295.90
July	17	3	14	-	+	-	7.66	-	-	7.66	-	7.66	7.66	-	-	7.66	15.31	22.97	38.29	23.2	15.31	23.2	-	61.71	1293	2.82	431
TOTAL	241	145	96	2189	12221	3427	1924	795	-	20556	2592	1231	3823	1626	364	893	1626	2883	28888	10819	4926	1062	-	16807	45695	100	
% N	-	60.17	39.83	4.79	26.75	7.5	4.21	1.73	-	44.98	5.67	2.69	8.36	3.56	0.796	1.96	3.56	6.31	63.22	23.68	10.78	2.32	-	36.78			

( ) → Number of individuals encountered

(+): the least (++) : least (+++) : medium (++++): much (+++++): the most

**Table 2.** Relative abundance of the phytoplankton and residues in the digestive tracts of *Tinca tinca* living in Hirfanlı Dam Lake.

MONTHS	Number of fish caught	Number of fish with filled tracts	Number of fish with empty tracts	CYANOPHYTA					BACILLARIOPHYTA											CHLOROPHYTA				EUGLONOPHYTA	OTHER RESIDUES					
				<i>Microcystis</i>	<i>Oscillatoria</i>	<i>Merismopedlia</i>	<i>Anabaena</i>	<i>Aphanizomenon</i>	<i>Cyclotella</i>	<i>Melosira</i>	<i>Navicula</i>	<i>Gyrosigma</i>	<i>Cymbella</i>	<i>Nitzschia</i>	<i>Pinnularia</i>	<i>Suirella</i>	<i>Gomphonema</i>	<i>Diatoma</i>	<i>Synedra</i>	<i>Amphipleura</i>	<i>Compylodiscus</i>	<i>Scenedesmus</i>	<i>Ankistrodesmus</i>	<i>Pediastrum</i>	<i>Oocystis</i>	<i>Spirogyra</i>	<i>Euglena</i>	Mud-Debris	Plant remains	Pinus Pollens
August	24	18	6	-	++++	+++	++++	-	-	++++	++++	-	++++	+++	-	-	-	-	-	-	-	-	-	-	+++	+++	++++	-	+++	++++
September	21	20	1	++++	++++	-	-	++	+++	+++	+++	-	-	-	++	++	-	-	-	-	-	+	++	++	+++	+++	+++	-	++	++++
October	21	13	8	++	++++	-	-	++++	++++	++	+++	-	+	+++	-	-	-	-	-	-	-	-	++	++	++	+++	+++	-	+++	++++
November	20	15	5	++++	++++	-	-	++	++++	++++	++++	-	++++	+	++	-	-	-	-	+	-	-	++	++	+	+++	+	+++	++++	
December	16	7	9	+	++	-	-	-	++	-	+	-	++	++	-	-	-	-	-	+	-	-	++	+	-	+	+	+	++	+
January	22	9	13	-	++	-	-	-	-	-	++	-	++	+	-	-	-	-	+	++	-	-	-	-	-	-	+	+	++	+
February	19	8	11	-	++	-	-	-	-	-	+	-	++++	+++	-	-	+	-	+	+++	-	-	-	-	-	-	+	++	+	+
March	21	15	6	+	+	-	-	-	-	-	+	++	++++	+	-	++	+	++	++	+	++	++	+++	-	-	+	+	+	++	+
April	18	10	8	-	+	-	-	-	-	-	++	+	+	+	-	+	+	-	-	-	+	+	++	+	-	+	+++	+	+	+
May	20	13	7	++	++	++	-	-	-	-	+++	+	+	++	-	+	++	-	-	+	+	++	+	+	+	++	+++	+	+++	++
June	22	14	8	-	++	++	+	-	-	++	+	-	+++	+	-	-	-	-	+	-	-	-	-	-	-	+	+++	++	+++	+++
July	17	3	14	-	+	++	++	-	-	-	++++	-	-	+	-	-	-	-	+	-	-	-	-	-	-	+	+	-	++	++

( ) → Number of individuals encountered  
 (+): the least    (++) : least    (+++) : medium    (++++): much    (+++++): the most

**Table 3.** The average fork lengths, the lengths of the digestive tracts *Tinca tinca* individuals with filled and empty tracts and volume of food content Per *Tinca tinca* individuals 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 <sup>3</sup> ) (Min-Max)
August	24	75	25	226.50 (149-275)	216.17 (149-270)	233.78 (140-310)	262.125 (140-310)	6.72 (0-22)
September	21	100	0	202.61 (149-290)	202.00 (150-330)	222.85 (150-330)	224.38 (150-330)	8.02 (0-24)
October	21	65	35	246.80 (210-291)	252.39 (210-291)	310.62 (280-330)	301.90 (270-330)	7.22 (0-21)
November	20	71.43	28.57	251.95 (223-322)	257.67 (225-332)	291.53 (260-360)	287.52 (260-360)	6.02 (0-28)
December	16	41.18	58.82	218.71 (155-250)	225.14 (195-274)	257.86 (225-310)	252.05 (200-310)	1.98 (0-6)
January	22	40.90	59.10	234.41 (147-347)	194.78 (180-261)	270.00 (230-305)	274.36 (230-380)	1.76 (0-4)
February	19	40.00	60.00	255.35 (224-284)	251.125 (237-264)	291.25 (268-300)	289.90 (268-380)	1.89 (0-3)
March	21	71.43	28.57	260.57 (235-315)	264.20 (255-315)	298.67 (250-350)	294.14 (250-350)	2.80 (0-6)
April	18	50.00	50	284.50 (230-317)	274.10 (230-317)	315.70 (310-330)	318.60 (290-380)	1.70 (0-3)
May	20	68.42	31.58	264.63 (208-305)	268.31 (310-305)	313.31 (250-360)	305.26 (240-360)	5.80 (0-7)
June	22	60.86	39.14	261.39 (205-380)	274.78 (205-380)	303.43 (240-360)	292.61 (240-360)	5.92 (0-16)
July	17	16.67	83.33	271.00 (217-335)	323.33 (315-335)	351.17 (345-360)	304.33 (245-370)	1.32 (0-3)

## Discussion

In the digestive tracts of *Tinca tinca* individuals, there were both animal and plant based organisms and detritus mud in the digestive tracts of *Tinca tinca* individuals in all months. It was observed that *Tinca tinca* is omnivorous. This study shows both similarities and differences with the studies of the different workers related to the digestive tract content of *Tinca tinca*. Weatherley [23] in his study he carried out in Tasmania reports that *Tinca tinca* individuals prefer Amphipod and Chironomid larvae, Mollusk and Odonata nymph. Giles et al. found abundant numbers of Cladocera (*Eurycercus*, *Daphnia*, *Bosmina*, *Alona*, *Ceriodaphnia*, *Simocephalus* sp.), Mollusk, Chironomid, Amphipod and Trichoptera larvae in *Tinca tinca* individuals living in Irish Lake [7]. It was also reported that *Tinca tinca* eats snails, worms, jointed legs, mussels, and larvae as well as moss [3]. According to Geldiay and Balik the major foods of *Tinca tinca* are mollusks, Chironomus, Copepod and Ephemeropterid larvae [1]. Giles et al. stated that the *Tinca tinca* individuals feed on Bivalvia, Mollusk, Amphipod, Gastropod, Trichoptera and Chironomid larvae [6]. The ratio of Oligochaeta in the digestive tract of



the *Tinca tinca* individuals in Hirfanlı Dam Lake was found to be relatively small. This may be due to rapid digestion of Oligochaetas as reported by some workers [6, 24].

Atasagun found that the digestive contents of the *Tinca tinca* individuals living in Mogan Lake was mainly consisted with zooplankton (58.55 %) and benthic organisms (41.45 %). He reported that they eat Cladocera (39.44%), Copepoda (16.66%), Ostracoda (3.56%), Rotatoria (6.31%) from Zooplankton and *Chironomus* (31.82%), *Corethra* (6.66%), Oligochaeta (2.95%) from benthic groups. Among the phthoplanktonic organisms Fitoplanktonik *Microcystis*, *Oscillatoria*, *Cyclotella*, *Melosira*, *Synedra*, *Cymbella*, *Epithemia*, *Navicula*, *Nitzchia*, *Kirchaeriella*, *Oocystis*, *Scenedesmus*, *Staurastrum*, *Spirogyra*, *Euglena* were predominant [4].

Although the type and the % composition of organisms consumed by *Tinca tinca* individuals living in Hirfanlı Dam Lake show some variation according to months zooplanktonic and benthic organisms and detritus mud constitute the major portion of their diet. This is in good accordance with Atasagun's data in Mogan Lake [4].

In the digestive contents of the *Tinca tinca* individuals living in Hirfanlı Dam Lake; Cladocera was dominant in fall and winter, Copepods were dominant in winter, fall and spring. Ostrocodas were much more frequent in spring and summer and Rotatoria dominated in spring and summer. Benthic organisms were found to be more frequent in summer and fall months. These were also in good compliance with Atasagun's data in Mogan Lake [4].

The number of individuals with filled tracts was higher in fall, summer and spring months. In July the number of organisms and the digestive tract content volume were at their lowest value with 16.67 % and 1.32 %. This shows that the increasing temperature increases the digestion rate of the foods.

Atasagun [4] also reported that the number of filled stomachs of *Tinca tinca* individuals living in Mogan Lake were lower in April, July and December. This shows a partial parallelism with our study.

The fork lengths of *Tinca tinca* individuals living in Mogan Lake were between 24.50 and 30.17 cm. The fork lengths of the individuals with filled stomachs changed between 28.00-30.57 cm. The length of the digestive tract ranged between 16.57-25.82 cm [4]. These findings are in good compliance with our data obtained for Hirfanlı Dam Lake.

It was observed that *Tinca tinca* living in Hirfanlı Dam Lake fed during their breeding period. Petridis states that the feeding activities decrease during the breeding period and the digestion rate increases due to elevated temperatures [6]. The fact that whether the aqueous systems are closed or open basins are effective on the diversity of the nutritious food and the population density of the fish. Apart from that the biotic and abiotic features of the investigated sites and the time of the analysis of the digestive tracts of the fish also effect the resulting data.

The organism on which *Tinca tinca* living in Hirfanlı Dam Lake feeds are also on the diet of *Cyprinus carpio* living in the lake. As in the case of the species with common ecological niches these two omnivore fish are in competition for food.

The qualitative and the quantitative analyses of the digestive tract contents of *Tinca tinca* living in Hirfanlı Dam Lake showed that the lake provides a good nutritious medium for the omnivore fish. It is suggested that more studies investigating the other population living in different localities will be very useful for comparative purposes.

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