Preliminary Studies on the Occurrence of Freshwater Epipelic Algae in the Densu Basin in Southern Ghana

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Abstract

The occurrence and composition of the freshwater algae in the epipelon were determined at three sites, namely Machigeni, Manhean and Weija, located in the coastal savanna thicket and grassland vegetation zone of the River Densu basin in southern Ghana. Samples of sediments from the water-substratum interface were taken at fortnightly intervals over 2 months at Machigeni, Manhean and Weija, in January 2008 and March 2008, and studied. The epipelic flora of River Densu exhibits high diversity, with the richest flora in Machigeni, followed by Manhean and Weija in that order. A total of 38 algal genera were identified over the period, with the Bacillariophyceae dominating with 19 genera followed by the Chlorophyta and the Cyanophyta with 13 and 6 genera, respectively. *Fragilaria*, *Melosira* and *Rhizosolenia* were the most abundant Bacillariophyta genera encountered. The Chlorophyta had *Closterium*, *Pediastrum* and *Spirogyra,* as the dominant genera. *Anacystis* and *Oscillatoria* had the highest number of cells among the Cyanophyta genera sampled.

Introduction

Although much has been written over the years concerning the occurrence of the freshwater algae, including the phytoplankton, in many rivers in West Africa (Eaton, 1965; Egborge, 1973, 1974, 1975), information on similar studies on epipelic communities are scarce. In Ghana there have been reports on the situation of freshwater algae in river Volta and the Kpong head pond (Biswas, 1966; 1968). The freshwater phytoplankton of the Densu river has also recently been enumerated, however, the composition of the epipelic forms were not discussed. Epipelic algae are algae that grow on sediments and are very important in the nutrient recycling in the aquatic ecosystem. The source of freshwater planktonic algae has always been a debate, with some schools of thought describing it as those attached to sediments (epipelic) or on other surfaces which gets detached under pressure. There are, however, truly planktonic forms. Data for the study of epipelic communities are, therefore, very scarce. Consequently, the present study could be described as a first attempt to study the occurrence of epipelic algae. This is particularly so as epipelic populations in water bodies in Ghana tend to have escaped researchers. The present study on epipelic algae is, thus, a contribution to limnological studies on the Densu river, and the information generated will provide the basis for further studies and also for comparison with future studies on epipelic algae in other environments in Ghana.

Materials and methods

Sampling sites

Three sampling sites, Machigeni, Manhean and Weija, located in the coastal savanna and grassland vegetation zone of the River Densu

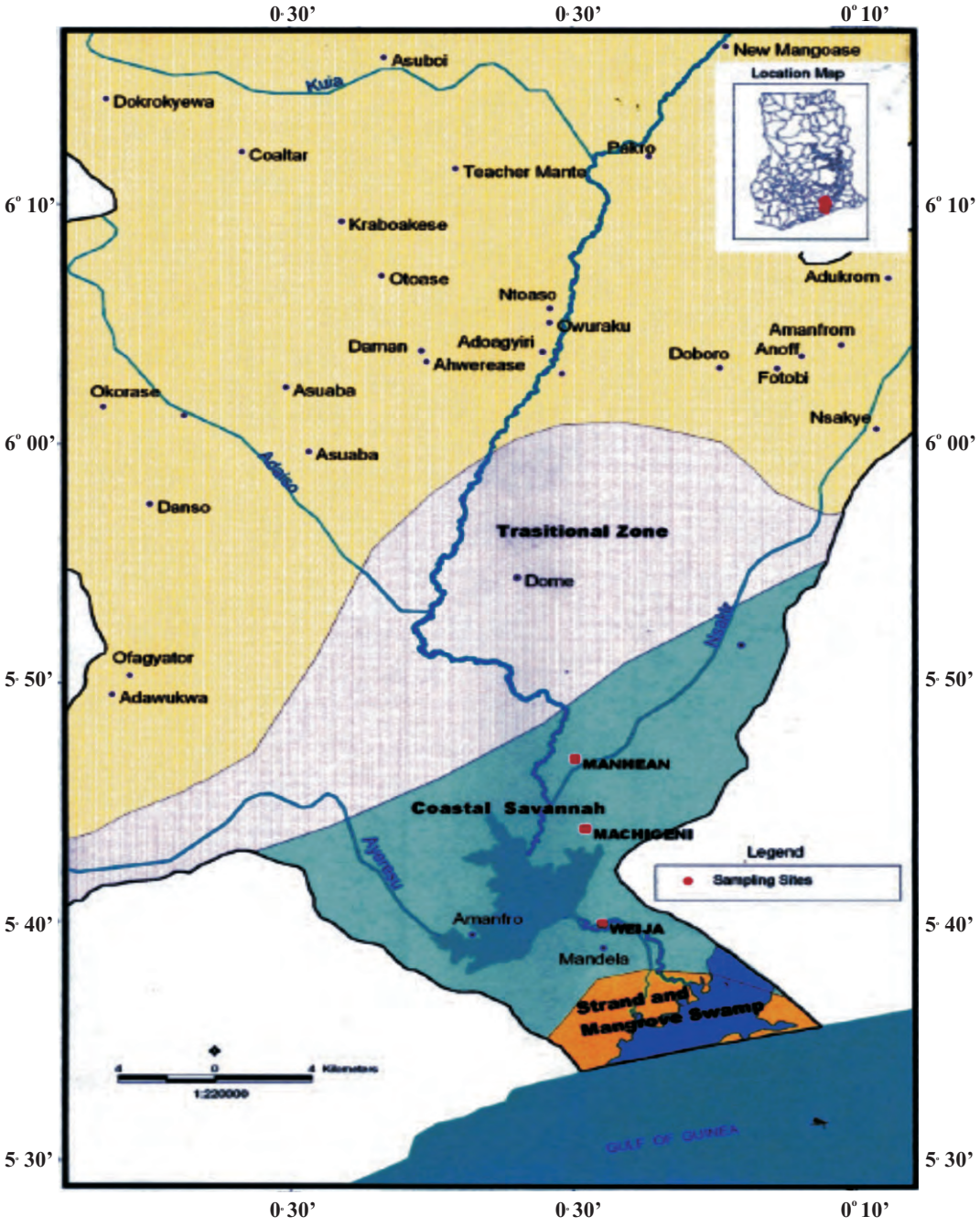

Fig. 1. Vegetation zones of south Densu basin and sampling sites on River Densu

basin in southern Ghana, were studied. (Fig. 1).

Machigeni. Human activities, especially fishing, are very intense at this site. Aquatic macrophyte vegetation, including *Azolla pinnata* var. *africana* Lam., *Nymphaea lotus* L. and *Pistia startiotes* L. was extensive at this site. This sampling site is at the widest part of the lake formed due to impoundment of the river. The bank is sandy and water flow is sluggish.

Manhean. Manhean shares similar features with Machigeni. These two sites are also close to each other in the coastal savanna vegetation zone. This site also has a sandy bank and clayey river bed. The river surface is very wide, and aquatic macrophytes, such as *Echinochloa colona* Pal. and *Nymphaea lotus* L., are common. This part of the lake is moderately deep and supports heavy human activity notably fishing, boat landing and commuting.

Weija. This is the southernmost sampling site and about the cleanest due to minimal human activities. This site is the water intake point for the Ghana Water Company Treatment Plant for supply to the western part of Accra. The banks are lined by boulders, an extension of the wall of the dam. Consequently, there is very little vegetation on the banks and surface of the river. Due to the damming, lake conditions prevail, with very little evidence of flow. The width of the surface is about 150 m.

Epipelic flora studies

About 25 ml of surface sediment was drawn from the water-substratum interface, by means of a pipette and rubber bulb, from the sampling sites at fortnightly intervals in January and March. Five samples were picked randomly five times, and the replicates were placed individually into 50 ml glass sample bottles, and transported to the laboratory within the shortest possible time. The sediments were allowed to settle and poured into McCartney tubes, fixed with iodine in potassium iodide (Lugol's iodine), and left standing for 24 h. Samples were then observed under the microscope for identification and enumeration of incident algae.

Identification of phytoplankton species

A binocular microscope or an inverted microscope was used to observe the species. Identification of the species of epipelic algae was done according to the works of Huber-Pestalozzi (1938) for Cyanophyta, Kramer & Lange-Bertalot (1986, 1988) for Bacillariophyceae and those of Ettl (1983) and Ettl & Gartner (1988) for Chlorophyta. In addition, relevant text books, keys and identification manuals of Prescott (1970), and Whitford & Schumacher (1973) were consulted.

Results

The epipelic algae studied at Manhean, Machigeni and Weija in January and March 2008 consisted of 38 algal genera, made up of 19 Bacillariophyceae genera, 13 Chlorophyta genera and six Cyanophyta genera. *Fragilaria*, *Melosira* and *Rhizosolenia* were the most abundant Bacillariophyta genera encountered in January 2008 but there were no clearly outstanding diatoms in March 2008. The diatoms, *Gyrosigma, Staunoreis* and *Stenopterobia,* recorded in March 2008, were absent in the water samples in January 2008. Of the Chlorophyta, *Closterium*, *Pediastrum* and *Spirogyra* were the dominant

genera in January 2008 but none was significantly outstanding in March 2008. On both occasions, *Anacystis* and *Oscillatoria* were the dominant Cyanophyta genera. Higher cell numbers of the dominant genera were observed in January at virtually all the sampling sites than in March. During the sampling period the following genera of the respective algal groups were present. Epipelic algae occurring in these studies are listed in Table 1.

Bacillariophyceae: *Amphipleura*, *Asterionella*, *Cocconeis*, *Cyclotella*, *Cymbella*, *Diotoma*, *Eunotia*, *Fragilaria*, *Melosira*, *Tabellaria, Synedra*, *Surrirella*, *Rhizosolenia*, *Pinnularia*, *Nitzschia* and *Navicula.*

Cyanophyta: *Anabaena*, *Anacystis*, *Gomphosphaeria*, *Merismopedia* and *Oscillatoria*.

Chlorophyta: All 13 genera were observed both in January and March.

No clearly defined disparities in algal densities were observed among the sampling sites during the sampling period.

Discussion

The epipelic algae of Machigeni, Manhean and Weija, located in the coastal savanna thicket and grassland of the River Densu basin in southern Ghana, showed a generally constant density. Hutchinson (1975) pointed out that, for the epipelon, cyanophytes and bacillariophytes (diatoms) prevail in months of lower temperature, a fact also observed by McIntyre (1975) and Patrick (1977). The densities of the algal groups observed in this study compare favourably with these observations. The differences in the densities could be attributed to high temperatures and subsequent high evaporation rates, as well as lack of rains. It would be interesting to compare densities during the rainy season.

Organisms occurring in one month, even when they occur in small densities, and completely absent during the other sampling period, are described as occasional species (Claps, 1996). Examples of such organisms observed in this study including *Characiopsis* (Chlorophyta), *Amphipleura*, *Gyrosigma*, *Stauroneis* and *Stenopterobia* (Diatoms), as well as *Lyngbya* (Cyanophyta), occur generally due to tidal action. Consequently, such organisms are not considered epipelic but rather planktonic, a situation yet to be fully explained. The relatively low number of cyanophytes genera observed in the study may, however, be attributed to changes in the factors like hydrology due to tidal action, as well as anthropogenic factors, that do not help the settlement of such opportunistic species.

It is not unusual to find strikingly different epipelic algae along a river course at the same time. Potter *et al.* (1975), for instance, found that the total number of algae at Site I located at a wide point of Moruya river in New South Wales, Australia, in an area that became brackish at high tide, ranged between 25 and 147 cells/ml. Populations at other sites II and III, located 7 km and 37 km, respectively, further upstream were always less that 50 × cells/ml. The over-riding factor in that case was the level of salinity of the water.

Another example is the report of Olive & Price (1978) on the spatial changes in diatom communities along the Cuyahoga river, N. E. Ontario (USA). Comparing the sizes of the body of water at the different sections of River Densu, especially at the sampling

TABLE 1
List of epipelic algae and their occurrence (# cells per ml of sample) at the sampling sites

Algal group		*Sampling site*					
		January 2008			*March 2008*		
	Genus	*Machigeni*	*Manhean*	*Weija*	*Machigeni*	*Manhean*	*Weija*
	Ankistrodesmus	2	3	1	20	16	32
	Chariopsis	1	1	1	0	0	0
	Closterium	100	34	182	67	20	55
	Microspora	15	30	3	6	3	10
	Mongeotia	30	3	2	2	4	1
	Oedogonium	26	24	22	1	2	2
Chlorophyta	*Pediastrum*	90	74	110	56	24	65
	Scenedesmus	1	2	2	11	11	15
	Spirogyra	86	20	146	25	30	12
	Straurastrum	2	2	0	1	2	1
	Tribonema	0	2	0	1	1	2
	Ulothrix	13	13	17	2	1	1
	Zygnema	12	12	42	12	30	11
Bacillariophyceae	*Asterionella*	2	3	3	1	1	1
	Coconeis	1	0	1	10	6	2
	Cyclotella	10	0	2	5	10	10
	Cymbella	3	10	5	10	20	1
	Diatoma	15	5	5	0	1	0
	Eunotia	2	3	1	1	0	1
	Gyrosigma	0	0	0	8	8	3
	Fragilaria	48	60	14	23	20	16
	Melosira	38	30	36	2	2	1
	Navicula	20	10	10	20	10	18
	Nitzschia	22	30	10	10	20	0
	Pinnularia	18	20	6	10	2	1
	Rhizosolenia	10	0	0	1	1	1
	Amphipleura	2	6	1	0	0	0
	Surrirella	88	80	68	11	32	21
	Synedra	6	6	4	2	12	11
	Stauroneis	0	0	0	2	0	1
	Strenopterobia	0	0	0	1	1	1
	Tabellaria	2	4	1	1	1	1
	Anabaena	370	56	164	66	10	62
	Anacystis	794	598	194	285	66	182
	Gomphosphaeria	10	3	29	14	10	25
Cyanophyta	*Merismopedia*	84	80	104	31	14	80
	Lyngbya	0	0	0	2	2	4
	Oscillatoria	330	317	275	214	253	223

sites, it is reasonable to conclude that the large size of the body of water at Manhean and Machigeni, and the drastic reduction of unidirectional flow led to generally constant densities of the epipelic algae. Indeed, the presence of macrophytes at the sampling sites could be the basis for the dominance of the Bacillariophyceae genera in the study, as these plants provide suitable surfaces for the diatoms, as observed by Claps (1991).

Conclusion

The paper is about the occurrence and composition of the fresh water epipelic algae in the River Densu basin in southern Ghana. The study has shown that the taxonomy of epipelic algae in the Densu basin is diverse. It should be possible to study and understand the combined effects of the numerous environmental factors on the occurrence of the epipelic algae. These factors, which have not been covered in the present study, would be considered for future investigations.

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