

Seasonal Variation of Testaceous Amoebae (Sarcodina, Protozoa) Population in the River Tigris

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ABSTRACT. Seasonal variation in the testaceous amoeba populations in the river Tigris was studied during 1984-85. Monthly samples were collected from eight stations along the stretch extending from Mosul to Baghdad. A total of 17 species were identified. *Diffugia* sp., *Arcella discoides* and *Centropyxis* sp. were the dominant taxa in the Tigris. Summer and late autumn were found to be the seasons of highest population density. The maximum abundance was $490\ l^{-1}$ recorded at station 6 during 1984. Variation in timing of peaks along the studied stretch is discussed.

Amoebae in lotic environments have received little attention. Gall (1972) described the rhizopod fauna of the river Tisza in Hungary. Holden and Green (1960) reported their abundance as a part of the plankton community in the rivers Sokoto and Fesfari in Nigeria. Bovee (1965) studied them quantitatively in a small stream, northern Florida. A more comprehensive study was that of Baldock *et al.* (1983) who discussed their distribution and abundance together with that of ciliates in the river Frome and Tadnoll Brook, England with particular attention to their association with water-crowfoot. Finally, the works of Schonborn (1977, 1981) and Opravilova (1983) on the population dynamics and production of testate amoebae in several lotic environment.

As far as the author is aware, the only reference in Iraq is that of Alhamed (1976) which gives data on the monthly abundance of *Diffugia* in Dukan reservoir. A two-year limnological study in the river Tigris has yielded some observations about testaceous amoebae and their seasonality which are reported here.

Sampling Stations and Methods

The Tigris is one of the hundred longest rivers of the world. It is about 200 km long, of which 1360 km run through Iraq. The width and water level of the river depend on seasonal discharges and the morphology of the river-bed (Rzoska 1980). Generally, the river is shallow (2 to 5 m depth) and up to 230 m wide during the low discharge season (summer). The river bed changes from rocky, stony and cobble to mainly silt and clay below Balaad (station 7; Fig. 1). Vegetation in the river course is mainly of terrestrial origin near the banks except at Samarra impoundment which is rich with patches of *Typha*, long grasses, *Potamogeton*, *Ceratophyllum* and *Vallisneria*. The Tigris receives five tributaries in Iraq. Several reservoirs have been built in recent years.

The studied stretch extends from Mosul to Baghdad, which covers almost 600 km of the river. Sampling stations were Mosul (1), Sharqat (2), Al-Namel (3), Al-Zewaia (4), Fat-ha (5), Samarra impoundment upstream the barrage (6), Balaad (7) and Baghdad below Al-Muthana bridge (8) (Fig. 1).

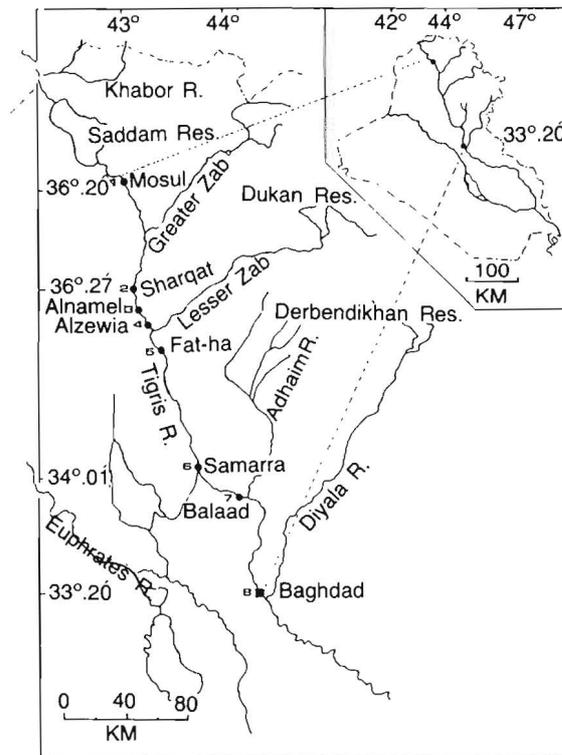


Fig. 1. Map of Iraq showing sampling stations (number 1 to 8) along the river Tigris.

Monthly samples were taken from the river during 1984-85. A 15 liter surface water sample was collected with a clean bucket and passed through a 26 μm plankton net. Animals were fixed and preserved in 4% formalin. Counting was carried out in the laboratory. The main references for identification were Deflandre (1929, 1959) and Ogden and Hedley (1980).

Results

Table 1 shows the list of the identified species. *Arcella discooides* and a distinct species of *Diffugia* and *Centropyxis*, listed as *Diffugia* sp. and *Centropyxis* sp., were the most frequent species in the samples. Most species were collected along the whole studied stretch. However, several species were restricted to two or three stations, while *Centropyxis aerophila*, *Diffugia globulosa* and *Cyclopyxis arcelloides* were found only at station 6.

The population density at station 1 never exceeded 20 amoebae l^{-1} throughout the study period (Fig. 2). Summer increases during 1984 were dominated by *Centropyxis* (*Centropyxis* sp. and *C. aculeata*) while *Arcella discooides* dominated the 1985 August increase (Fig. 3).

Table 1. The identified taxa of testaceous amoebae, % frequency and presence at stations along the Tigris during 1984 and 1985

Species	Frequency %	Stations
1) <i>Arcella discooides</i> Ehrenberg, 1871	67.70	All
2) <i>A. dentata</i> Ehrenberg, 1838	4.10	2,3,6
3) <i>Arcella</i> sp.	1.04	2,7
4) <i>Centropyxis constricta</i> Ehrenberg, 1841	7.80	1,3,4,5,6,7,8
5) <i>C. aculeata</i> Ehrenberg, 1838	39.50	All
6) <i>C. hemisphaerica</i> Barnard Wailes	1.04	3,6
7) <i>C. aerophila</i> Deflandre, 1929	0.52	6
8) <i>Centropyxis</i> sp.	58.30	All
9) <i>Cyclopyxis arcelloides</i> Penard, 1902	0.52	6
10) <i>Diffugia acuminata</i> Ehrenberg, 1838	39.00	All
11) <i>D. lobostoma</i> Leidy, 1879	13.50	All
12) <i>D. oblonga</i> Ehrenberg, 1838	5.20	1,2,3,7,5
13) <i>D. globulosa</i> Dujardin, 1837	0.52	6
14) <i>Diffugia</i> sp.	75.50	All
15) <i>Lesquereuisa spiralis</i> Ehrenberg, 1840	3.60	1,2,3,4,6
16) <i>Euglypha filiera</i> Penard, 1890	1.50	3,4,6
17) <i>Euglypha</i> sp.	1.04	2,3

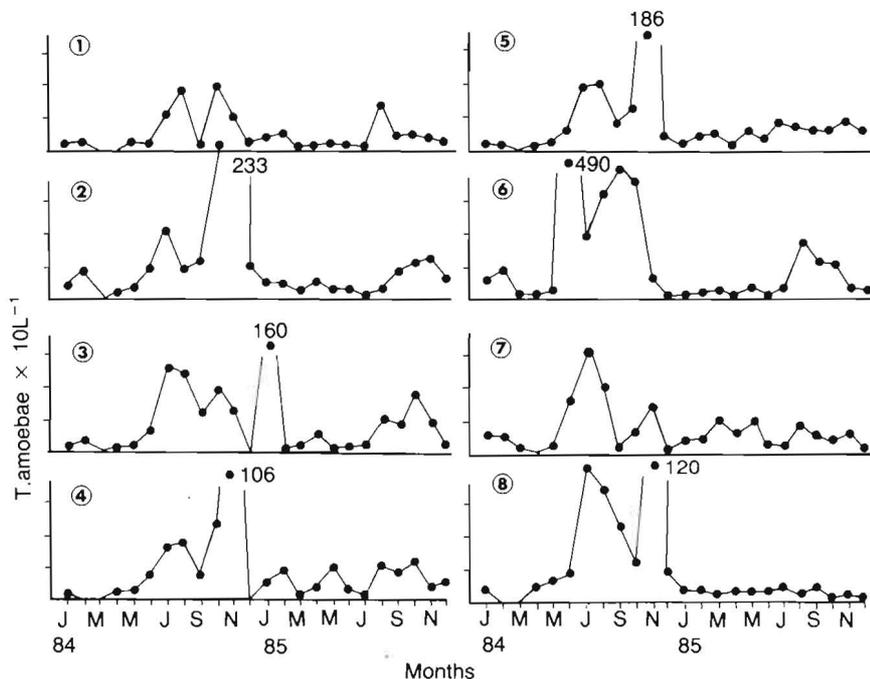


Fig. 2. Seasonal variation in the total testaceous amoebae population along the river Tigris at stations 1-8 during 1984-85. Note the difference of Y-axis scale of station 6.

Stations 2, 4 and 5 showed a similar population pattern with a slight increase during Summer and a peak during Autumn 1984, but a small population size throughout 1985. The peaks were formed mainly from *Diffflugia* which comprised up to 70% of the population, when it reached more than 130 l^{-1} (Figs. 3, 4). *Centropyxis* sp. was the second most numerous species which formed up to 40% of the population (maximum density more than 50 l^{-1}). However, during 1985 although the population density was less than 20 l^{-1} , it was mainly formed from *Arcella discoides*. The peak at station 3 was 160 l^{-1} recorded during January 1985 which was 8 folds greater than that of 1984 maximum. In term of composition, the 1985 peak was mainly from *Arcella discoides* and *Centropyxis* sp., while the 1984 maximum was formed of *A. discoides* and *Diffflugia* sp.

At station 6, a peak of 490 l^{-1} was noticed during June 1984. It was composed mainly from *Diffflugia* sp. which accounted for almost 95% of the population (Fig. 4). The population size declined to its lowest during July to double again to about 200 l^{-1} during September 1984. The September population was composed mainly from *Diffflugia* sp. (40%) and *A. discoides* (30%). Furthermore, during the next month (October) *A. discoides* formed about 80% of the total testate amoebae

population (160 l^{-1}) at this station. During 1985, only one maximum (80 l^{-1}) was noticed. It occurred during August. *A. discoides* was the principal taxon during this maximum and formed 95% of the population (Fig. 4).

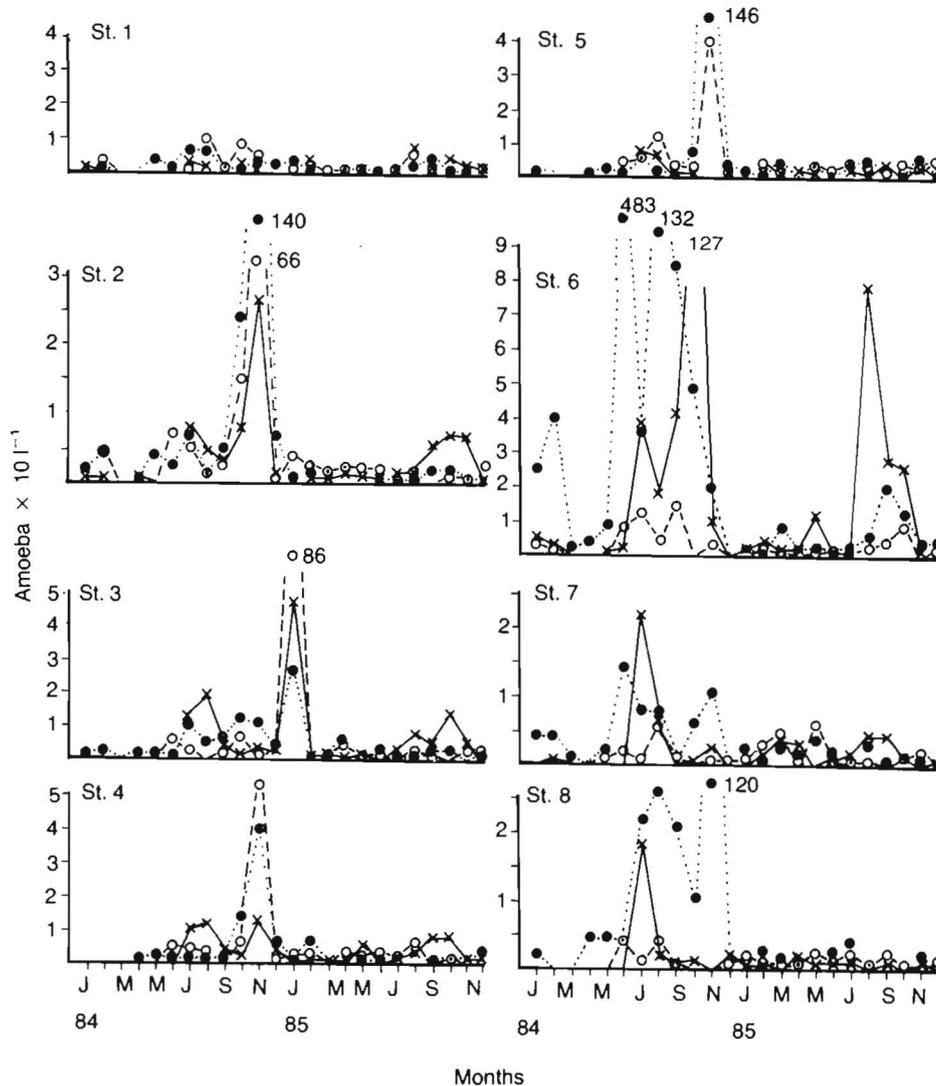


Fig. 3. Seasonal variation in the population density of three species of testaceous amoebae in the river Tigris during 1984-85. St=station. (x) *Arcella discoides*. (0) *Centropyxis* sp. • *Difflugia* sp. Note the difference of Y-axis scale of stations 2,7 and 8.

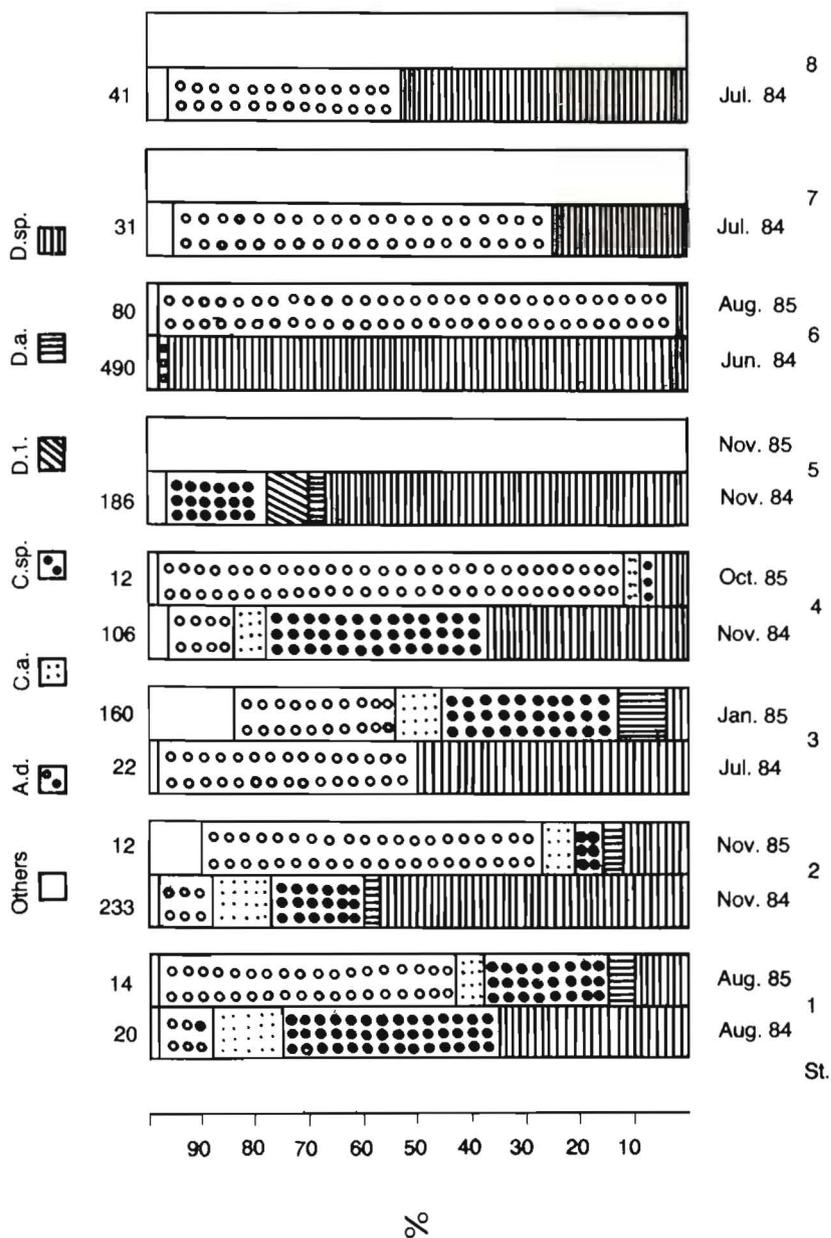


Fig. 4. Composition of peak testaceous amoeba populations at stations 1-8 during 1984-85. Number above columns represents peak density (individual/l). Month and year below columns represents peak time. St=Stations; A.D.=*Arcella discoides*; C.a.=*Centropyxis aculeata*; C.sp.=*Centropyxis* sp.; D.1.=*Diffugia lobostoma*; D.a.=*Diffugia acuminata*; D.sp.=*Diffugia* sp. Empty columns indicate a population density less than 10 individual/l.

The maximum population at stations 7 and 8 occurred during July 1984, when the population reached 31 and 41 amoebae l^{-1} , respectively. At both stations, the principal taxa were *A. discoides* and *Diffugia* sp. which together formed more than 90% of the population. Again, at both stations, the population size during 1985 did not exceed 10 l^{-1} and was formed mainly from *A. discoides*.

The mean annual population density during 1984 was greater than that of 1985 (Table 2). The maximum was 103.9 l^{-1} per annum at station 6 during 1984.

Table 2. The mean annual population density of testaceous amoebae in the river Tigris at stations 1-8 during 1984-85. Numbers are individuals per liter

Station	1984	1985
1	7	4
2	30	6
3	10	19
4	16	6
5	22	4
6	104	16
7	9	5
8	22	3
mean	28	8

Discussion

Most of the species in the river Tigris belonged to the genera *Diffugia*, *Centropyxis* and *Arcella*. A similar result was reported by Holden and Green (1960) in two Nigerian rivers. These genera were commonly represented in river plankton although in their trophic phase they are typically benthic form. This would indicate a resemblance between the Tigris and other rivers of the world. However, the list of Tigris species is still incomplete, and remains a field for further investigation since a net sampler was used during this survey, which allowed small individuals to pass through (Bottrell *et al.* 1976).

Variations in peak timing between the studied stations were evident. Kofoid (1908) explained the appearance of testaceous amoebae in Illinois river plankton as due to either increased river discharge or the production of planktonic forms by species which were normally not planktonic. In the Tigris, high river discharge started during late September or October (Sabri *et al.* 1988), which may be responsible for the November peak at upstream stations. A similar reason was

suggested by Holden and Green (1960) in the river Sokoto. However, the second factor of Kofoid (production of planktonic forms) would explain the summer increases in population density and peaks at stations 6 to 8. Summer and early autumn are the low discharge seasons in the Tigris (Sabri *et al.* 1988). Some Amoebae were described as pseudoplanktonic or meroplanktonic (Davis 1962 and Schonborn 1962). *Diffugia* and *Arcella discoides* dominated the population at station 6 and downstream. Thus, the peaks and high summer density would be due to the planktonic phase of these organisms. This suggestion is supported by the appearance of *Diffugia* in the Dukan reservoir plankton during August only (Alhamed 1976). In conclusion, it is possible that the appearance of testaceous amoebae in the Tigris plankton may be due to several factors along its course.

Impoundments along the river course would resemble lentic rather than lotic ecosystems in maintaining an extremely diverse communities (Hutchinson 1967 and Shiel and Walker 1984). This is reflected in the present investigation in which the Samarra impoundment (Station 6) possessed most of the collected species and the highest population density.

It is evident from the results, that the mean annual population density, as well as the peak density, of testaceous amoebae during 1984 was at least 4 fold greater than that of 1985. In term of composition, *Arcella discoides* was the principal taxon along most of the river. Saddam reservoir (located 20 km upstream Station 1) had started filling during 1985 and reduced the river discharge (Sabri *et al.* 1988). Reduction in river discharge could be the reason of the low population density of testaceous amoebae during 1985 (see above). Moreover, *A. discoides* produce a gas vacuoles which assist in floatation and thus it is likely to be common in the plankton (Hutchinson 1967). Furthermore, planktonic organisms were more abundant in regulated streams than unregulated ones (Petts 1984, Shiel and Walker 1984). Thus, the pattern of change in populations of testaceous amoebae during 1985 may well be due to the Saddam reservoir filling during early 1985.

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التغاير الفصلي لسكان الأمبيات الصدفية في نهر دجلة

أنمار وهبي صبري

قسم الأحياء المجهرية - هيئة الزراعة والبيولوجي - ص. ب ٧٦٥ - بغداد - العراق

درس التغاير الفصلي لسكان الأمبيات الصدفية في الجزء العلوي من نهر دجلة للعامين ١٩٨٤ و ١٩٨٥ م. جمعت النماذج شهرياً من ثماني محطات هي مدينة الموصل، الشرقاط، قرية النمل، الزوية، الفتحة، سامراء، بلد، وأخيراً بغداد. في كل محطة تم جمع ١٥ لتر ماء من سطح النهر وذلك باستخدام دلوّ مدرج ثم إمرار الماء خلال شبكة الهائسات (حجم الفتحة ٢٦ مايكرون) لتركيز الحيوانات.

لقد تم تشخيص ١٧ نوعاً خلال مدة الدراسة، ان الأنواع *Diffugia* sp. ، *Arcella discoides* و *Centropyxis* sp. هي الأنواع المتغلبة في نهر دجلة. لقد وجد أن الفترة من فصل الصيف إلى نهاية الخريف هي أفضل المواسم حيث تميزت هذه الفترة بكثافة سكانية عالية. بلغت أقصى كثافة سكانية مسجلة خلال فترة الدراسة ٤٩٠ حيوان/ لتر وقد سجلت في محطة سامراء (المحطة السادسة) خلال عام ١٩٨٤ م. نوقش في متن البحث الاختلافات بين المحطات من حيث توقيت أقصى كثافة سكانية أو نسب الأنواع المتكونة منها وأثر بعض العوامل عليها.