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ECOLOGY OF CLADOCERA (CRUSTACEA) IN WADI EL-RAYAN

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ABSTRACT

Wadi El-Rayan Lake was created as a reservoir for agricluture drainge water from El-Fayoum province exceeding the capacity of Qarun Lake.

Eleven cladoceran species were listed from the area during the period of investigation. Seven of them, namely Diaphanosoma mongolianum, Leydigia acanthocercoids, Macrothrix laticornis, Oxyurella tenuicaudis, Alona rectangula, Ceriodaphnia quadrangula and Chydorus sphaericus are new to the area.

Diaphanosoma mongolianum proved to be a perennial and common species recorded all the time from most of the area and monopolized the Cladoceran community during autumn, while the others appeared sporadically.

A complete absence of Cladocera from the drain was observed durning autumn. The community composition, the distribution, the seadonal variation and bilolgical quality parameters were discussed.

INTRODUCTION

Developing the first production from the inland water represents a great hope to face the increased demand of protein for feeding the enoromous increasing population in Egypt. Being a link between the primary producers and higher consumers, the planktonic crustaceans including Cladocerans, play an important role in determining the character of energy flow through the aquatic ecosystem.

Few are the studies dealing with the Egyptian fresh water Cladocera. According to the available literature, Claodecera was indluding through the studies generally carried out on the zooplankton of Maruit Lake [1,2,3,4], Nozha Hydrodrom [5], Idku Lake [1,6,7], Burullus Lake [8]. Manzalah Lake [9,10], ElSerw Fish Farm [11], Nile River [12] and Nasser Lake [13]. Moreover Obuid Allah [14,15] published on the seasonal variation in population of Cladocera in the Nile at Assiut and the distribution of fresh water Caldocera in 11 districts in Egypt repectively, and Guerguess [16] studied the effect of aeration regime on mass production of a Cladoceran species. since the work of Khalil [17] and Saleh [18] who recorded 4 and 14 species of Cladocera in Wadi El-Rayan, repectively, no studies concerned with Cladocera were performed in this ecololgically interesting area.

Wadi El-Rayan Lake:

In Wadi El-Rayan depression (40 Km South -West to El-Fayoum province in the western desert), the new man made lake of Wadi El-Rayan (30° 23, 29° 10` N) is represented by two distinct parts at two elevations. To the first part (about 15,000 Feddans), the agriclture drainage water of El-Fayoum province ecxceeding the capacity of Qarun Lake, is channelled through a tunnel (3 m diameter and 9 km long) branching from El-Wadi Drain. The surplus water from the first part floods to the second part via a shallow canal connecting the colseset ends of the two parts and characterized by dense vegetation of aquatic macrophyts and water falls along it dropping 10 m. The filling of the area started in 1968 and has been operating regularly since early (1974) [19]. Boraey [20] reports that the Lake received the first lot of drainage water in April 1973. The aquatic area of the second part is increasing with time where newly flooded areas are continuously added to the South western sides of this part. The final area of the Wadi El-Rayan Lake is estimated to be 190 Km^2 at a contour of-13 m.[21].

MATERIAL AND METHODS

Seasonal plankton samples were collected durng 1989 from eight localities (Fig. 1) representing different ecological conditions in Wadi El-Rayan. Table (1) summarizes the location and the abiotic vaeriables of the samples localities. The samples were obtained

Table 1: Samlpeled localities and their physicochemical variables (D: Feeding drain; A.d: average depth in metres; A.PH; average PH; 02: averabe dissolved oxygen in mg / L; S%, average salinity.)

Station	Location	A.d.	A.PH.*	O2. *	S %. *
D	pre the outlet of El Wake Drain	2	8.5	7.5	1.2
1	First Elevation 200 meters in front of El-wadi drain.	5.5	9.0	8.5	1.4
2	outlet Middle of the first elevation	14.5	9.0	8.5	1.5
3	West of the first elevation	8.6	9.1	8.0	1.6
4	South-east of the first elevation	23	8.7	9.1	1.5
5	Preentrance of the connecting chamel	2	9.1	8.5	1.6
6	End of the connecting channel	2	8.7	8.6	1.3
7	Second elevation, 200 meter off thw water fall.	2	8.6	8.3	2.5

After Konsowa (1991)

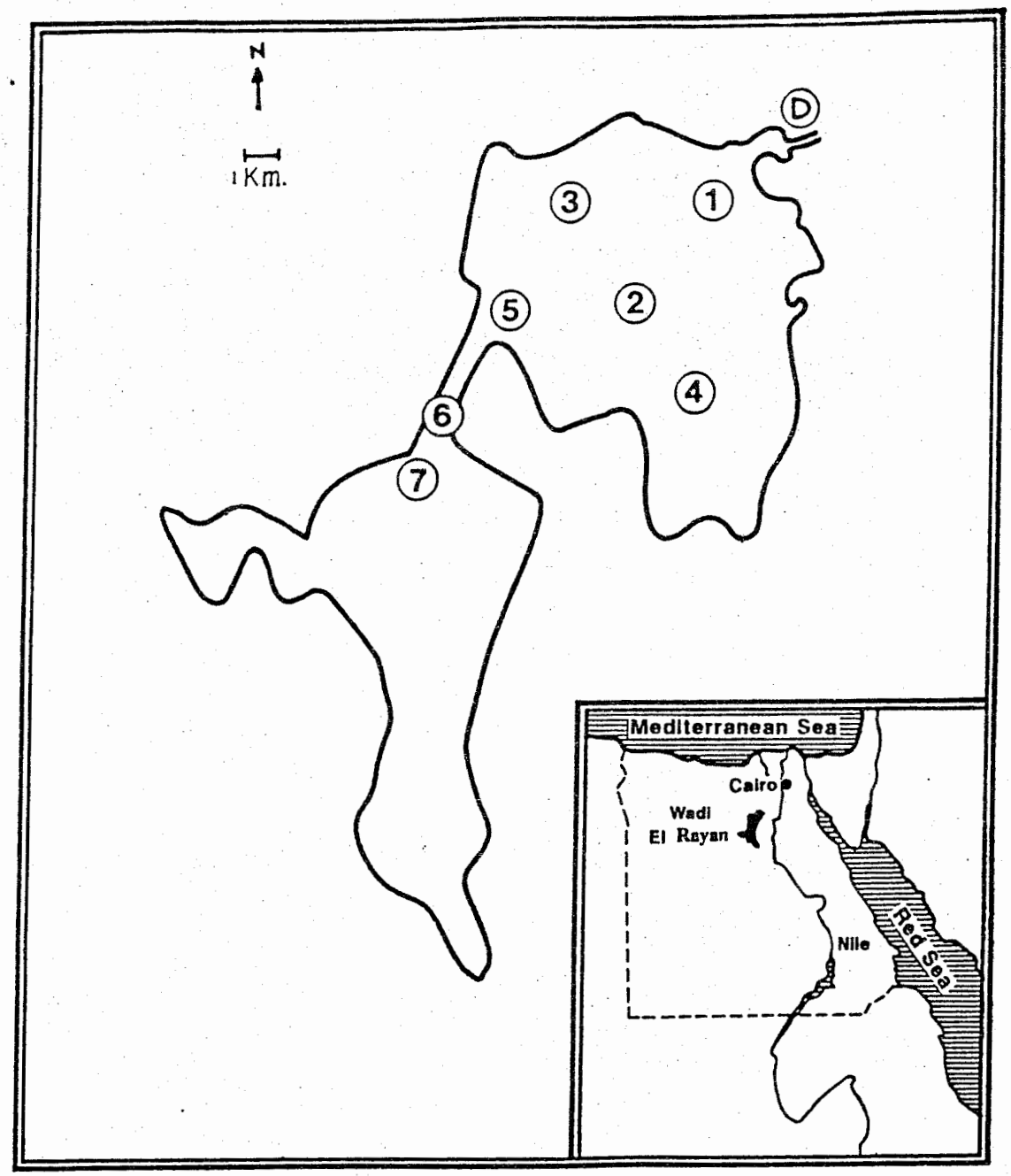

Fig. 1: Sampled localities

by filtering 150 liters of surface water at each station through a standard plankton net (20 μm mesh size). The filtrate was preserved in 6% formalin. In the laboratory, each sample was standerized to 150 ml. Triplicate subsamples (each of 3 ml volume) were examined under a 100 X binocular microscope. Consultuing Brooks[22], Scoufield & Harding[23], Amoros[24] and Krovchinskly[25] the Clacoceran species were identified. The species identification was confirmed by professor Dumont, head of Laboratory of Animal Ecology, University of Gent, Belgium. The individuals of each spesies in each subsample were counted and the average was calculated. The average population densities expressed by the average number of individuals per cubic metre calculated according to the equations:

$$P.D = \frac{n_i \times 1000}{3} \quad \text{and T.P.D.} = \quad \Sigma \frac{n_i \times 1000}{3}$$

Where: P.D. is average population density of a given population density of a given species, T.P.D is the average of density of total Cladocera and n_i is the average number of a given speies in the subsamples. The Sorensen index of similarity was calculated for each combination of 2 stations to the according to the equation of Sorensen 1948 cf [26]:

$$S = \frac{2c}{a+b} \times 100$$

where cis the number of speues common to both associations, a the number of species in one association and b the number of species in the other association. The index of biotal dispersity (IBD)

as devised by Koch (1957) cf. [26].

$$IBD = \frac{T-S}{S(n-1)} \times 100$$ (where T is the arithmetical sum of Species living in each of n compared associations, and S is the total list of species in n compared associations) was used to assess how widely dispersed spersed species are between a number of stations. The Shanon index of general diversity (H) was calculated by station and season.

$$\{ H = -\Sigma (n_i / N) \log e (n_i / N) \}$$

where n_i is the number of individuals [27]. The equitability was calculated by the equation H/loge S where S is the total number of species.

RESULTS

Through the present survey, total number of 11 Cladoceran species (Table 2) were recorded. Seven of them namely, Diaphanosma mongolianum, Leydigia acanthoceroides, Alona, rectangula Oxvruella tenuicaudis, Macrothrix laticornis, Ceriodaphnia quadrangula and Chydorus sphaericus are new to the area.

Diaphanosoma mongolianum dominataed the Cladoceran community in all the investigated sites except El-Wadi Drain (Station D) and Station 5 where chydorus sphaericus and Bosmina lingirostris dominated the community respectively. B.longirostris and C.quadrangula were recorded from all stations but station 6.

Table 2: species composition, distribution, population density (p.D) as number of organisms / m3, Diversity index ($\bar{H}$), Equitability (E) and dominance% of Cladocera in the sampled localities.

Station	D		1		2		3		4	
Species	P.D	%	P.D	%	P.D	%	P.D	%	P.D	%
Diaphansoma mongolianum	55.5	5.24	8958	81.55	3750	87.02	4513.75	88.92	4305.75	56.78
Bosmina longirostris	155.7	14,71	1097.25	9.99	83.75	1.94	284.75	5.61	2092.75	27.60
Daphnia longispina	---	---	305.5	2.78	392.25	9.1	69.5	1.37	986	13
Daphnia cucullata	---	---	14	0.13	---	---	27.74	0.55	28	0.37
Chydorus sphaericus	444.5	41.97	416.75	3.79	14	0.32	83.25	1.64	27.75	0.37
Ceriodaphina quadrangula	27.75	2.62	96.5	0.36	69.5	1.61	69.5	1.37	129.5	1.71
Maerothrix laticormis	236.25	22.31	83.25	0.76	---	---	---	---	---	---
Oxyurella tenuicaudis	69.5	6.56	41.75	0.38	---	---	14	0.28	14	0.18
Aolna rectangula	---	---	---	---	---	---	14	0.28	---	---
Leydigigia acanthoceroid	55.75	5.26	---	---	---	---	---	---	---	---
Monopilus dispar	14	1.32	---	---			---	---	---	---
Total species	8		8		5		8		7	
Total species	1059		10986		430986		5076.5		7583.75	
Diversity Index¯(H)	1.3620		0.719		0.719		0.512		1.068	
equitability (E)	0.655		0.346		0.346		0.246		0.544	
Dominance&	64.38		91.5		91.5		94.53		84.37	

Table 2: species composition, distribution, population density (p.D) as number of organisms / m3, Diversity index (H), Equitability (E) and dominance% of Cladocera in the sampled localities.

Station	5		6		7		Average	
Species	P.D	%	P.D	%	P.D	%	P.D	%
Diaphansoma mongolianum	736.25	83.27	416.5	81.03	236.25	56.62	2871.38	72.08
Bosmina longirostris	979	50.89	---	---	41.75	10.01	591.88	14.86
Daphnia longispina	83.5	4.34	---	---	---	---	229.59	5.76
Daphnia cucullata	27.75	1.44	---	---	---	---	12.19	0.31
Chydorus sphaericus	---	---	41.75	8.12	---	---	128.5	3.23
Ceriodaphina quadrangula	41.75	2.17	---	---	14	3.36	52.69	1.33
Maerothrix laticormis	---	---	14	2.72	---	---	41.69	1.05
Oxyurella tenuicaudis	55.5	2.88	14	2.72	83.5	20.01	36.53	0.92
Aolna rectangula	---	---	27.75	5.40	41.75	10.01	10.44	0.26
Leydigigia acanthoceroid	---	---	---	---	---	---	6.97	0.17
Monopilus dispar	---	---	---	----	---	---	1.75	0.04
Total species	6		5		5			
Total species	1923.75		514		417.25			
Diversity Index (H)	1.094		0.728		1.221			
equitability (E)	0.611		0.452		0.759			
Dominance &	98.16		98.15		76.63			

C.sphaericus appeared in all sites except stations 5 and 7. while O.tenuicaudis disapeared from stations 2 and 7. Daphnia cucullata was recorded from half the investigated sites. Each of M.laticrnis and A.rectangula was only hauled from three sites, while each of Leydigia acanthocercoid and Monopils dispar only appeared in El-Wadi Drain. figure (2) shows that D.mongolianun dominates the Cladoceran community of the whole area. It constituted 72.22% of the total Cladocera, while M.dispar was the least represented species and constituted 0.04% of the totalcladocera (Table 2).

The highest diversity (H = 1.362) appeared in El-Wadi Dranin, while the lowest one (H = 0.501) was recorded in station 2 (Table 2). The highest equitability was observed in station 7 (E= 0.759) and the lowest (E = 0.246) was recorded in station 3. Both the similarity index (Table 3) and the biodipersity index (Fig. 3) show a strong relation between stations 1 & 4, 1&3 and 3 & 4.

The following are the species composition and the biological quality parameters in the sampled localities:

Station D:

The Cladoceran community in El-Wadi Drain was composed of 8 species (Table 2). Its average population density (P.D) during 1989 was 1059 organisms / m^3 (Table 2 and Fig. 4). It was dominated by chydorus sphaericus and Macrothrix laticornis. The community dominance index (CDI) = 64.38, while Ceriodaphnia quad-

Table 3: Similarity Index.

	D	1	2	3	4	5	6	7
D	---	75.6	61.5	62.5	66.7	57.1	61.5	61.5
1	---	---	76.9	87.5	93.3	85.7	57.1	61.5
2	---	---	---	76.9	83.3	72.7	40.0	60.0
3	---	---	---	---	93.3	85.7	61.5	76.9
4	---	---	---	---	---	92.3	50.0	66.6
5	---	---	---	---	---	---	36.3	72.7
6	---	---	---	---	---	---	---	60.0
7	---	---	---	---	---	---	---	---

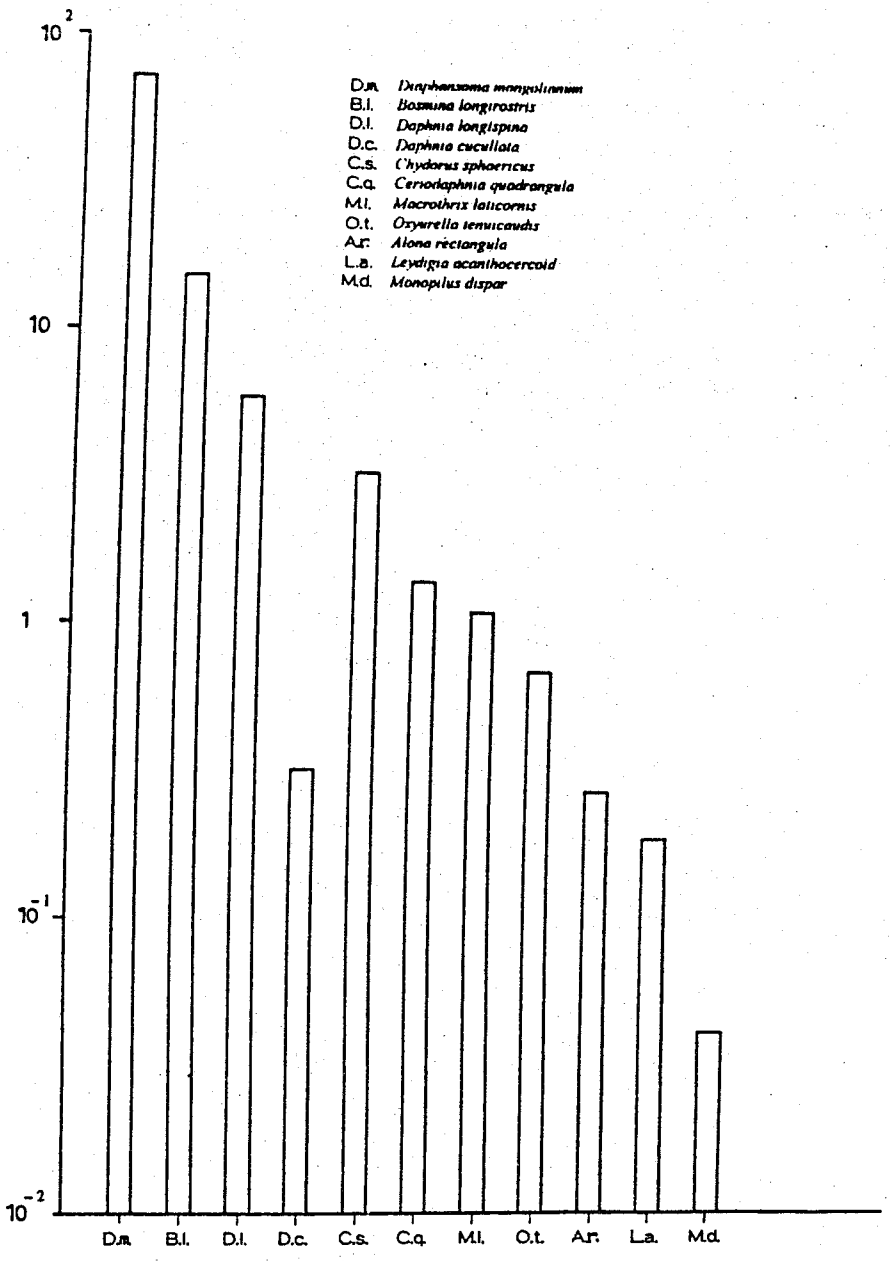

Fig. 2: Log percentage of Cladocera species to the total Cladocera production of the whole area during 1989.

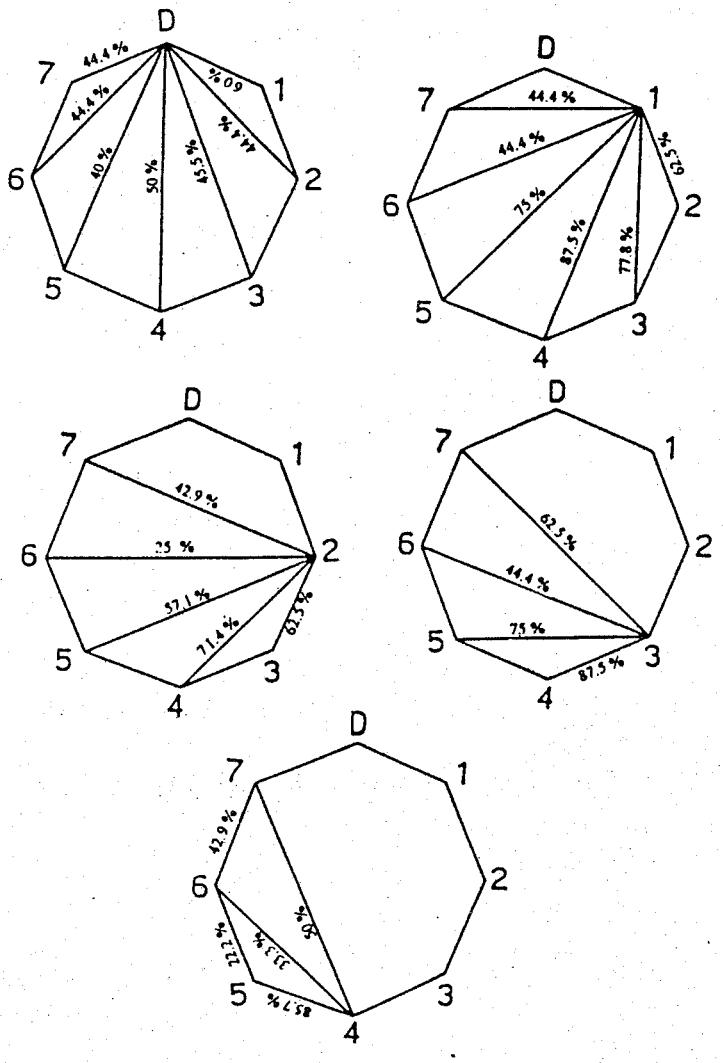

Fig. 3: Biodispersity of Cladocera in Wadi El-Rayan.

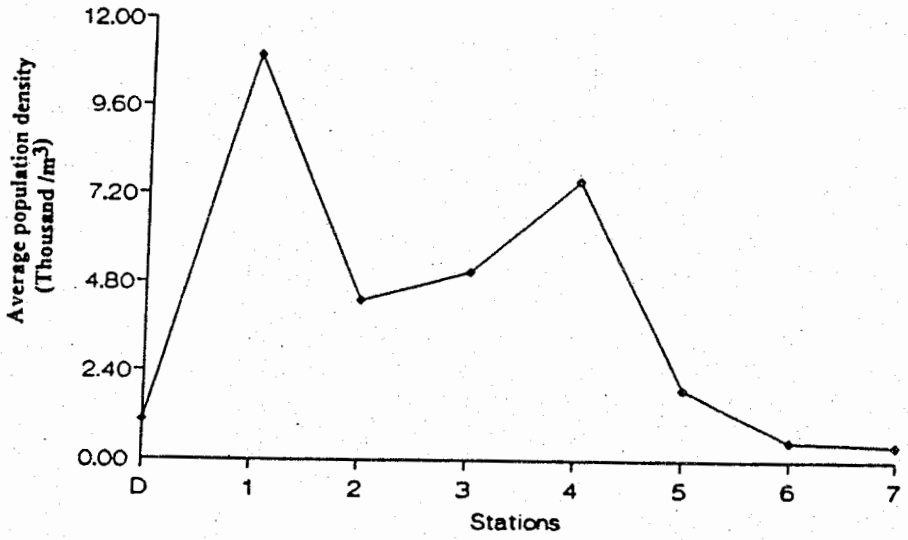

Fig. 4: Average frequaency (in individualss / m3 / year) of the total Cladocera in the sampled localities in Wadi El-Rayan during 1989.

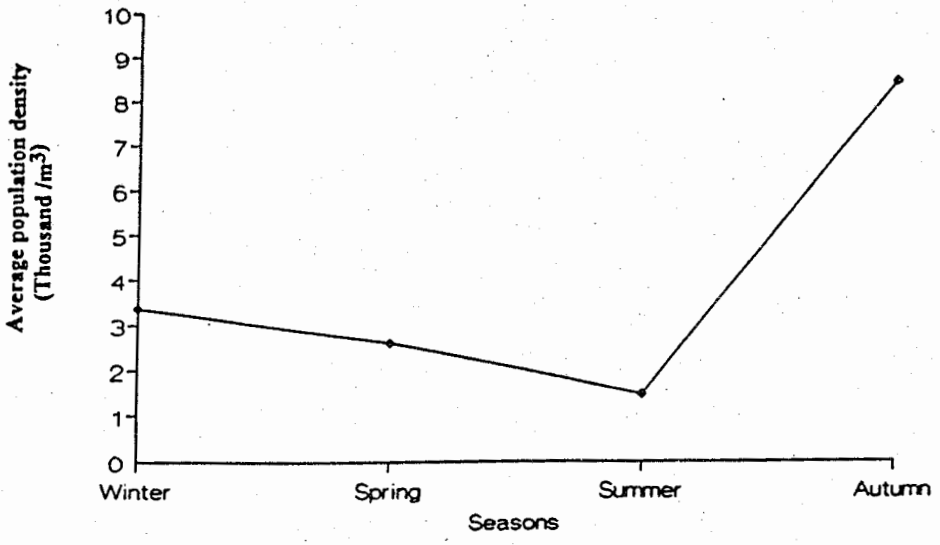

Fig. 5: Seassonal variation of total Cladocera in Wadi El-Rayan lake during 1989.

rangla and Monopilus dispar were weakly represented. The diversity index (H = 1.362 while the equitability (E = 0.655). Ldeigia acanthoceroid and M.dispar were confined to this station.

station 1:

This station was the most productive site in the area investigated (Fig.4). Its PD (109 86 individuals /m3) was 10 folds its corresponding value in the drain. As in the drain, the cladoceran community was composed of 8 species (Table 2). In addition to the absence of two species previously mentioed as cofined to the drain, Alona rectangula was also absent. The community was dominated by D.mongolianum (81.55%) and to a very less extent by B.longirostris (9.99%), DCI = 91.5. The other species were weakly represented. H = 0.719 and E = 0.346.

Station 2:

Only 5 species were recorded from this station (Table 2). As in station 1, D.mongolianum was the dominant species (81.55%) followed by D.longipina (9.1%). The highest CDI (92,12) and the lowest diversity (H = 0.501) were at this site, while E was relatively low (0.311). The production in this station (4309.5 organisms/m3/year) was less than half its value in station 1 (Table 2 and Fig. 3).

Station 3:

As in stations D and 1,8 species recorded. m.laticornis, L.acanthoceroid and M.dispar were absent. This station represents the third productive site in the area (Fig. 3). A production of 5076.5 organism / m3 / year was recorded (table 2). H = 0.512 was nearly equal to its value in station 2, while E= 0.246 was the minimum between its corresponding value for the other sites. The community was dominated by D.mongolianum (88.92%) and B.longirostris was the following abundant species (5.61%), DCI = 94.53% (Table 2).

Station 4:

Seven species were recorded and 4 were absent D.mongolianum was the dominant species and B.longirostris was common, CDI = 84.37% (Table 2). This station is the second fertile site in the area (Fig. 3) recording a production of 7583.75 organisms / m3 / year. $\bar{H}$ = 1.068 is relatively high, while E = 0.544 is moderate.

Station 5:

Only 6 species were recorded (Table 2) B.longirsotris was the dominant (50.89%) and D.mongolianum was the codominant species (38.27%). Copared with the previous station, the production (1923.75 organisms/m3/year) was low (Fig.3), $\bar{H}$ = 1.094 was nearly equal to its value in the previous station E = 0.611.

Station 6:

Only 5 species were recorded (Table 2) D.mongolianum was the dominant species (81.03%) and C.sphaericus was the following species (only 8.12%). The production (415 organisms / m3 / year) was low (Fig. 3), H = 0.728 was moderate and E = 0.452.

Station 7:

As in station 2 and 6, the community in station 7 was composed of 5 species (Table 2). D.mongolianum dominated the community (56.62%) and O.tenuicaudis was the co-dominant species (20.01%), CDI = 76.63%. The lowest production (417.25 organisms / m^3 / year) (Fig. 4). the highest equitability (E = 0.759) and biodiversity, after stations D, were observed in this site (Table 2).

Seasonal variation:

As showning Figure 5, autumn, was the most productive season due to the floruishment of D.mongolianum, during it. The PD (8486 individuals / M3) during the autumn was more than 5 folds the PD during the summer (Table 4) when D.mongolianum monopolized the communityj. During winter and spring a relative high number persisted (about 3000 organisms / m^3). In the winter, B.longirostris was the dominant species (Table 4). The highest diversity index ($\bar{H}$ = 1.259) andequitability (E = 0.547) were observed during the spring, while, the highest dominance percentage

Table 4: Seasonal abundance, diversity index, Equitability and dominance percentage of Clodocera in Wadi El-Rayan durnig 1989.

Species	Winter	%	Spring	%	Summer	%	Autumn	%	Average	Average
Diaphansoma mongolianum	368	10.94	1313	50.5	1486	100	8319	89.3	2871.5	72.08
Bosmina longirostris	2187	85.03	167	6.42	---	---	14	0.16	592	14.86
Daphnia longispina	534	15.88	384	14.77	---	---	---	---	229.5	5.76
Daphnia cucullata	21	0.62	28	1.08	---	---	---	---	12.25	0.31
Chydorus sphaericus	7	0.21	451	17.35	---	---	56	0.66	128.5	3.32
Ceriodaphina quadrangula	176	5.23	34	1.31	---	---	---	---	52.5	1.32
Macrothrix laticormis	7	0.21	118	4.54	---	---	41	0.48	41.5	1.04
Oxyurella tenuicaudis	42	1.25	77	2.96	---	---	---	---	29.75	0.75
Aolna rectangula	14	0.42	---	---	---	---	28	0.33	10.5	0.26
Leydigigia acanthoceroid	7	0.21	21	---	---	---	28	0.33	14	0.35
Monopilus dispar	---	---	7	0.81	---	---	---	---	1.75	0.04
Total species	10		10		1		6			
Total species	3363		2600		8486		8486		3983.75	
Diversity Index ($\bar{H}$)	1.108		1.259		0		0.128			
equitability (E)	0.481		0.547		0		0.071			
Dominance%	80.91		67.85		100		89.69			

(98.69%) was observed during the autumn (Table 4). Table 5 shows that station 3 was the most productive site during the autumn, while the least productive sites were the drain and station 3 during the summer and station 7 during the spring. The cladocerans were not detected from station 2 during the summer and from the drain during the autumn.

In the drain, the Cladocera production attained its peak durning spring when PD was about 7 and 33 fold its value during winter and summer seasons respectively.

In stations 1,2,3 and 6, the cladoceran production attained its climax during the autumn while in stations 4,5 and 7 the winter was the most productive season (Table 5).

Dominant Kinds:

Diaphanosoma mongolianum was the dominant and perenial species in the cladoceran community of the area investigated.Its production represented about 72% of the toatl population Autumn was its flourishing season (about 8000 organisms / m^3). Spring and summer produced a relative low density (about 1300 and 1500 individuals / m^3, respectively), while the winter was the poorest season (Fig. 7). The only previous record of this species in Egypt was that recorded by Obuid Allah [14] from the Nile. Korovchinsky [25] states that D.mangolianum was found mainly in the temperate and subtropical zones and its distribution extends from North-eastern

Table 5: Distribution and seasonal Variation of total Clasocera (Org. /m3) in wadi El-Rayan dumig 1989 .

Station	winter	Spring	Summer	Autumn	Average
D	513	3612	111	0	1059
1	5000	9612	7222	2210	10986
2	945	1627	0	14666	4310
3	1695	1732	111	16777	5077
4	14279	2056	3667	10333	7583
5	2695	1778	222	2000	1924
6	0	278	333	1444	514
7	780	112	222	555	416
Average	3363	2600	1486	8486	2983.75

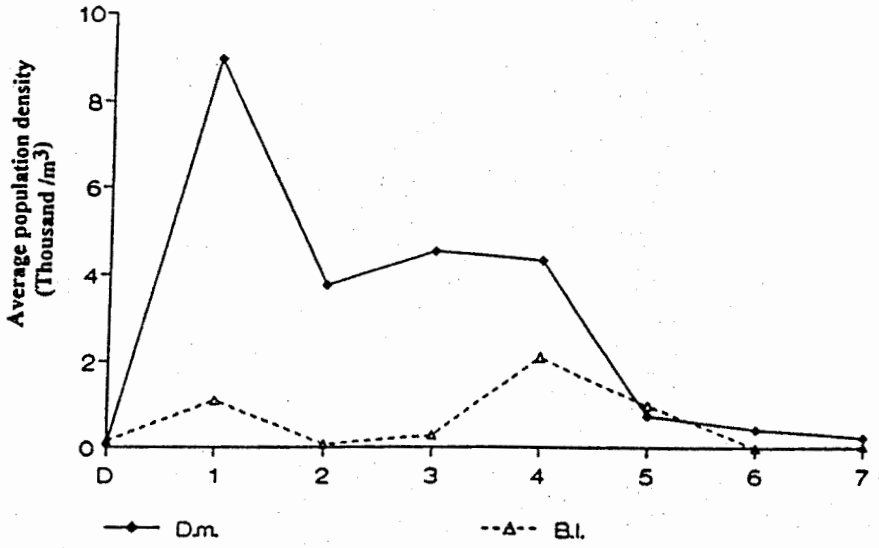

Fig. 6: Distribution of Diaphanssoma mongolianum (D.m) and Bosminal longirostris (B.1) in Wadi El-Rayan.

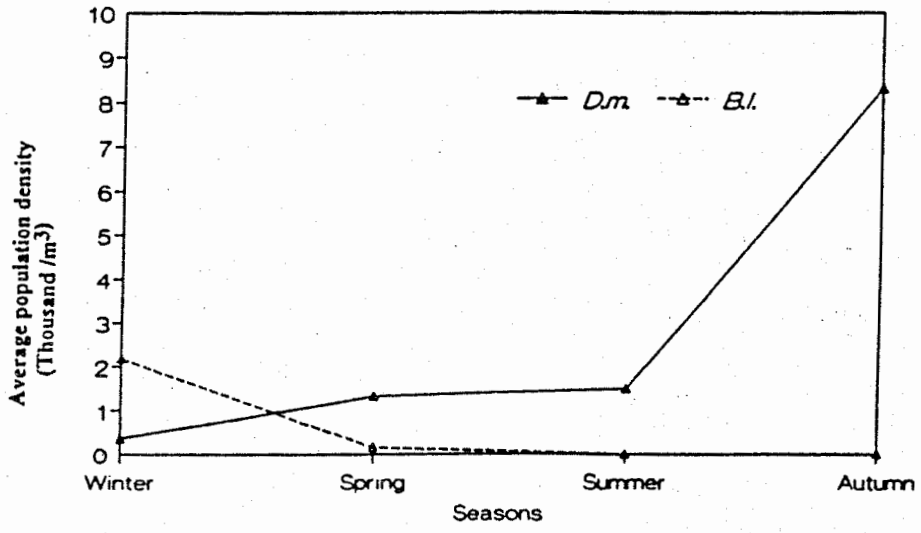

Fig. 7: Seasonal variation Diaphanssoma mongolianum (D.M) Bosmina longirostris (B.1) in Wadi el-Rayan.

China to Spain, as well, it was detected in the white Nile and some Ethiopian lakes.

The following dominant species was Bosmina logirostris which represented about 15% of the population, while the other species all together only represented 13% (Table 4).

B.olgirostris had a short duration in the plankton of the area. It disappeared completely during summer, was scarce during autumn (14 orgaisms / m^3) during spring (Fig. 7).

The peak of D.mongolianum production for the whole period appeared in station 1, while that of B.logirostris appeared in stations 4 and 1 (Fig. 6).

DISCUSSION

inspite of the fact that El-Wadi Drain is the source of the Wadi El-Rayan Lake, Daphnia longispina, D.cucullata and Alona rectangula were not detedted in the drain through the present investigation. Their presence in the lake is still weak, the two Daphnia species only appeared during winter and spring, while A.rectagula was only recorded during autumn and winter. It is more probable that these species had been introducedto the lake through the water used for transplantation of fish fries or / and by birds during their wintering migration.

The deblooming of cladocerans in Wadi El-Rayan during

spring and summer confirms the statement of Tail [28] that tmperature seems to play a major role in limting large cladocerans. As well spring and summer are the flourishing seasons of Cyanophycae in Wadi El-Rayan [17] and that agrees with Wodago and Balyey [29] who found that cladocerans density in Langano Lake (Ethiopia) show a negative correlation with the crop of Cyanophycae.

The coincidence of the blooming of phytoplankton in Wadi El-Rayan during autumn (1989) 30 with the blooming of D.mongolianum and disappearance of the Daphina (which represents the third dominant cladoceran group) may give the attention to the observation of Gliwicz [31] that a replacement of Daphain sp. by Diaphanosma sp. took place in a Brasilian reservoir with eutrophication condition. As well, the dominance of D.mongolianum during summer and autumn agrees with the results of Robinson and Robinson [32] and Obuid Allah [15] who recorded that the peak of this species occurs during warm months.

The disappearance of D.gesssneri for a period of time each year and also with Kalk[34] who showed that Daphnia prefers cooler period and can't survive under dxperimental conditions at temperature above 22°C.

Contary to the peresent results was the behavior of D.gessneri in an Amazonian flood plain lake where its peak of abundance was recorded by Carvbalho[35] during May and then de-

creased until complete disappearance during November, December and January. He attributed the disappearance of this species to the high turbidity and intense fish predation.

Dumont et al., [36] claimed that in african shallow sahel zone lakes, Lates larvae are the main predator on Daphnia and this predator will be a factor efficient enough to Eliminate Daphnia completely.

However, hte temporary disappearance of Daphnia from Wadi el-Rayan may be attributed to th high temperature in summer (30° C) and to fish predation and the flourishment of Cyanophyceae during autumn.

The behavior of Bosmina longirostiris in dominating the cladoceran community in Wadi El-Rayan during winter agress with its behaviour observed by Helal [12] and Aboul Ezz [8] Damietta Nile Branch and Burulls Lake, respectively. This confirms the statment of Saint [37] that Bomina domunates during winter.

Both the species composition and the seasonal variation of cladocera in Wadi el-Rayan through the present investigation proved to be widely different from those recorded during 1979-80 by Khalil 17. In the survey of 1979-80 only 4 species namely Daphnia longispina, Ceriodaphnia lacustris, Bosmina lonirostris and Moina sp. were procured. All of them were perennial. Inspite of the fact that the present survey comprises 11 species (7 of them are new

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records), both Ceriodaphnia lacustris and Moina sp. are absent. Also Daphnia dominated the cladoceran community in 1979-80 all the year around with a spring peak. Al well, the total cladocerans bloomed in spring too.

The wide differences between the community of Cladocra in the two surveys may indicate that the Wadi El-Rayan Lake is still in the phase of formation and its ecosystem is still unsettled.

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EFFECT OF SNA 415, STRAIN OF BACILLUS THURINGIENSIS AND SCHISTOSOME INFECTION ON THE SURVIVALNESS AND FECNDIUTY OF BIOMPHALARIA ALEXANDRINA SNAILS

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ABSTRACT

Effect of SAN415 strain of Bacillus thuringiensis and Schistosome infecion on snsil survivalness and fecundity was investigated, in a population of laboratory-bred Biomphalaria alexanderina. Both the survival rates and egg production capacity)assessed by determing number of egg masses / 10 snail / week ; number of eggs / egg mass and histological examination of the ovitestis) have been adversely affected by Schistosoma mansoni miracidial infection. The effect is inversly proportioal to the number of infecting miracidia and by treatments with a sublethal concentration of SAN 415 strain of Bacollus thuringiensis.

INTRODUCTION

Bacillus thuringiensis. in its commercial bacterial preparation is recently used as a biological agent to control insects (Armstrong