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A Study on Zooplankton of a Grass Carp Nursing Pond

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Abstract: This study was conducted in an earthen pond having an area of 0.61 ha and a depth of 1 meter. Five-day-old grass carp larvae were stocked at a rate of 100000/ha in the pond. Zooplankton samples were taken every week from July to September. Zooplankton community was dominated by various rotifer species apart from the week 7 and 8; the mean abundance ratio was 74%. It changed to small cladocerans in 7^{th} and 8^{th} weeks. The mean abundance ratio for Cladocera was 24%. Cladocera was represented by small cladocerans such as *Bosmina longirostris, Daphnia hyalina, D. pulex, Diaphanosoma* sp. and *Alona* sp. Large cladocerans, *D. longispina* and *D.magna* were rarely found. Planktonic crustacean population in this nursing pond consisted primarily of Calanoid and Cyclopoid species nauplii and copepodits.The ratio of Copepoda abundance was 2%.During the study, the biomass of Cladocera was the highest in the zooplankton community.

Key Words: nursing pond, zooplankton abundance, zooplankton biomass, grass carp larvae

Ot Sazanı Yavru Havuzunun Zooplanktonu Üzerine Bir Çalışma

Özet: Bu çalışma, alanı 0,61 ha ve derinliği 1 m olan bir toprak havuzda yürütülmüştür. Havuza beş günlük ot sazanı larvaları 100000 adet/ha stoklanmıştır. Zooplankton örnekleri Temmuz'dan Ağustos'a kadar haftalık olarak alınmıştır. Zooplankton topluluğunda 7. ve 8. haftalar dışında çeşitli rotifer türleri dominanttır ve ortalama bolluk oranı %74 olmuştur. Küçük Cladocera'lar 7. ve 8. haftalarda dominant olmuşlardır.Cladocera'nın ortalama bolluk oranı % 24'dür. Bu çalışmada Cladocera'lar *Bosmina longirostris, Daphnia hyalina, D. pulex, Diaphanosoma* sp. ve *Alona* sp. gibi küçük Cladocera'larla temsil edilmişlerdir. *Daphnia longispina* ve *D.magna* gibi büyük olanlarına nadiren rastlanmıştır. Büyütme havuzlarında planktonik Crustacea populasyonu, Calanoid ve Cyclopoid türlerin nauplii ve kopepoditlerinden meydana gelmiştir. Copepod bolluğu oranı % 2 olmuştur. Çalışma süresince zooplankton topluluğu içinde en yüksek biyomas Cladocera'ya ait olmuştur.

Anahtar Kelimeler: yavru havuzu, zooplankton bolluğu, zooplankton biyoması, ot sazanı larvası

Introduction

In the early stage of larval development and growth of fish, zooplankton, made up mainly Rotifera and Crustacea of which Cladocera and Copepoda, and benthic invertebrates are the most important and the principal foods (Watkins et al. 1981, Opuszynski 1987).

Fish culturists have become aware that a basic understanding of zooplankton community dynamics is essential to the successful culture of fish fry and must achieve the production of the proper size, type, and amount of zooplankton and benthos to meet the needs of fish. (Parmley and Geiger 1985). Objectives of this study were to determine taxonomic composition, succession patterns, abundances and biomass of zooplankton community of a nursing pond.

Material and Methods

The earthen pond chosen for the study was located in the Fisheries Department of The State Water Works of Keban, Eastern Anatolia. The area of the earthen pond was about 0.61 hectare and the depth was about one meter. The stocking material of the pond was five-day-old grass carp larvae at a stocking rate of 100000/ha.

The pond received an initial treatment with organic manure (8 tonnes per hectare). Inorganic fertilizers; superphosphate and ammonium nitrate were also applied (each 100 kg per ha). Half of the application was added when pond filling took place. The remainder was given in two applications after the first and the second weeks, respectively.

Zooplankton samples were taken weekly from the center of the pond from July to September 1998.Two replicate vertical zooplankton hauls were collected on each sampling date, using a plankton net with 55 μm mesh size. Samples were preserved in 4% formaldehyde solution.

The average abundance of individuals per ml of each species of Rotifera, Cladocera and Copepoda was estimated by counting 5 subsamples (each 1 ml) under an inverted microscope. This average number was multiplied by 100 or 200, depending on the final volume of diluted sample and divided by the liters of water which the sample was taken from, in order to calculate the number of individual per liter (Edmonson and Winberg 1971, Wetzel 1983, McCauley 1984). The zooplankton were identified under a binocular microscope according to Edmonson

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(1959), Harding and Smith (1974), Kolisko (1974), Koste (1978) and Smith (2001).The average biomass of the individuals were estimated in dry weight from the geometric figures of the organisms. Volumes of these figures were calculated from three-dimensional measurements. Measurements were carried out under binocular microscope with an oculer meter. Only organisms without eggs, embryos and epphibia were measured. The calculated volumes were converted to wet weight by assuming that 1 mm^3 weights 1 mg, and hence to dry weight assuming the dry weight for all species to be 7% of live weight (Dumont et al. 1975, McCauley 1984, Lawrence et al. 1986, Kırkağaç and Köksal 1999).

The water temperature, dissolved oxygen and pH of the pond were measured *in situ*.

Results

Zooplankton species are given in Table 1. From Rotifera; *Polyarthra, Filinia, Hexarthra, Asplanchna, Cephalodella, Lepadella* and *Lecane* species were found in all weeks. The abundances of *Hexarthra* and *Polyarthra* were higher in the first week. The following week, the abundance of *Brachionus* was the highest in Rotifera. In the third week, *Filinia* was the dominant and again *Hexarthra* was the dominant organism in Rotifera in the fourth week. The following three weeks, the abundance of *Brachionus* was the highest. *Brachionus calcyflorus* reached to its highest value in the second week and it appeared again in the weeks 5 and 7. Then it changed to *Brachionus angularis* and *Brachionus urceolaris* in weeks 8 and 9, respectively. *Synchaeta pectinata* was found in the weeks 5, 6 and 9. *Trichocerca ruttneri* was also found in the week 6. *Keratella cochlearis* was observed after week 6. In the weeks 8 and 9, the dominant organism changed to *Keratella* and also *Asplanchna* tended to increase in the week 8. From Cladocera; *Bosmina longirostris* was found in all weeks and reached to the highest abundance in week 7, then tended to decrease, gradually. Beside *Bosmina longirostris, Diaphanosoma sp., Alona* sp. and *Daphnia* species were also found from Cladocera. But the abundances were not as high as *Bosmina longirostris*. Daphniids were found especially in week 3 and week 8. Copepoda was represented by the nauplii and the copepodits of *Cyclops* sp. and *Diaptomus castor*. The abundances of zooplankton groups are given in Table 2. Rotifera was the only organism group in the first week, and also the dominant group until week 7 and the mean abundance ratio was 74%. Then, it changed to Cladocera in weeks 7 and 8.The mean abundance value for Cladocera was 24%. Copepoda was not found in weeks 1, 4 and 7 and the ratio of Copepoda was 2% in the study.

Table 1. The list of the zooplankton species in the pond

Rotifera	Cladocera
Asplanchna priodonta Gosse	*Alona* sp.
Brachionus angularis Gosse	*Bosmina longirostris* O.F.M.
Brachionus calcyflorus Palas	*Daphnia hyalina* Leydig
Brachionus urceolaris O.F.M.	*Daphnia longispina* O.F.M.
Cephalodella gibba Ehr.	*Daphnia magna* Straus
Filinia longiseta Ehr.	*Daphnia pulex* De Geer
Hexartra mira Hudson	*Diaphanosoma* sp.
Lecane luna O.F.M.	**Copepoda**
Lecane (M) hamata	*Cyclops* sp.
Lepadella ovalis O.F.M.	*Diaptomus castor* Jurine
Keratella cochlearis Gosse	
Trichocerca ruttneri Donner	
Synchaeta pectinata Ehr.	

The biomass of the zooplankton groups is given in Table 3. During the study, the biomass of Cladocera was generally higher than the other organism groups (Figure 1). Cladocera biomass reached to its highest values in the week 7.

The mean water temperature were 20 ± 0.5, 22 ± 0.5, 21.7 ± 1 and 20 ± 0.5°C in June, July, August and September, respectively. Dissolved oxygen was about 8.07 ± 0.65 ppm and pH was about 7.68 ± 0.10.

Discussion

In this study, zooplankton community was dominated by various rotifer species (Table 1) apart from the weeks 7 and 8. In these weeks, it changed to small cladocerans such as *Bosmina longirostris, Daphnia hyalina, D. pulex, Diaphanosoma* sp. and *Alona* sp. Large cladocerans such as *D. longispina* and *D.magna* were found rarely.

Table 2. Zooplankton abundances in the nursing pond, by week (individual/L)

Weeks	Sampling dates	Organism groups: Rotifera	Cladocera	Copepoda	Total
1	July 7	218 ± 24	-	-	218
2	July 14	490 ± 136	3 ± 1	10 ± 3	503
3	July 21	88 ± 13	30 ± 5	3 ± 1	121
4	July 28	251 ± 75	6 ± 2	-	257
5	Aug. 4	436 ± 131	67 ± 10	6 ± 2	509
6	Aug. 11	327 ± 34	114 ± 17	5 ± 2	446
7	Aug. 18	493 ± 112	684 ± 35	-	1177
8	Aug. 25	203 ± 31	440 ± 26	12 ± 3	655
9	Sept. 2	124 ± 28	55 ± 12	19 ± 2	198

Table 3. Zooplankton biomass in the nursing pond, by week (µg-dry weight/L)

Weeks	Sampling dates	Organism groups: Rotifera	Cladocera	Copepoda	Total
1	July 7	6.9 ± 2	-	-	6.9
2	July 14	11.1± 1	11.7 ± 1	24.4 ± 3	47.2
3	July 21	3.3 ± 1	111.6 ± 5	2.0± 1	116.9
4	July 28	9.2 ± 5	20.7 ± 2	-	29.9
5	Aug. 4	25.9±13	231.7 ± 10	0.2 ± 5	257.8
6	Aug. 11	14.4 ± 4	464.4 ± 17	28.5± 3	504.6
7	Aug. 18	29.4± 11	6198.8 ± 35	-	6228.2
8	Aug. 25	44.3± 6	1847.9 ± 26	161.7± 8	2053.9
9	Sept. 2	18.3 ± 5	406.15 ± 12	44.3 ± 2	468.7

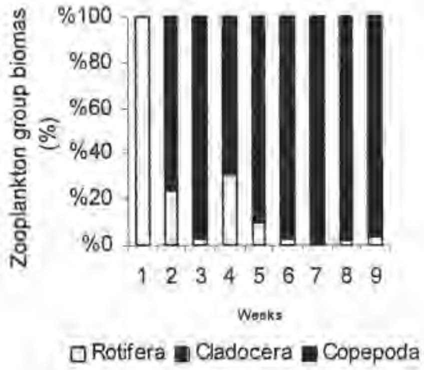

Figure 1. The biomass of the zooplankton groups in the nursing pond

Planktonic crustacean population in this nursing pond consisted primarily of calanoid and cyclopoid species nauplii and copepodits and the dominant cladoceran was *Bosmina longirostris* and it was followed by *Daphnia* species. This result was similiar to that of Parmley and Geiger (1985) who investigated the succession patterns of zooplankton in fertilized culture ponds without fish and to that of Korinek et al. (1987) who indicated the structure of zooplankton community in the ponds with high density of fish (>10000 number/m^2) and also similiar to that of Irvine et al. (1989) and that of Kırkağaç and Köksal (1999).

Korinek et al. (1987) reported that in the ponds with high density of fish, the share of Cladocera in the zooplankton biomass was less than 50% and the size groups over 2 mm did not exist.The only exception was the early spring when the grazing pressure of fish was low or the ponds were not yet stocked. The turnover of zooplankton biomass is faster than the one in ponds with low fish stock as generation times of rotifers and small cladocerans were shorter than those of large daphniids. The turnover of the cladoceran biomass was approximately once every five to seven days in summer. This shows that cladoceran biomass was replaced more than twenty times during a growing season. In this study, altough the stocking rate of fish was high in the pond, the ratio of Cladocera was found as 71% and also the size group was less than 2 mm. The exception that was mentioned below for the early spring in the ponds were observed in the pond during the study. The size and the stocking rate of grass carp influenced the zooplankton communities in this pond.

Zooplankton was not attractive feed for grass carp due to feeding habits, especially after two weeks of hatching in the ponds, then it changed to mostly phytoplankton until grass carp reached to 4.55 mm. Afterwards macrophytes took place. Grass carp, while feeding on macrophytes, ingested all living organisms associated with plants, mostly *Lecane* and *Monostyla* from Rotifera and *Bosmina longirostris* from Cladocera (Kırkağac 2003). Richard et al. (1985) reported that the effect of grass carp indirectly on zooplankton would most likely be through the reduction of nutrient-absorbing competition from macrophytes and associated periphytic algae. This was resulted in the increased abundances of zooplankton communities which was shifted to small suspension-feeders such as rotifers and small cladocerans and also used as indicators of advancing trophic conditions.

Such baseline zooplankton data can result in improved efficiency in fish production and pond management.

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