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A Study on the Cladocera of the River Tigris

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ABSTRACT. The population of cladocera has been investigated in Tigris river from January 1983 to January 1984. A total of 33 species were identified. The dominant species were *Bosmina coregoni, B. longirostris, Ceriodaphnia rigaudi, Macrothrix laticornis* and *Alona rectangula*. A maximum of 163×10^3 m^{-3} was recorded. Late Summer and Autumn were found to be the best growth seasons. Upper stream stations were characterized with small number of species, mostly of benthic origin and lower population density. The effects of Samarra impoundment are shown in the results. Variations between stations along the river were evident and are discussed.

Cladocera constitute a main group of zooplankton communities in nearly all inland waters (Hutchinson 1967, Whitton 1975). In Iraq, although such ecosystems are quite common, few have been adequately studied. Mohammad (1979) reported the dominance of cladocerans in a polluted channel in Baghdad. Apart from Alsaboonchi *et al.* (1986) who worked on Garma (Southern marshes), all existing papers on the subject are confined to either a report on the number of individuals (Alhamed 1976) or lists of cladocera species from different localities (Gurney 1921, Mohammad 1965, Khalaf and Smirnov 1976). Finally, the most extensive and recent works by Mohammad (1986) and Mangalo and Akbar (1988), compare the cladocera populations of the rivers Tigris, Euphrates and Diyala in the Baghdad area. It is evident from the existing literature that there are no detailed studies on cladocera along any river in Iraq. Their relative importance and species structure along the river Tigirs are going to be discussed in the present work.

Sampling Stations and Methods

Eight sampling stations were established along the river Tigris. The stretch covered almost 600 km, extending from north Mosul to Baghdad (Fig. 1). The

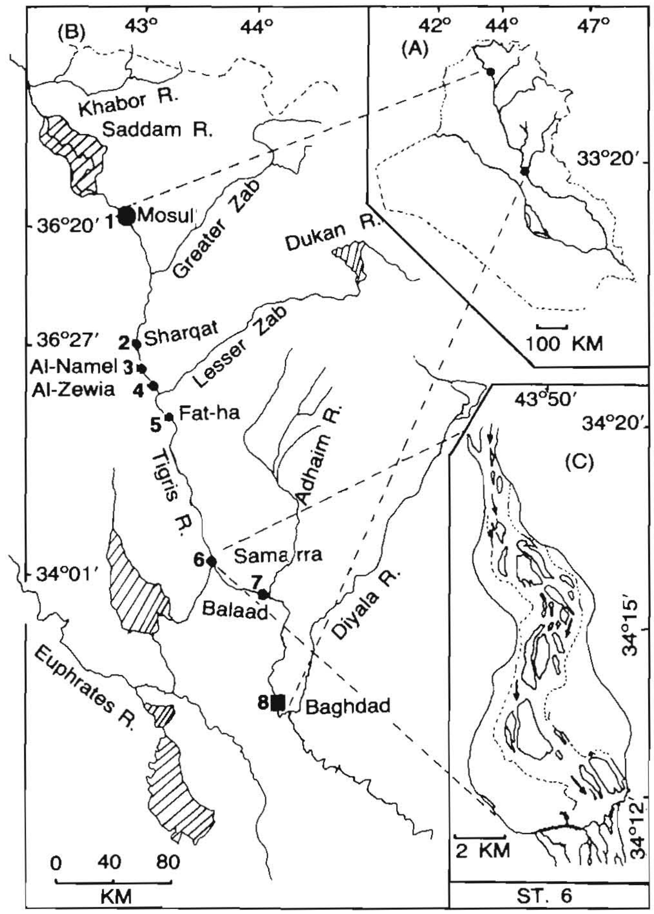

Fig. 1. Map of the Republic of Iraq showing localities of sampling stations (indicated by number 1 to 8) along the Tigris river Insert, station 6 "Samarra Impoundment".

description of sampling stations is simplified in (Table 1). Monthly sampling was conducted from January 1983 to January 1984. Each station was represented by three subsamples (from midriver and both banks).

Sixty liters of water were strained through a plankton net (size 55 μm). The net was carefully washed and rinsed with distilled water before use. Animals were preserved in 4% formalin. Individuals were identified up to species level and counted. The following references were used for identification: Brooks (1959), Scourfield and Harding (1966), Smirnov (1974), Pennak (1978), Frey (1982) and Dumont and Pensart (1983).

Table 1. Some details of sampling stations along Tigris river

Station	Station number	Distance by river (km)	Above Sea level (m)	Slope cm/km	Notes
Mosul (36° 20N', 43° 08E)	1	0	240	70-80	Base type mainly pebble and cobble, near 3rd bridge.
Sharqat (35° 27N', 43° 16E)	2	117	–	–	Base type mainly cobble and rocky, near Sharqat floating bridge.
AL-Namel (34° 40N', 43° 20E)	3	137	–	–	Village south of Sharqat, base type mainly silt and stones.
AL-Zewia (34° 56N', 4° 29E)	4	170	–	–	Floating bridge, near the village base type mainly silt and gravel.
Fat-ha (35° 50N', 43° 35E)	5	202	120	50	10 to 12 km below the junction with Lesser Zab river Narrow rocky defile, badrock and cobble, large amount of tar and small bitumenous springs.
Samarra (34° 12N', 53° 43E)	6	295	–	–	The impoundment before barrage. 18 km long X maximum 5 km width. Filled with patches of vegetation, base type mainly clay, silt and sand.
Balaad (34° 01N', 44° 09E)	7	345	–	–	4 to 5 km downstream from Theloeaia bridge. Base type mainly sand, silt and clay. Base type mainly silt and clay.
Baghdad (33° 20N', 44° 25E)	8	515	35	7	Base type mainly silt and clay. Near AL-Muthanaa bridge.

Results

A total of 33 cladoceran species were identified in the river Tigris (Table 2). Station 6 was characterized by presence of individuals all around the year, while at station 1 they were absent for 9 months. Generally, their absence period was reduced as the river passes southward. Station 8, on the other hand, showed completely different trend as individuals were absent for six months. The absence was mostly associated with swelling condition of the river during winter rainfall and spring flood (Fig. 2).

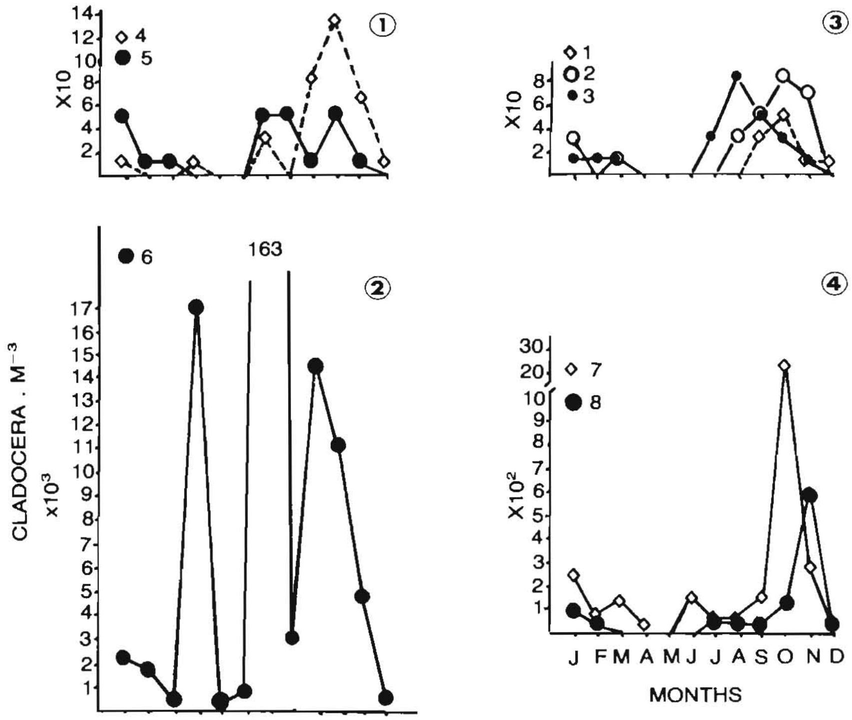

Fig. 2. The total number of individuals m^3 at stations 1 to 8, throughout 1983. Numbers inside the figure indicate the station.

Cladocera at station 1 were representd by 3 species only. A mean total of 8 ± 1 species were collected from each of stations 2,3,4,5 and 8. In station 7 a total of 14 species were observed. At station 6, on the other hand 32 species were observed, exceeding the total number of the species at each of the other stations, by almost 2 to 11 fold during 1983 (Table 2). *Dunhevedia crassa* appeared only at stations 1 and 6, while the species composition of stations 2, 3 and 4 was broadly similar (Table 2). *Alona rectangula* and *Diaphanosoma brachyurum* first appeared at station 2 and 3 during August and July, respectively. *Bosmina coregoni* and *Ceriodaphnia rigaudi* appeared in the river fauna at station 5 (Fat-ha) and at all further stations downstream. Almost all species which were identified from stations 7 and 8 were observed at station 6. *Alonella* sp. was recorded at station 8 only. Few individuals of benthic forms, such as *Ilyocryptus sordidus* were collected in most stations during April, May and November.

An increase in the number of individuals was evident during mid-summer to mid-autumn in stations 1 to 5, but in no instance their presence exceeded 150 m^{-3}

Table 2. Species list of Cladocera, and their Citation Stations in Tigris river, throughout 1983

	Species	*Stations
1	*Diaphanosoma brachyurum* (Lieven)	2,3,4,6,7
2	*Daphnia lumholtzi* Sars	6
3	*Simocephalus vetulus* Schodler	2,3,4,6
4	*S. expinosus* (Koch)	6
5	*S.* sp.	6
6	*Scapholebris kingi* Sars	6,7
7	*Ceriodaphnia reticulata* (Jurine)	6
8	*C. rigaudi* Richard, 1894	5,6,6,8
9	*C.* sp.	6
10	*Bosmina coregoni* Baird	5,6,7,8
11	*B. iongirostris* (O.F.M.;	6,7,8
12	*B.* sp. Baird, 1845	2,5,6
13	*Ilyocryptus sordidus* (Lievin)	3,4,6,7,8
14	*Macrothrix rosea* (Jurine)	2,4,6,7
15	*M. laticornis* (Jurine)	2,3,4,5,6,7,8
16	*M.* sp.	3,4,5,6,8
17	*Camptocercus rectirostris* Scholder	6,7
18	*Alona guttata* Sars	6
19	*A. quadrangularis* (O.F.M.)	6
20	*A. rectangula* Sars	1,2,3,4,6,7
21	*A. intermedia* Sars	6,7,8
22	*A. costata* Sars	6,7
23	*A. monacantha* Sars	6
24	*A. affinis* (Leydig)	3,6
25	A. *karua*	1,6,7
26	*A.* sp.	6
27	*Pleuroxus denticulatus* Birge	6
28	*P. trigonellus* (O.F.M.)	6
29	*Pleuroxus* sp.	6
30	*Dunhevedia crassa* King	1,6
31	*Chydorus sphaericus* (O.F.M.)	4,5,6,7
32	*Ephemeroporus barroisi* (Richard)	2,4,5,6
33	*Alonella* sp. Sars, 1862	8

* Numbers indicated stations along the river.

(Fig. 2). This increase was dominated by *M. laticornis* and *A. rectangula* (Figs. 3, 5).

The total number of individuals showed 3 increases during the year at station 6 (Fig. 4). Spring increase became clear in April, the summer outburst in July, while the autumn increase reached its peak in September. The spring population amounted to be more than 17×10^3 m^{-3}, with *B. coregoni* (Fig. 4) and

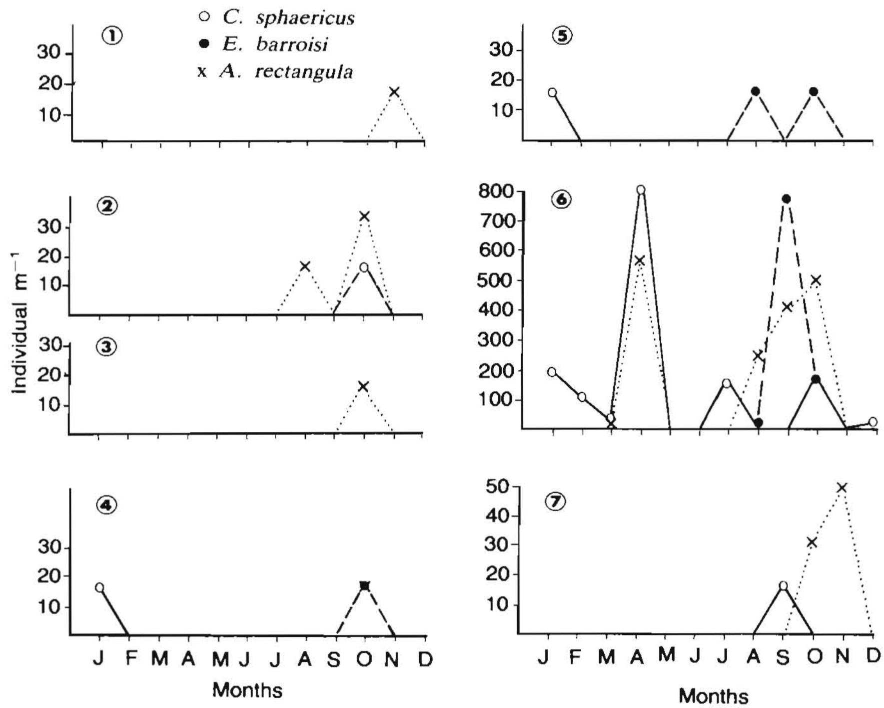

Fig. 3. Seasonal variation in the population density of *Chydorus sphaericus* (o), *E. barrosi* (•) and *Alona rectangula* (x) along the Tigris river throughout 1983. Encircled numbers indicate station number.

Scapholeberis kingi forming more than 33% and 23% of the population, respectively. The summer outburst of the population exceeded 163×10^3 m^{-3}. *C. rigaudi* and *M. laticornis* were represented more than 50% of the population (39% and 19%, respectively). In contrast, the autumn maximum of 14×10^3 m^{-3} in September was dominated by over 50% *B. longirostris*. This increase extended into October though with some decline in total number (11×10^3 m^{-3}) and with different dominant species. At this time, *B. coregoni* contributed more than 47% of the population. *M. laticornis* was the second important taxon during September and October although it did not exceed 18% of the population. Moreover, *Ephemeroporus barroisi* formed almost 10% of the population during October at this station (Fig. 3).

The maximum at station 7 was evident during October only. The total number exceeded 2×10^3 m^{-3} with *B. coregoni* making up more than 70% of the population. The next commonest species was *C. rigaudi* (Fig. 4).

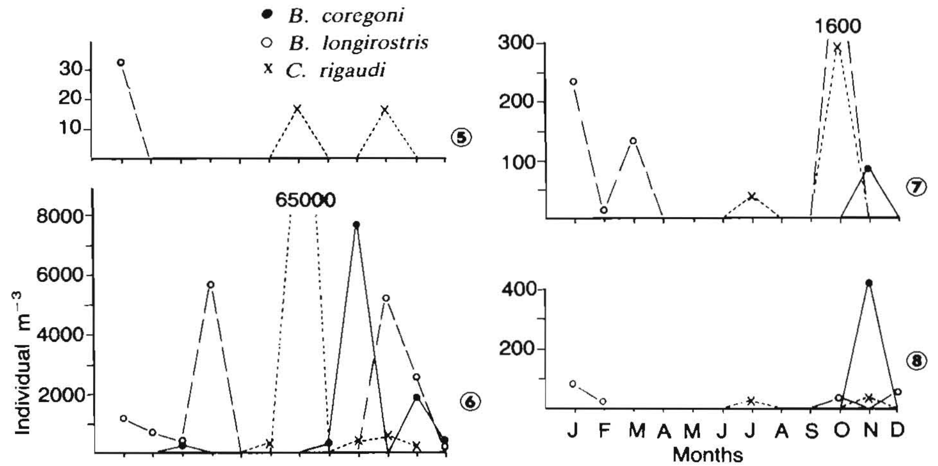

Fig. 4. Seasonal variation in the population density of *Bosmina coregoni* (o), *B. longirostris* (•) and *Ceriodaphnia rigaudi* (x) in stations 5 to 8, throughout 1983. *Note* those species were not observed at stations 1 to 4.

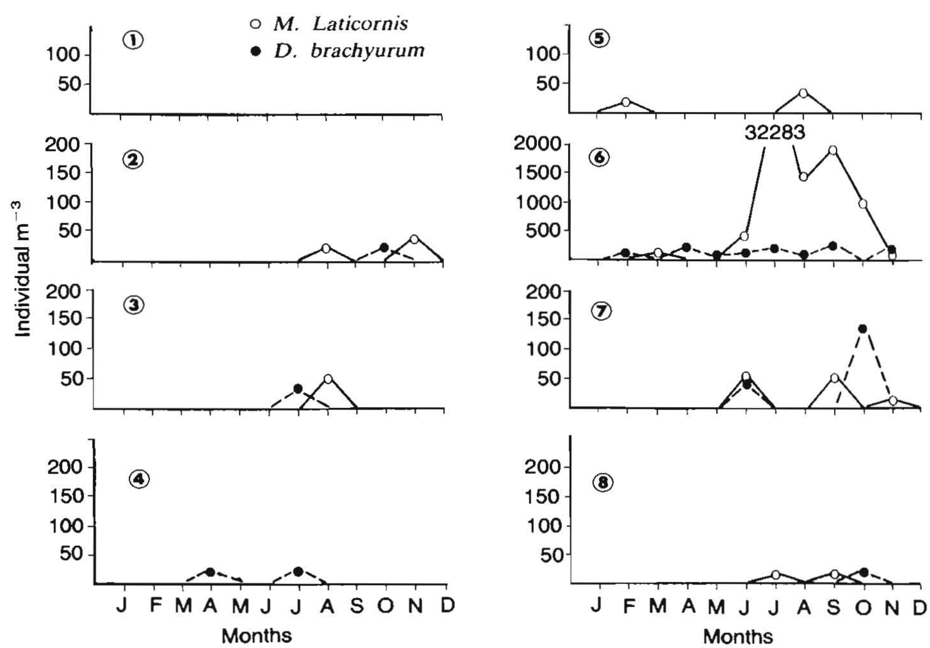

Fig. 5. Seasonal variation in the population density of *Macrothrix laticornis* (o) and *Diaphanosoma brachyurum* (•) at stations 1 to 8, throughout 1983. Both species were not observed in station 1 during the study period.

The increase at station 8 appeared during November. The total number reached 0.5×10^3 m^{-3}. *B. longirostris* represented more than 80% of the maximum population (Fig. 6).

Discussion

The results have shown that *Bosmina* was one of the important taxa in the river Tigris, for most of the year especially at downstream stations. Its total count exceeded 80% of the population during autumn. This would reflect a similarity between Tigris and other river systems (Pahwa and Mehrotra 1966, Chiaudani and Marchetti 1983).

The principal Daphnidae in the river Tigris during the present investigation was *Ceriodaphnia rigaudi*. It had a maximum of 65×10^3 m^{-3} during July. *Ceriodaphnia* is a dominant taxa in rivers Ganga (Pahwa and Mehrotra 1966) and Sokoto (Holden and Green 1960). Daphnids are known to be summer organisms (Pedros-Allio and Brock 1985). They are open water swimmers, feeding on detritus and algae (Frey 1985). Peaks in algal population growth at both stations 6 and 7 occurred a month earlier. The genus *Daphnia*, which includes many species common in river zooplankton, especially in the temperate zone (Fernando 1980a), was represented in the river Tigris by *D. lumholtzi* only. Few individuals of this species were collected from Samarra water during November. Khalaf and Smirnov (1976) also reported the same species at the same month, but from other localities. It seems that this species may be an Autumn form in Iraq. Alsaboonchi *et al.* (1986) from a full year investigation in Garma marshes, did not report any representative of this genus. The scarcity of *Daphnia* spp. was also reported by Fernando (1980a,b) in freshwater ecosystems of South East Asia. However, Mohammad (1965, 1979) listed three species belonging to this genus, other than *D. lumholtzi*, which were *D. magna*, *D. pulex*, and *D. longispina*. The last species is common in rivers (Whitton 1975). Thus, it is most likely that more species of this genus will be found in Tigris.

Macrothrix laticornis was the principal member of the Macrothricidae in our samples. It formed 19.5% of the population at Samarra during July. In contrast, *M. spinosa* forms about 36% of the cladocera at the shore of Euphrates (Khalaf and Smirnov 1976) was not found in our samples. Such high percentage was explained by the presence of submersed weed and aquatic plants in the river. *Ilyocryptus*, a benthic form related to active and strong current (Holden and Green 1960), appeared in the Tigris (as *I. sordidus*) during the high water level of the river.

The Chydoridae was the dominant family in the river Tigris in respect of number of species. This result is similar to that obtained by Mohammad (1965) and Khalaf and Smirnov (1976) from many sites in Iraq. Their appearance during April and September to November was mostly associated with algal blooms. These cladocerans are primarily benthic (Van Urk 1983, Frey 1985) and many became planktonic during algal bloom (Pennak 1978). In the Tigris, the principal taxa were *Alona rectangula*, *Chydorus sphaericus* and *E. barroisi*. *A. rectangula* is one of the principal taxa in river Po (Whitton and Crisp 1983). *Chydorus* is a common river plankton (Whitton 1975). In all instances, the chydorids formed no more than 10% of the standing crop in our samples.

It was found that benthic forms (such as *Alona*) were dominant in upstream stations, while planktonic forms (such as *Bosmina*) were dominant in downstream stations. This result is in accordance with many river systems in the world (Greenberg 1964, Hynes 1970). Presence of few species in head-waters compared to other areas is known for many rivers in the world (Whitton 1975). This phenomenon was clear in our samples as the upper most station at Mosul (station 1) was characterised with the least number of species. While, the number of species in all other locations except Samarra and Balaad was 8±1 throughout 1983. The same number of species was reported in the river Ganga in India (Pahwa and Mehrotra 1966). In Samarra impoundment (station 6) a total of 32 species were collected. This result would support Jenkins *et al.*, (1984) conclusion on macroinvertebrates - habitat relationships in the river Teifi, where sites with the greatest variety of habitats were generally rich in taxa.

The effect of Samarra impoundment was evident on station 7. A total of 14 species were found at this station. Cladocera were absent from this site for two months in comparison with more than 5 months absence in all other river stations. The effect can be also noticed from the presence of *S. kingi*, *C. rectirostris* and *A. costata* at stations 6 and 7, but not in 8. Effects of impoundment on river systems are well documented (Kruglova 1981, Pinel - Alloul *et al.* 1982, Pedros-Allio and Brock 1985). Quantitatively, the effect of the impoundment (station 6) on Balaad (station 7) was not evident at any period of the year but the October peak. During this peak, *B. coregoni* was the dominant species in both stations.

Stations 2 to 4 had almost similar species composition. *B. coregoni* and *C. rigaudi* first appeared at station 5 and were present in the river till the last station at Baghdad. Species such as *S. vetulus D. crassa* and *E. barroisi* were collected from upper stations only. Species such *M. laticornis*, on the other hand, were found in all stations but the first. These results strongly indicate the variation in species composition along the river Tigris.

Summer and Autumn were found to be the best growth seasons for cladoceran populations in the river Tigris. During other seasons, the organisms were either scarce or completely absent in almost all stations. Tigris water was turbid throughout the year, but the turbidity decreased during low river discharge (summer till late autumn) (Alsahaf 1975, Talling 1980). Correlation between low turbidity and cladoceran populations would be in accordance with previous investigations (Shen and Tai 1961, Chiaudani and Marchetti 1983). However, at station 6 the population peaks would indicate otherwise. The bloom of algae at this station occurred during February, June and August. Thus, April, July and September cladoceran peaks may be due to food availability. Such a conclusion could be drawn from the results of station 7 as well. This conclusion would be in line with the theoretical appearance of zooplankton after algal bloom. Thus in the river Tigris, as in other river ecosystems (Whitton 1975) it is difficult to trace which is more important for cladoceran growth, low turbidity, algal bloom or both, since the two occurred at the same period.

It was shown in the results that the maximum population growth along the river occurred at Samarra impoundment (163×10^3 m^{-3}). This result is in accordance with previous studies on river - impoundment or lake systems (Pinel-Alloul *et al.* 1982, Pedros-Allio and Brock 1985). The maximum in the Tigris is greater than that recorded in the rivers Po (1×10^3 m^{-3}), Sokoto (2.7×10^3 m^{-3}), Fesafari (3.4×10^3 m^{-3}) and Ganga (14×10^3 m^{-3}) (Holden and Green 1960, Pahwa and Mehrotra 1966, Chiaudani and Marchetti 1983). This could reflect better fertility of the Tigris since in general zooplankton abundance is strongly and positively correlated with the trophic state (Blancher 1984). The high fertility of Tigris water is indicated by the rich algal population, which reached 41×10^6 cells L^{-1} during 1983. However, a maximum similar or greater than that of Tigris in cladoceran population growth has been reported previously from many other rivers (Whitton 1975).

Most of the species showed a single density peak during Spring (*C. sphaericus* and *S. kingi*), Summer (*M. laticornis* and *C. rigaudi*) or Summer till mid-autumn (*D. brachyurum, E. barroisi* and *B. longirostris.* On the other hand, *A. rectangula* and *B. coregoni* had shown two density peaks during 1983. The first peak during Spring while the second one during autumn. Almost all the above peaks were evident at station 6 (Figs. 3-5).

In general the cladoceran population in the Tigris resembles that of the other rivers of the world. Small numbers of species and individuals were recorded at upper reaches of the river, while planktonic forms were dominated lower reaches. The principal taxa were *Bosmina, Ceriodaphnia, Macrothrix* and *Alona.* More species of *Daphnia* may well be recorded in future studies. The low turbidity and algal blooms may influence the population density. The effect of the man-made impoundment at Samarra was evident in the river during the present study. Variations between the river segments were evident.

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دراسة على براغيث الماء في نهر دجلة

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هيئة الزراعة والبايولوجي ـ شعبة البيئة والموارد المائية ـ ص. ب ٧٦٥ ـ بغداد
[١]قسم العلوم الحياتية ـ كلية التربية ـ جامعة بغداد ـ بغداد ـ العراق

درس التغاير الفصلي لسكان براغيث الماء في نهر دجلة. جمعت النماذج شهرياً من ثمان محطات موزعة على المنطقة الممتدة من شمال مدينة الموصل ولغاية بغداد جنوباً. تم في كل محطة جمع ١٥ لتراً من ضفتي ووسط النهر كما تم امرار الماء خلال شبكة الهائمات (حجم الفتحة ٢٦ مايكرون) لتركيز الحيوانات ثم حفظها بالفورمالين.

لقد تم تشخيص ٣٣ نوعاً خلال مدة الدراسة. كما وجد أن الأنواع *Bosmina coregoni*, *B. longirostris, Ceriodaphnia rigaudi Macrothrix laticornis* و *Alona rectangula* هي المتغلبة في نهر دجلة. لوحظ أن فترة نهاية الصيف والخريف هي أفضل مواسم التكاثر والتي تميزت بكثافة سكانيه عاليه بلغت أقصاها ١٦٣ × ١٠^{٣} حيوان / لتر سجلت في المحطة السادسة «حوض سد سامراء». كما لوحظ أن كثافة براغيث الماء وعدد أنواعها تكون قليلة في أعلى النهر مقارنة بأسفل النهر إضافة إلى كون غالبية الأنواع التي جمعت من أعلى النهر تكون قاعية الأصل Benthic في حين أن المتغلب في محطات أسفل النهر وعلى الأخص المحطة السادسه نزولا هي الأنواع الهائمه Planktonic. لقد أوضحت النتائج أن حوض سد سامراء قد أثر على الكثافة السكانية وعدد الأنواع في النهر أسفل موقع السد. نوقشت في متن البحث الفروق الملاحظة على طول النهر كما نوقشت حالة براغيث الماء في نهر دجلة بالمقارنة مع بعض الأنهار في العراق والعالم.