LIMNOLOGICAL INVESTIGATION OF PERIPHYTON IN THE NOUZHA HYDRODROME.

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ABSTRACT

Qualitative and quantitative estimation of periphyton was carried out in the Nouzha Hydrodrome by exposing glass slides in water for short periods. Two stations were selected; Station I being situated among the growing hydrophytes **Potamogeton pectinatus** and is considered as a sheltered area and station II was fixed one km apart from the shore and was exposed to water currents.

The periphyton communities in the two stations were nearly similar in composition but they differed in their growth rates. These communities comprised diatoms which appeared in abundance all the year round. The filamentous chlorophytes were more dominant in early spring and was responsible for the increased biomasses of periphyton. The cyanophytes appeared frequently in the summer particularly at station I.

The daily net increase of periphyton ranged between 0.06 and 1.60 mg fresh wt./cm^2/day at station I (average 0.32 mg fresh wt./day) and between 0.12 and 1.94 mg fresh wt./cm^2 at station II (average 0.54 mg fresh wt./day). The peaks were recorded in March and April for the two stations respectively.

The chlorophyll content constituted about 0.031% and 0.028% of the total fresh weight of periphyton at stations I and II respectively. The total chlorophylls comprised 0.049% and 0.040% of their biomasses.

The photosynthetic rate in periphyton as calculated from chlorophyll content followed the same seasonal cycle recorded for their biomasses. The highest gross primary production was observed in March at station I (3699 mg C/m^2/day) and in April at station II (4969 mg C/m^2/day). The average annual values of the two stations amounted respectively to 753 and 1395 mg C/m^2/day.

It is concluded that the productivity of periphyton

in the Nouzha Hydrodrome exceeds the gross primary production of phytoplankton which reached an average lower value of 317 mg C/m^2/day for the whole year.

INTRODUCTION

The Nouzha Hydrodrome, the field of the present investigation, was previously subjected to extensive limnological studies carried out by Elster et al (1960 a). These covered the physical, chemical and biological conditions of the hydrodrome during the period 1954-56. Further estimations were done on the phytoplankton community (Salah, 1959), the density distribution of the hydrophytes (Zaki, 1960) and the population dynamics of zooplankton (Elster et al, 1960 b). The study of periphyton in the hydrodrome was, however, neglected inspite of the fact that it plays an important role in the biological productivity of the different water masses (cf. Welch, 1952). It was previously demonstrated to be consumed by the dominant fish **Tilapia spp.** inhabiting the hydrodrome (Elster et al 1960 a).

The aim of the present study is to give a qualitative and quantitative estimate of the periphyton growing on artificial substratum (glass slides) along the different months. The rate of periphyton growth is also evaluated.

MATERIAL AND METHODS

a- Physico-chemical methods

The Secchi depth was measured by lowering a white enameled Secchi disc of 30 cm diameter in the water until it just disappeared. The water temperature was determined by using a simple bucket thermometer graduated to 0.1°C.

The chlorosity of water was determined according to Mohr's method by titrating 10 ml of water samples against exactly 0.01 N silver nitrate solution. Results are given in mg Cl/L at laboratory temperature.

The Hydrogen ion concentration was measured electrometrically by using a Beckman glass electrode pH-meter

The total alkalinity was determined by titrating 10 ml of water samples against exactly 0.01 N HCl, using methyl orange as indicator. The total alkalinity is calculated in mili.eq./L.

b- Biological methods

Periphyton colonization was studied by suspending glass slides with dimensions 2.6 X 6 cm, and fixed on wooden frames. Each two slides were put face to face to permit colonization of periphyton on a single side for each slide. The frames containing the glass slides were exposed beneath the water surface at about 25 cm depth. The glass slides were exposed in the field for short periods between 14 and 25 days. Longer exposure periods were rarely done.

At the end of each exposure period, the galss slides were trasferred carefully from water into small jars containing the same hydrodrome water. On returning to the laboratory, the slides were taken from the jars, supported on their edges on a filter paper for five minutes to decante and weighed. The periphyton was then removed carefully from the surface of the glass slide and the glass slide was weighed again. The periphyton biomass was calculated in gram fresh weight per unit area per exposure period.

The chlorophyll content was also estimated by soaking weighed amounts of periphyton in 90% acetone solution for 18 hours in the dark. Chlorophylls a,b and c were then estimated spectrophotometrically by measuring the extinction coefficient of the dissolved chlorophylls at wave lengths 663,645 and 630 mμ. and substracting the blanks taken at 750 mμ. reading. The amount of chlorophylls were then calculated according to the trichromatic equations given in the Unesco Monograph on the determinations of the photosynthetic pigments (1966).

Exposure of the glass slides in the hydrodrome was continued during the period July, 1968 - June, 1969. Two stations were selected as representing the two main habitats. Station I was situated at the margins of the hydrodrome among the growing hydrophyte **Potamogeton pectinatus** L. and this represented a sheltered area. Station II was situated one km away from the shore line beside a fixed buoy and it represented an exposed area free of hydrophytes, fig.1. The latter station was subjected to water currents produced by wind action.

DESCRIPTION OF THE HYDRODROME

The Nouzha Hydrodrome is an isolated part of Lake Mariut that was previously used as sea-plane base. Its area amounts to 504 hectare (1200 feddan) and it is surrounded by concrete embankment of about 9 km length, fig.1. Its bottom lies at an average depth of 3.65 m (below mean sea level). The hydrodrome receives constantly fresh Nile water from the Mahmoudia canal through a feeding channel situated at the north-western corner. The surplus water is discharged through an outlet located at the south-eastern extremity, opposite to the inlet. This outlet is closed by movable wooden bars. The average depth of water in the hydrodrome was about 3.0 m. Its level was subjected to small fluctuations with an amplitude of 50 cm during the whole year.

PHYSICO-CHEMICAL CONDITIONS OF THE HYDRODROME WATER

a- Temperature

The general climate of the hydrodrome area is that of the warm temperate

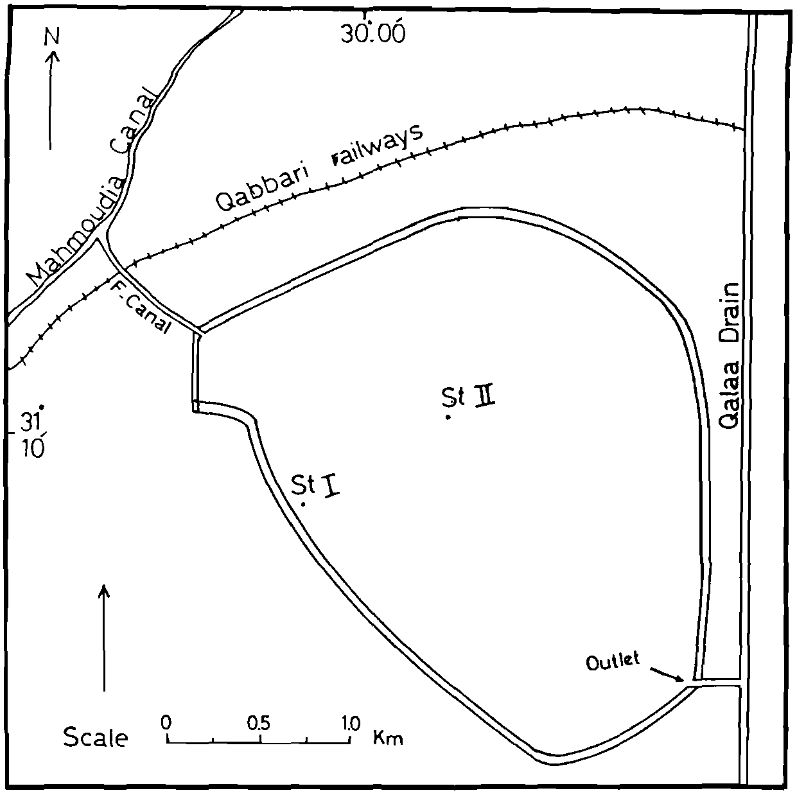

Fig. 1. Map showing the Nouzha Hydrodrome and position of stations.

zones. The average monthly air temperature ranged between 14.0 and 27.0°C. The lowest air temperature was observed during January and February. It increased gradually throughout the spring and the summer (March-August) but decreased again by the end of the year.

The water temperature usually follows that of the air. It fluctuated between 13.0 and 28.5°C during the period of the present investigation, table 1. The lowest value was recorded in January and the highest in July.

b- Water trasparency

The hydrodrome water is more or less turbid due to the suspended silt introduced with the Nile water and/or to stirring up of the bottom muds produced by wind action. The Secchi depth ranged between 29 and 72 cm. It remained at a more or less constant low value between May and September, but it increased pronouncedly in March and April, table 1. According to Vollenweider (1960), the photosynthetic zone was estimated as equivalent to 2.5 the value of Secchi readings in the Nouzha hydrodrome. Thus, the photosynthetic depth was calculated to range between 73 and 190 cm during the present investigation.

Table 1
Seasonal variations of some physico-chemical parameters of the hydrodrome water.

Month	Water Temp. °C.	pH	Chlorosity mg. Cl/L.	T. alk. mill. eq./L	Secchi depth in cm.
July, 1968	28.5	8.4	420	480	32
August	27.5	8.6	430	490	32
September	25.5	8.7	430	540	33
October	24.0	8.9	450	600	40
November	20.0	8.7	480	560	43
December	14.0	8.6	420	375	37
Jan., 1969	13.0	8.5	310	420	32
February	14.5	8.5	320	420	32
March	22.5	8.1	320	430	45
April	22.5	8.4	340	440	72
May	23.5	8.5	320	420	29
June	28.0	8.4	300	460	30

c- Chlorosity

The water of the Nouzha Hydrodrome is slightly brackish. Its chlorosity ranged between 300 and 480 mg Cl/L. It remained relatively low during the winter and spring months but increased slightly in the summer and autumn, table 1. The present results indicate that the chlorosity of the hydrodrome water was subjected to a pronounced decrease during the last years as its average concentration in 1956 amounted to 1900 mg Cl/L (Elster et al, 1960 a). Such a drop in the water chlorosity would favour the growth of the oligohalobous fresh water algae.

d- Hydrogen ion concentration and total alkalinity

Like all inland waters of Egypt, the pH values of the Hydrodrome water lie on the alkaline side and it ranged between 8.10 and 8.9. The pH remained more or less constant during most of the year, being 8.5 $\pm$ 0.1 with the exception of the relatively higher values observed between September and November, table 1.

The total alkalinity of the Hydrodrome water fluctuated between 4.2 and 6.0 mill.eq./L. It remained relatively low during the winter and the spring but tended to increase gradually throughout the summer and the autumn. The highest alkalinity values were reached between September and November parallel to the increase of pH.

THE PERIPHYTON COMMUNITY

The colonization of periphyton on glass slides in the Nouzha Hydrodrome harboured a rich community which were nearly similar in the two stations. They included members of the Divisions Chlorophyta, Cyanophyta and Chrysophyta (class Bacillariophyceae). Most of them are littoral forms and they appeared also in the plankton (Salah, 1959). The more dominant epiphytic diatoms which appeared throughout the year comprised **Cocconeis placentula** Ehr., **Gomphonema constrictum** var., **Capitatum** (Ehr.) Cleve. **Bacillaria paradoxa** Gmel, **Epithemia sorex** Kutz, **Epithemia zebra** (Ehr.) Kutz. **Rhoicosphaenia curvata** (Kutz) Grun., **Navicula** spp.

The filamentous green algae were observed in abundance during the spring and they included **Cladophora** sp., **Oedogonum** sp. and **Stigeoclonum tenue** Kutz. The blue green algae developed mostly during the summer particularly at station I. They persisted as rare forms in the other seasons. The more frequent cyanophytes comprised **Lyngbya** spp., **Oscillatoria** spp. and **Anabaena** spp. A list of the algal species recorded in the periphyton community are shown in table 2. Their frequency distribution during the different seasons are also given.

THE GROWTH RATE OF PERIPHYTON

The periphyton biomasses recorded in mg. fresh weight/cm^2/period during the different months are shown in tables 3 and 4 for stations I and II respectively. The daily net increase is also evaluated by dividing the weight of the standing crop by the duration of the exposure periods.

The daily net increase of periphyton at station I ranged between 0.06 and 1.6 mg fresh wt./cm^2/day. The highest biomass was observed in early spring (March) due to the increased density of the green algal filaments of **Oedogonium** and less so of **Cladophora**, a smaller peak was also observed in mid summer (July), attaining 0.81 mg. fresh wt./cm^2/day. The summer peak resulted from the increased numbers of the filaments of blue green algae **Lyngbya** and **Oscillatoria.** The periphyton biomasses remained relatively low throughout the rest of the year particularly in late spring and early summer which represented the principal growth period of the surrounding hydrophyte **Potamogeton pectinatus.**

The daily net increase of periphyton at station II ranged between 0.12 and 1.94 mg fresh wt./cm^2/day. Like station I, the highest production rate was observed in early spring (April) due to the increased density of the filamentous green algae **Oedogonium** and **Cladophora,** otherwise it remained at a moderate density during most of the year with a tendency to increase in the autumn.

The average daily net increase of periphyton for the whole year amounted to 0.32 mg fresh wt./cm^2/day for station 1 and 0.54 mg fresh wt./cm^2/day for station II. This means that the efficiency of periphyton

Table 2

List of the algal species recorded in the periphyton and their frequency distribution during the different seasons given as dominant (xxx), frequent(xx) and rare(x).

Periphyton	Win.	Spr.	Summ.	Aut.
BACILLARIOPHYCEAE :				
Amphora ovalis Kutz		x	x	x
Bacillaria paradoxa Gmel.	xxx	x	x	xx
Biddulphia leavis Ehr	xx	xx	x	xx
Cocconeis placentula Ehr	xxx	xxx	xx	xx
Cymbella tumida	x	xx	x	
Diploneis elliptica (Kutz) Cleve	xx	x		x
Epithemia sorex Kutz	x	xx	xx	xx
" **zebra** (Ehr.) Kutz	x	xx	xx	xx
Fragillaria sp.	x	x	x	xx
Gomphonema constrictum Var. **capitatum**(Ehr.) Cleve	xx	x	xx	xxx
Melosira granulata (Ehr.) Ralfs	x	xx	x	x
" **crucipunctata** Bachm	xx	xx	x	x
Mestogloia pumilla (Grun) Cleve	x	x		x
Nitzschia frustulum (Kutz)			x	x
Nitzchia obtusa Sm. Var. **scalpelliformis** Grun	x	x		
" **apiculata** (Greg) Grun	x	x		
" **scalaris** (Ehr.) Sm			x	x
" **sigma** (Kutz) W.Sm.	x	x	x	
" **microcephala** Grun.	x	x	x	
" **punctata** (W. Sm.)	x	x	x	
Navicula spp.	xxx	x	xx	xxx
Pleurosigma elongatum Sm		x	xx	xx
Rhopalodia gibba (Ehr.) Mull.	x	xx	xx	x
Rhopalodia gibberula (Ehr.) Mull	x	xx	xx	xxx
Rhoicosphaenia curvata (Kutz) Grun.	xxx	xxx	x	x
Synedra ulna (Nitzch.) Ehr.	xx	x	xx	xx
Synedra tabulata (Ag.) Kutz.	x	x	x	xx
Surirella striatula Turp.			xx	
CHLOROPHYCEAE :				
Aphanochaete sp.		xx	x	
Chaetophora sp.		x	x	x
Cladophora sp.	xx	xx	x	x
Closterium lanceolatum (Kutz)		x	x	
Oedogonium sp.	x	xxx	xx	xx
Stigeocolonium tenue Kutz	x	xx	xx	xx
Spirogyra sp.		x	x	x
Ulothrix sp.		xx	x	x
CYANOPHCEAE :				
Anabaena constricta (Szafer) Geit		x	x	
Anabaena variabilis Kutz		x	x	
Calothrix sp.		x	x	
Lyngbya mexiensis Hansg.		x	xxx	x
Lyngbya epiphytica Heironymus		x	xx	x
Microcystis aerogenosa Kg.		x	x	
Oscillatoria tenuis Agardh		x	xxx	
Oscillatoria irrigua		x	xx	
Spirulina platensis (Nord) Geit			xx	

TABLE 3
Seasonal variations of the average periphyton biomass at the end of the exposure periods, daily net increase in mg fresh wt./cm^2/day and frequency composition of the community given as dominant (xxx), frequent (xx) and rare (x) at station I.

period of exposure	Duration in Days	Periph. biomass mg/cm^2/p.	net fresh wt/cm^2/day	Periphyton community		
				Diatoms	Chlorophyta	Cynophyta
22. 5-16. 6.68	25	2.91	0.12	xx	x	xx
16. 6- 3. 7.68	17	2.31	0.14	xx	x	xx
3. 7-24. 7.68	21	17.04	0.81	xx	xx	xxx
24. 7- 8. 8.68	15	6.85	0.46	xx	xx	xxx
8. 8-24. 8.68	16	2.56	0.16	xxx	x	xx
24. 8- 9. 9.68	16	1.99	0.12	xxx	x	xx
9. 9-25. 9.68	16	3.36	0.21	xxx	xx	xx
25. 9- 8.10.68	13	3.12	0.24	xxx	xx	xx
8.10-28.10.68	20	5.54	0.28	xxx	xx	xx
28.10-11.11.68	14	1.88	0.13	xxx	xx	x
11.11-30.11.68	19	6.48	0.34	xxx	xx	x
23. 1-12. 2.69	20	1.12	0.06	xx	x	x
11. 3-30. 3.69	19	30.30	1.60	xxx	xxx	x
30. 3-20. 4.69	21	1.61	0.08	xxx	x	x
20. 4-12. 5.69	22	1.67	0.08	xxx	x	x

production in the areas exposed to water currents (st. II) was nearly doubled when compared with that grown in sheltered areas (st. I).

CHLOROPHYLL CONTENT

The chlorophyll content of periphyton was estimated during the period from November, 1968 to May, 1969 and the results are given in table 5. The concentration of chlorophyll (a) in periphyton showed a linear relation to its fresh weight. The concentration of chlorophyll (a) at station I ranged between 0.433/cm^2 after 22 days exposure (in April) and 9.905/cm^2 after 19 days exposure (in March). The peak was recorded in early spring coincident with the highest periphyton biomass. The concentration of chlorophyll (a) at station II ranged between 0.504 µg/cm^2 after 22 days exposure (in February) and 10.591/cm^2 after 21 days exposure (in April). The highest values were also recorded in early spring.

The percentage of chlorophyll (a) to the fresh weight of periphyton fluctuated between 0.026 % and 0.033 % for station I and between 0.023 % and 0.031 % for station II. The mean values for the two stations

TABLE 4

Seasonal variations of the average periphyton biomass at the end of the exposure periods, daily net increase in mg fresh wt./cm^2/day and frequency composition of the community given as dominant (xxx), frequent (xx) and rare (x) at station II.

period of exposure	Duration in days	Periph biomass mg/cm^2/P	Net fresh wt./cm^2/ day	Periphyton community		
				Diatoms	Chlorophyta	Cyanophyta
22. 5-16. 6.68	25	8.10	0.32	xx	x	xx
16. 6- 3. 7.68	17	5.31	0.31	xx	x	xx
3. 7-24. 7.68	21	9.90	0.47	xx	x	xx
24. 7- 8. 8.68	15	6.11	0.41	xx	x	xx
9. 9-25. 9.68	16	9.67	0.60	xx	x	xxx
25. 9- 8.10.68	13	5.67	0.44	xx	xx	x
8.10-28.10.68	20	11.52	0.58	xxx	xx	x
28.10-11.11.68	14	3.27	0.23	xxx	xx	x
11.11-30.11.68	19	14.26	0.75	xxx	xx	x
30.11-16.12.68	16	13.82	0.86	xxx	xx	x
16.12-27. 1.69	42	9.46	0.23	xxx	xx	x
27. 1-12. 2.69	16	1.97	0.12	xxx	x	x
12. 2-30. 3.69	46	33.18	0.72	xxx	xx	x
30. 3-20. 4.69	21	40.73	1.94	xxx	xxx	x
20. 4-12. 5.69	22	3.05	0.14	xx	xx	x

amounted respectively to 0.031 % and 0.028 % of the total biomass.

Like chlorophyll (a), the total chlorophylls showed also a linear relation with the periphyton biomass. Their concentration ranged between 0.608 and 15.670 cm^2 for station I and between 0.634 and 15.467/cm^2 for station II. The average percentage of the total chlorophylls for the two stations amounted respectively to 0.049 % and 0.040 %. This indicates that the percentage of chlorophylls (b) and (c) to chlorophyll (a) was relatively high for periphyton grown in the sheltered area (st. I) when compared with that developed in the exposed area (st. II). This can be explained by the fact that pigments other than chlorophyll (a) have some importance in transferring light energy to chlorophyll (a) to increase its phtosynthetic efficiency (Currie, 1958). Such a phenomenon may compensate the reducing effect produced by the growing hydrophytes on the incident light at station I by increasing the photosynthetic efficiency of chlorophyll (a).

TABLE 5

Relation between chlorophyll content of periphyton in/cm²
and its biomass in mg fresh wt/cm² estimated at this end of the
exposure periods.

Sampling date	Duration in days	Periphyton on biomass (mg/cm/²)	Chlorophyll a μg/cm²	Chlorophyll a % to biomass	Total chlorophyll μg/cm²	Total chlorophyll % to biomass
St.I						
30/11/68	19	6.48	2.083	0.032%	3.3331	0.051%
30/ 3/69	19	30.30	9.905	0.033%	15.670	0.052%
20/ 4/69	21	1.61	0.434	0.027%	0.608	0.038%
20/ 4/69	40	10.50	2.844	0.027%	4.476	0.043%
12/ 5/69	22	1.67	0.433	0.026%	0.634	0.038%
Average		10.112	3.140	0.031%	4.944	0.049%
St.II						
30/11/68	19	14.26	2.115	0.029%	5.822	0.041%
16/12/68	16	13.82	3.631	0.026%	0.159	0.046%
12/ 2/68	16	1.97	0.504	0.026%	0.634	0.032%
30/ 3/68	46	33.18	10.057	0.031%	13.907	0.042%
20/ 5/69	21	40.73	10.591	0.026%	15.467	0.038%
12/ 5/69	22	3.05	0.710	0.023%	1.039	0.034%
Average		17.84	4.935	0.028%	7.171	0.040%

CALCULATION OF THE PHOTOSYNTHETIC RATE

The photosynthetic rate in periphyton was estimated according to the relation given by Ryther and Yentsch (1957) where every gram chlorophyll (a) assimilates an average value of 3.7 gm C/hour at light saturation. The linear relation established between chlorophyll (a) content and periphyton biomass. Table 5 gives also a good tool for evaluation of the gross production rate of periphyton grown on the glass slides. Taking in consideration the day length during the different months, the gross primary production of periphyton is calculated throughout the year in mg C/m²/day as shown in table 6. It is to be noted that the solar radiation of the area under investigation exceeds the saturation point of photosynthesis all the year round (cf. Ryther, 1956). From this table it appears that the gross production rate of periphyton in the hydrodrome followed a similar seasonal cycle recorded for its biomass. The gross

TABLE 6
Seasonal variations of the gross primary production of periphyton in mg C/m^2/day as calculated from pigment data and periphyton biomass

Sampling date	Duration in days	Gross primary production in mg C/m^2/day Station I	Station II
16/ 6/1968	25	414	1153
3/ 7/1968	17	329	756
24/ 7/1968	21	2,426	1,409
8/ 8/1968	15	940	839
9/ 9/1968	16	257	-
25/ 9/1968	16	428	1,237
8/10/1968	13	366	633
28/10/1968	20	648	1,347
11/11/1968	14	201	350
30/11/1968	19	692	1,522
16/12/1968	16	-	1,399
27/ 1/1969	42	-	955
12/ 2/1969	16	120	221
30/ 3/1969	19	3,699	-
30/ 3/1969	46	-	3,711
20/ 4/1969	21	213	4,969
12/ 5/1969	22	230	387
Average		753	1,397

primary production of periphyton at station I ranged between 120 and 3699 mg C/m^2/day. The highest production rate was observed in March. A second smaller peak was also recorded during the summer (July). The gross primary production of periphyton at station II ranged between 221 and 4969 mg C/m^2/day. The peak was observed there in April. The average annual values amounted to 753 mg C/m^2/day at station I and 1395 mg C/m^2/day at station II.

Thus, results of both gross primary production and daily net increase of periphyton were similar , being nearly doubled at station II when compared with that recorded at station I.

DISCUSSION

The Nouzha Hydrodrome represents a fresh water habitat which receives constantly Nile water from the Mahmoudiah Canal. Its total area amounts to 504 hectare and with a water depth of about 3.0 m.

The most important physical conditions that may affect the distribution of plant life in water comprise temperature and light. As regards to the water temperature, it ranged between 13°C in winter (January) and 28.5°C in summer (July), following the monthly variations of air temperature. It was previously mentioned by Aleem and Samman (1969) that the rapid fall of water temperature below 17°C in early winter has a pronounced reducing effect on phytoplankton production in the neighbouring Lake Mariut. This seems also reliable for periphyton as the lowest growth rate was observed in the two stations during January, coinciding with the lowest water temperature. However, the substitution of the diatoms by the filamentous green algae **Cladophora** in winter diminished rapidly such a reduction in the periphyton biomass. The seasonal variations of water temperature appears also to affect the succession of the periphyton community.

The Hydrodrome water is more or less turbid due to the suspended silt particles introduced with the Nile water and/or to stirring up of the bottom muds. The depth of the photic zone as evaluated from the Secchi disc reading ranged between 73 and 190 cm. Thus it is suspected that epiphytes can not flourish well at the hydrodrome bottom since the depth of water there exceeds the euphotic zone. The distribution of periphyton appears to be confined mostly to the concrete embankment surrounding the hydrodrome as well as on the submerged hydrophyte **Potamogeton pectinatus** boardering its margins.

The chlorosity of the hydrodrome water is low. It fluctuated between 300 and 480 mg Cl/L. The higher values were recorded in late summer and during autumn while the lower appeared in winter. Accordingly, most of the periphyton species recorded in the hydrodrome are fresh water forms, i.e oligohalobous.

The pH values of the water lie on the alkaline side and they ranged between 8.1 and 8.9. The algal species observed there are considered as Alkaliphilous and they flourish well within this range of pH values.

The periphyton community in the Nouzha Hydrodrome was rich in the number of species. They were included in the divisions Chlorophyta, Cyanophyta and Chrysophyta (Class Bacillariophyceae). Most of them are littoral forms which appeared also in the plankton (Salah, 1960). The diatoms comprised an important constituent of the periphyton during most of the year. The Chlorophytes showed their maximum frequency in spring and less so in autumn and winter. the Cyanophytes were more frequent during summer and they persisted as rare forms throughout the rest of the year.

The succession of the more dominant species during the different seasons can be summarized as follows:

a- Winter periphyton community
Dominant: **Bacillaria paradoxa, Cocconeis placentula, Navicula** spp., **Rhoicosphaenia curvata, Cladophora** sp.

Frequent: **Biddulphia leavis, Diploneis elliptica, Gomphonema constrictum** var. **capitatum, Melosira crucipunctata.**

b- Spring periphyton community
Dominant: **Coccneis placentula, Rhoicosphaenia curvata, Oedogonium** spp.

Frequent: **Biddulphia leavis, Cymbella tumida, Epithemia sorex, Epithemia zebra. Melosira granulata, Melosira crucipunctata, Rhopalodia gibba, Rhopalodia gibberula, Cladophora** sp.,**Stigioclonium tenue.**

c- Summer periphyton community
Dominant: **Oscillatoria** spp., **Lyngbya** spp.

Frequent: **Cocconeis placentula, Epithemia sorex, Epithemia zebra, Gomphonema constrictum** Var. **capitatum, Navicula** spp., Pleurosigma **elongatum, Rhopalodia gibba, Rhopalodia gibberula, Synedra ulna, Surirella striatula, Oedogonium** sp., **Stigeocolonium tenue, Calothrix** sp., **Spirulina platensis.**

d- Autumn periphyton community
Dominant: **Gomphonema constrictum** var. **capitatum, Navicula** spp., **Rhopalodia gibberula.**

Frequent: **Bacillaria paradoxa, Biddulphia leavis, Cocconeis placentula, Epithemia sorex, Epithemia zebra, Fragillaria** spp., **Pleurosigma elongatum, Synedra ulna, Synedra tabulata, Oedogonium** sp., **Stigeoclonium tenue.**

The growth rate of periphyton fluctuated between 0.06 and 1.60 mg fresh wt/cm^2/day at station I and between 0.12 and 1.94 mg fresh wt/cm^2/day at station II. the peaks were recorded in the two stations in early spring as a result of the increased density of the filamentous green algae **Oedogonium** and **Cladophora.** The average daily net increase of periphyton during the whole year amounted respectively to 0.32 and 0.54 mg fresh wt/m^2/day for stations I and II. This indicates that the growth of periphyton is more effcient in the exposed areas rather than the areas sheltered by the growing hydrophytes. This may also reflect an inverse relation existsing between the growth of hydrophytes and periphyton production. Such a condition appeared clearly at station I where the month of April which represents the principal growth period of **Potamogeton pectinatus** was accompanied by a sharp drop in periphyton production. The same inverse relation was also demonstrated between phytoplankton production and the growth of the hydrophyte **Najas armata** in the Nouzha Hydrodrome during two successive years (1957-58) as a result of competition for nutrients (Vollenweider and Schmid, 1961).

The chlorophyll content of periphyton showed a linear relation to its fresh weight. Thus, their peaks were recorded in early spring coinciding with their highest biomasses. The average percentage of chlorophyll (a) to the fresh weight of periphyton amounted respectively to 0.031% and 0.028% for stations 1 and 11. The total chlorophylls constituted also about 0.049% and 0.040% of the periphyton biomasses at stations 1 and 11. the relatively higher concentration of chlorophyll content at station 1 may be explained by the fact that the reduced light conditions created by the growing hydrophytes are met with increased chlorophyll content in periphyton particularly chlorophyll (b) and (c) to increase its photosynthetic efficiency.

The gross primary production of periphyton as calculated from chlorophyll content ranged between 120 and 3699 mg C/m^2/day at station I and between 221 and 4969 mg C/m^2/day at station 11. The peaks were recorded in march and April for the two stations respectively, fig.2. The drop in periphyton production at station 1 in April resulted from the inhibiting effect produced by the rapid growth of the surrounding hydrophyte **Potamogeton pectinatus** during that month. On the other hand, the relatively higher values of periphyton production recorded in July at the same station was accompanied by a decreased density of the hydrophytes.

Previous monthly estimations of the gross primary production of phytoplankton in the Nouzha Hydrodrome during 1958 gave values ranging between 132 and 1243 mg C/m^2/day (Samaan and Vollenweider, unpublished data), as shown in fig. 2. The peak of primary production of phytoplankton was recorded in February, coinciding with the death of **Najas armata** and release of nutrient salts, otherwise it remained low throughout the rest of the year. The average daily gross primary production of phytoplankton for the whole year amounted to 337 mg C/m^2/day. This appears relatively low when compared with the average values of the gross primary production of periphyton which reached 753 and 1397 mg C/m^2/day for stations I and II.

It is concluded that the growth rate of periphyton under certain natural conditions may represent an important form of aquatic plant life, being more efficient as primary producers than phytoplankton. Consequently, the increase of the productivity of such water habitats may be induced by creating more suitable conditions for the growth of periphyton, for example by increasing the area of their mechanical supports.

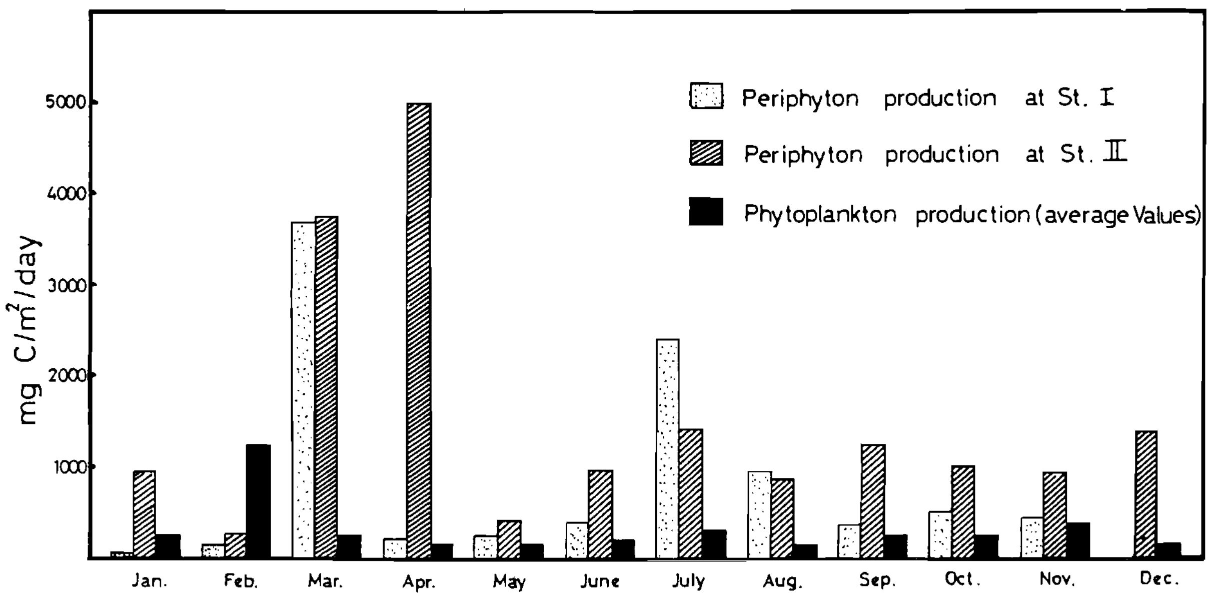

Fig. 2. Gross primary production of periphyton in mg. C / m^2 / day calculated from chlorophyll content and phytoplankton production in mg. C / m^2 / day, estimated by C - 14 method.

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