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Floristic Composition of Soft-Bodied Algae of Pandam Lake (Pandam Wildlife Park, Nigeria)

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ABSTRACT

A first investigation of the composition of soft-bodied algae of Pandam Lake in Pandam Wildlife Park was carried out in February 2014. Phytoplankton and epiphytic samples were collected from eight different sites in order to describe the floristic composition of the lake. On the whole, a total of 117 taxa belonging to 45 genera were recorded. Of this total, Chlorophyta had 91 taxa (33 genera), Cyanophyta had 13 (8 genera) while Euglenophyta had 13 taxa (4 genera). Genera represented with the highest number of taxa include: Cosmarium (17), Scenedesmus (8), Micrasterias (7), Staurastrum (6), Closterium (5) and Euastrum (5), While 24 genera had one taxon each. Frequency of occurrence of species ranged from 6.50 to 87.50%. Five of most frequent species include; Oedogonium sp 1 (87.50%), Microcystis Sp 1 (75%), Oedogonium Sp 2 (50%), Paimella miniata (50%) and Spirogyra Sp 2 (50%). This report is the first for the lake and so a useful checklist of soft algae in the park that will serve as reference point. Microphotographs some of the taxa are presented.

Key words: *soft-bodied algae, Composition, Communities, Pandam Lake, Pandam Wildlife Park.*

INTRODUCTION

Nature reserves are adjudged based on the number and type of different species found in them especially birds, mammals, aquatic species and plants. Thus, reports have centred on diversity either of habitats or species as the most commonly used criteria in designating a reserve or restricted area[31].

Whereas many of our conservation areas have baseline information on biological resource components such as birds, mammals and terrestrial plants, very little attention is given to aquatic plant resources especially the algae. Far fewer studies have been conducted on the flora of aquatic ecosystems such as wetlands; even though research into the benefits that wetland ecosystems provide has been extensive[16]. Consequently, many of our conservation areas do not have baseline information on the aquatic resource component, especially the algae. The study of aquatic reserves is important in that they not only contribute significantly to the biodiversity, but are also critical to the establishment, sustenance and functionality of any natural reserve.

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The abundance and community composition of aquatics like algae constitute the important component of parks as they most often reflect the chemical properties of the water such as pH and nutrient levels[18].

Pandam Wildlife Park is an important Bird Area (IBA), with the lake and surrounding environments supporting about 217 bird species and several species of mammals and plants[13]. At the moment, information on the aquatic macrophytes and algae is particularly absent for Pandam Wildlife Park. Published works on Pandam Wildlife Park include that of Akosim *et al*[4]., on the role of aquatic bodies in Avifauna and fish conservation in the park, Dami and Manu[11] on the bird species of the park and the surrounding farmlands and Ijeomah and Emelue[20] on ecotourism management and sustainable utilization of biodiversity in Pandam Wildlife Park.

This research presents the first report and useful checklist of the diversity of soft-bodied algae in the park. We have assumed that information from this study will not only contribute to the knowledge of the aquatic biodiversity but will provide the baseline data that will also serve as reference point for monitoring changes in the algal communities. Therefore, this work was aimed at determining the floristic composition of soft-bodied algae in the park.

MATERIALS AND METHODS

Study area

Pandam Wildlife Park is located north of Benue River[13] and south of Plateau State[2] along Lafia-Shendam Road in Quanpan Local Government Area of Plateau State[19]. It lies between latitudes 8° 35'N and 8° 55'N and longitude 8° 00' E and $10^0$00'E (Figure 1). It covers a total area of 2240 ha[13].

The park is bounded by Namu and Kayarda towns on the east, by Dep River on the Northwest, Li on the south. Aning and Pandam towns are on the south[4]. The entire park lies within the northern guinea savanna[3]. The wet season extends from April to November while dry season starts from December and ends in March[4]. The monthly mean rain fall is between 0.00-24.5cm[4]. The mean monthly temperature ranges between 25.8˚C in August to 35.7˚C in March[23].

Methodology

Sampling was conducted in February 2014, during periods of base flow to avoid as much as possible, extreme flow conditions that may represent unusual stress, assemblage instability or danger to field crew. Stratified sampling method was employed so that eight sampling points (Table 1) were identified for the collection of algae and water samples. Selection of sampling sites was done to provide a representative profile of the lake's alga species in order to get as broad as possible, an estimate of the biota and to ensure that all plant species were accounted for. The sites were also chosen to allow for comparisons of species distribution and physico chemical attributes across the lake.

The location of each site was determined with a GPS (Garmin eTrex) and at each sampling site, the canoe was anchored and the depth, turbidity and temperature were recorded. Sampling involved the collection of duplicate samples for physico-chemical analysis. Water was collected from each site in a two-litre plastic vessel and subsequently Conductivity, Alkalinity and pH were determined in the laboratory.

The Phytoplankton samples were collected by using 55µm mesh-sized plankton net. Epiphytic samples were collected from different parts of plant materials with representative algal growth by shaking, squeezing and washing the plants portions as the case may be. Toothbrush or scraper was used to dislodge them from plant surface in the washing dish. The dislodged suspensions from each group of substrate type at site were composited[6] and preserved in 4% formalin.

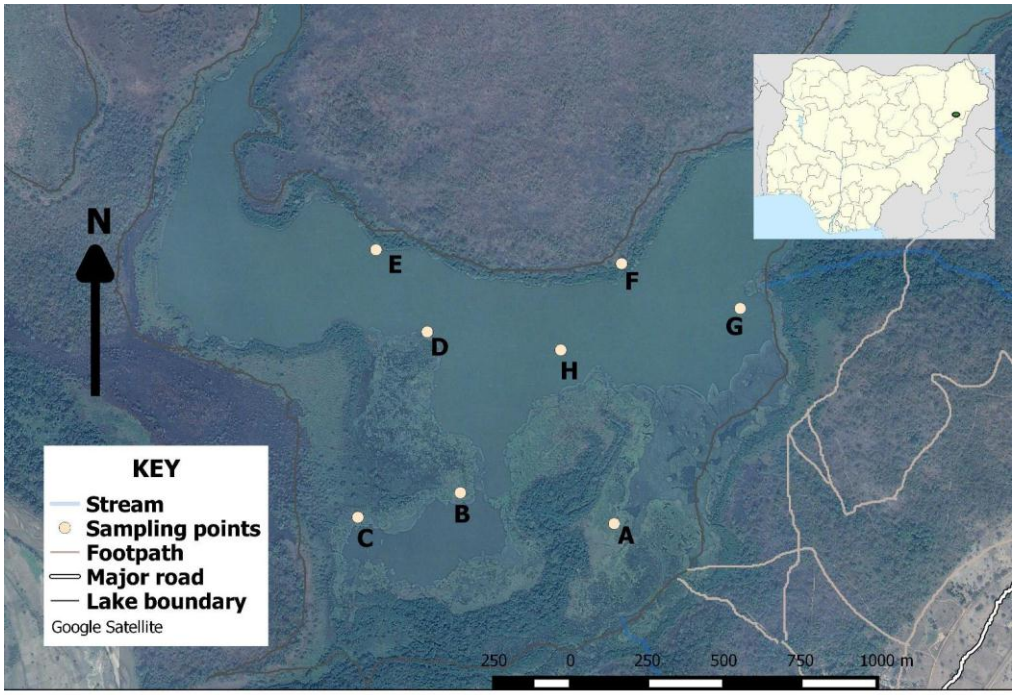
Algal species were identified using Olympus binocular microscope and photographs were taking using an attached Celestron Digital Microscope Imager (Model 44421). Alga taxa were identified to the lowest possible taxonomic level at 400 X magnification. Identification was based on the

following: Belcher and Swale[7], Prescott[26], Gerreth, and Denny[15], Pentecost[24], Kelly[21], Bellinger and Sigee[8] and Guiry and Guiry[17].

Data analysis was designed to determine species composition, generic richness, and relative frequency of occurrence.

Table 1: Description of Sampling Sites along Pandam Lake in Pandam Wildlife Park, Plateau State

Sites	Location	Altitude (m)	Grid reference	
			Latitude (North)	Longitude (East)
1	Shoreline	1.21	$08^{0}38.981^{1}$	$008^{0}58.461^{1}$
2	Shoreline	1.21	$08^{0}39.230^{1}$	$008^{0}58.507^{1}$
3	Body of lake	1.21	$08^{0}39.331^{1}$	$008^{0}58.411^{1}$
4	Body of lake	1.21	$08^{0}39.332^{1}$	$008^{0}58.358^{1}$
5	Shoreline	1.21	$08^{0}39.501^{1}$	$008^{0}58.147^{1}$
6	Shoreline	1.21	$08^{0}39.736^{1}$	$008^{0}58.565^{1}$
7	Body of lake	1.21	$08^{0}39.635^{1}$	$008^{0}58.672^{1}$
8	Body of lake	1.21	$08^{0}39.500^{1}$	$008^{0}58.534^{1}$



Pandam Wildlife Park, Quanpan LGA, Plateau State, Nigeria.

RESULTS

Results obtained (Table 2) during the sampling period showed that water temperature varied from 32.30 to 34.50°C. (mean = 33.50°C), pH fluctuated between 7.7 and 8.40 (mean ± s.e = 8.15 ± 0.03), indicating alkaline character. Dissolved oxygen concentrations ranged between 2.20 to 7.60mgl[1] (mean ± s.e = 5.74 ± 0.38). Conductivity varied from 68.90 to 102.30 (mean ± s.e = 74.34± 1.52). Generally, the surface water of the lake was characterized by low turbidity with an overall mean of 0.46m that ranged from 0.15 - 0.82m. Alkalinity had a mean of 25.3mg1^{-1} $CaC0_3$ with values ranging from 23 to 28mg1^{-1} $CaC0_3$.

The concentration of phosphate measured during the study showed values that ranged from 0.05 -0.08mg1^{-1} with an overall mean± s.e of 0.66 ± 0.02. The Nitrate concentration ranged from 10.0mg1^{-1} to 20.0mg1^{-1} with an overall mean of 12. 63.

Table 2. Descriptive Statistics of physical and chemical attributes water Pandam Wildlife park Lake

Statistcic	Mean Depth (m)	Water Temperature (°C)	Turbidity (m)	pH	Conductivity (μScm^{-1})	Alkalinity ($mgl^{-1}CaCo_3$)	Dissolved oxygen (mg^{-1})	Nitrate-Nitrogen (mg^{-1})	Phosphat-Phosphorus (mg^{-1})
Mean	1.07	33.46	0.46	8.15	74.34	2.53	5.74	12.63	0.66
Std. Deviation	0.44	0.59	0.16	0.15	7.42	0.20	1.88	3.10	0.09
Minimum	0.10	32.30	0.15	7.70	68.90	2.20	2.20	10.00	0.50
Maximum	1.84	34.50	0.82	8.40	102.30	2.90	7.60	20.00	0.80

Floristic Composition

The species list across sites and community types is shown in Table 3. A total of 117 soft-bodied algal species belonging to three different taxonomic groups namely; Chlorophyta, Cyanophyta and Euglenophyta were recorded during the survey. Chlorophyta was the prominent division with 91 taxa while Cyanophyta and Euglenophyta had 13 taxa each. The microphotographs of some predominant species recorded during the study are shown in Plate 1.

Occurrence

The epiphytic community recorded highest number of soft-bodied taxa (104) compared to the phytoplankton community (47). On the whole, percentage frequency of occurrence of species ranged from 6.50 to 87.50 % (Table 4). Five of most frequent species include; *Oedogonium* Sp 1 (87.50 %), *Microcystis* Sp 1 (75 %), *Oedogonium* Sp 2 (50 %), *Paimella miniata* (50 %) and *Spirogyra* Sp 2 (50%) as they occurred in 50 percent or more of the samples whereas 50 taxa occurred only once during the survey. The most dominant Chlorophyta reported in the lake was *Oedogonium* spp, *Palmella miniata* and *Cosmarium*. Among Cyanophyta, *Microcystis* was the main representative of the group while Euglenophyta showed dominance only by species of *Euglena* spp and *Trachelomonas*).

DISCUSSION AND CONCLUSION

This study reveals that the lake Pandam has diverse algal species with the epiphytic forms recording higher number of species compared to the phytoplankton community. The comparatively higher number of algal species for epiphytic community compared to the phytoplankton is due to the availability of substratum for attachment. Round *et al*[27]., reported that periphytons are more diverse than the plankton, both in terms of number of species and the life forms present. The low species composition of the phytoplankton community can also be due to grazers[25].

The diversity of soft algal species at the lake study sites recorded the total number of 117 algal taxa belonging to Chlorophyta, Cyanophyta and Euglenophyta, which corroborate with similar studies by Adebisi[1], Ayodele *et al*[5]., Calijuri *et al*[9]., Chergui *et al*[10]., and Ewebiyi *et al*[14]., Sindama[29] which showed that green algae and blue algae dominate most tropical African lakes. This finding agrees with that of most authors who reported that the phytoplankton community in fresh water is mostly chlorophyta, cyanophyta, diatoms and dinophyta[30]. Kemdirim[22] observed four major groups of phytoplankton in Shendam and Pankshin reservoirs and in another study identified Chlorophyceae as the dominant family in Shendam reservoir.

The abundance and frequent occurrence of *Microcystis* and *Oedogonum* spp in the study must have been caused by the polluted nature of the water due to the anthropogenic activities carried out around its shore. They are also known to be tolerant and resistant to organic water pollution and are taxa that infer nutrient enrichment. Similar observations were recorded by Dimowo[12] and Shakila and Natarajan[28].

Overall, the biodiversity analysis showed that the Lake was rich in microalgae especially with high abundance of unicellular/colonial

forms. Chlorophytes and Cyanophytes were found to be dominant in the study area. Physico-chemical analysis also revealed the eutrophic nature of the lake favouring the microalgal dominance often evident from lush algal growth of both and submerged aquatic macrophytes.

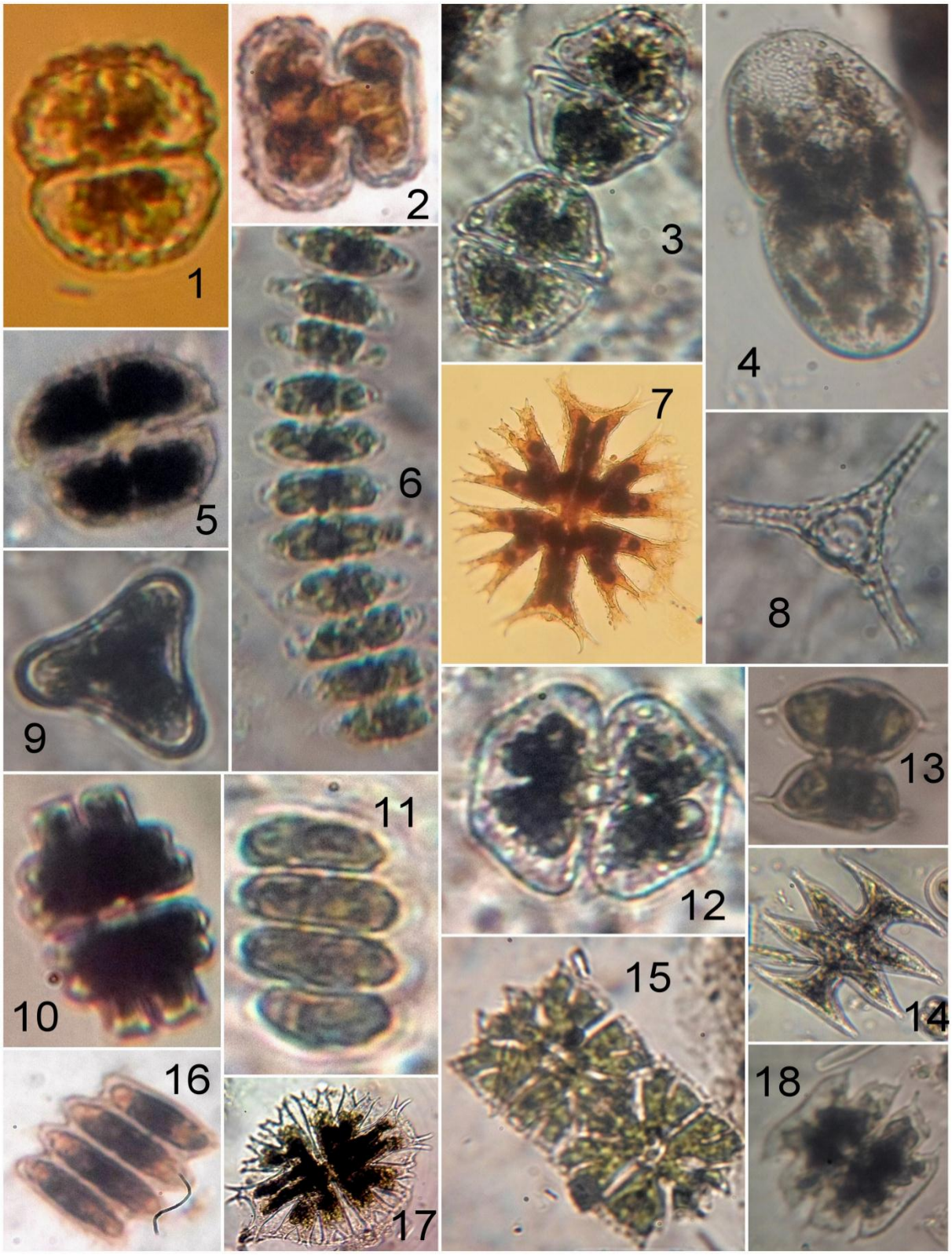
The baseline information provided by this study will serves as a reference point for monitoring future changes on this assemblage as the lake water becomes progressively polluted.

Table 3: List and Occurrence of Non-diatom Algal Taxa at Pandam Lake of Pandam Wildlife Park, Nigeria

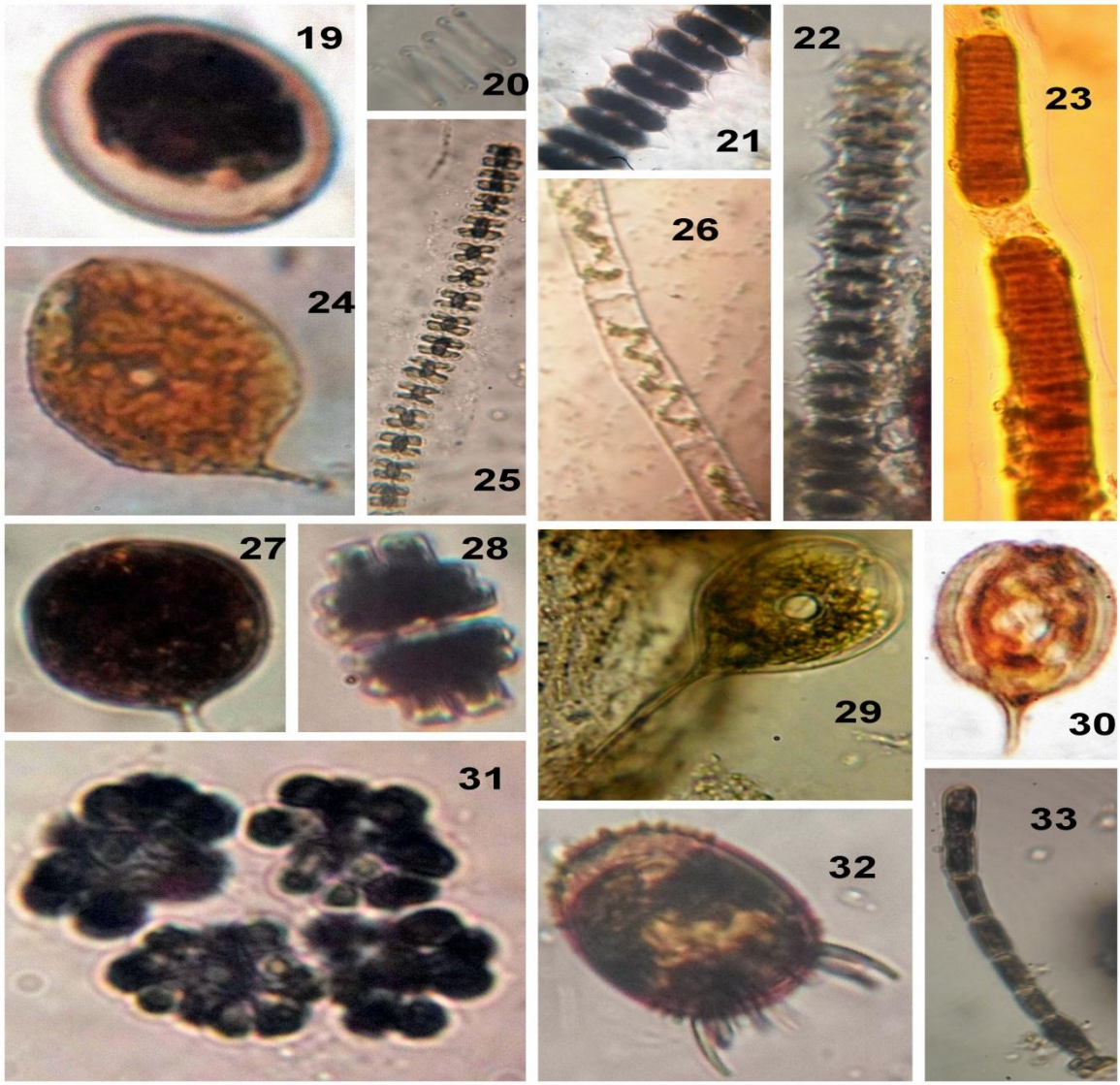
Algal Taxa	Community		Freq. of Occurrence (%)
	Epiphytic	Phytoplankton	
Chlorophyta			
Chlorophyceae			
Ankistrodesmus fusiformis Corda		+	25.00
Arthrodesmus fuellebornei Schmidle	+		18.75
Arthrodesmus sp 1	+		6.25
Arthrodesmus sp 2	+		6.25
Bulbochaete sp	+		12.50
Chaetophora sp 1	+	+	31.25
Closterium diana Her	+		6.25
Closterium directum W.Archer	+	+	6.25
Closterium lunula Ehrenberg & Hemprich ex Ralfs	+		6.25
Closterium sp 1	+	+	25.00
Closterium sp 2		+	6.25
Coelastrum sp 1	+		6.25
Coelastrum sp 2		+	6.25
Coelastrum sp 3		+	6.25
Cosmarium subcucumis	+		6.25
Cosmarium conspersum Raifs var *scotti* croasd	+		12.50
Cosmarium geminatum Lund	+		6.25
Cosmarium granatum Breb.	+	+	12.50
Cosmarium javanicum Nordstedt	+		6.25
Cosmarium psedoarmatum Scott & Press Forma	+		6.25
Cosmarium pseudoretusum F. Ducellier	+		6.25
Cosmarium pseudoretusum var. *africanum* (Fritsch) Krieger & Gerloff	+	+	18.75
Cosmarium quadratum Raifs ex Raifs.	+		6.25
Cosmarium quadrum Lundell	+		6.25
Cosmarium sp 1	+	+	25.00
Cosmarium sp 2	+		6.25
Cosmarium sp 3	+		6.25
Cosmarium sp 4		+	12.50
Cosmarium subspeciosum var. *Valiatus* Nordst	+	+	25.00
Cosmarium vegneli WIlle Var. *Minimum* Elchler	+		6.25
Cosmarium vitiosum Sctt et.Gronbi	+		6.25
Crucigenia fenestrate Schmidle		+	6.25
Cylindrocystis brebisonii var. *monor* w & w	+		12.50
Dictyosphaerium sp 2	+	+	37.50
Eudorina sp	+		12.50
Gloeocystis sp 1	+		6.25
Hydrodictyon sp 1	+		12.50

Monoraphidium minutum (Nag) Kom. Legn	+		12.50
Mougeotia sp 1	+	+	37.50
Mougeotia sp 2	+		25.00
Oedogonium *broterianum* Lacerda	+		6.25
Oedogonium sp 1	+	+	87.50
Oedogonium sp 2	+	+	50.00
Oedogonium sp 3	+		6.25
Oocystis solitaria Wittrock		+	6.25
Palmella miniata Leiblein	+	+	50.00
Pediastrum sp 1	+	+	18.75
Pediastrum tetras (Ehr) Raifs *var. Tetraodon* (Corda) Hans	+		12.50
Protococcus sp	+	+	25.00
Scenedesmu Intermedius Chod.		+	6.25
Scenedesmus aculeolatus Reinsch *(obliquus)* Turp Kutz	+		12.50
Scenedesmus acuminatus (Lagech) chodat	+		18.75
Scenedesmus acunae Comas	+		6.25
Scenedesmus granulatus West & West	+		12.50
*Scenedesmus quadricauda (*Turg) Breb.	+	+	12.50
Scenedesmus sp 1	+		12.50
Scenedesmus sp 2	+		25.00
Spirogyra sp 1	+		43.75
Spirogyra sp 2	+	+	50.00
Staurastrum asterias Nygaard	+		6.25
Staurastrum cingulum Smith Var. *Obesum* Smith	+		18.75
Staurastrum lanceolatum var. *compressus*	+		6.25
Staurastrum leptocladum Nordst	+	+	12.50
Staurastrum muticum Breb.	+		12.50
Staurastrum paradoxum Meyen var. *Parvum*	+		6.25
Staurodesmus arthrodesmus Schm	+		6.25
Staurodesmus glaber (Her) Teil. Var. *recurvatus*	+		6.25
Ulolhrix cylindricum Presc	+		6.25
Ulothrix subtilis Kützing	+		12.50
Ulothrix sp 1	+	+	25.00
Ulothrix sp 2	+		6.25
Conjugatophyceae			
Micrasterias abrupta West et West	+		6.25
Micrasterias alata Wallich var. *alata* forma	+	+	12.50
Micrasteria crux-melitensis (EHR) Has F. *minor* Turn	+		6.25
Micrasterias foliacea Bailey ex Ralfs	+		6.25
Micrasterias pinnatifida Morpha	+	+	12.50
Micrasterias radians Turner	+	+	31.25
Micrasterias zeylanica Fritsch Formal	+	+	6.25
Sphaerozosma leave Nordstedt	+		12.50

Spondylosium nitens (wall) Arch. F. *minor* Turns	+		18.75
Spondylosium planum (Wolle) West & West	+		18.75
Spondylosium sp	+		12.50
Zygnema sp 1	+		18.75
Desmidium coarctatum Nordstedt	+		12.50
Euastrum elegans Ralfs	+		6.25
Euastrum sinuosum var. *subjenneri* West & West	+		6.25
Euastrum verrucosum Ehr. ex Raifs	+		6.25
Euastrum sp 1	+		6.25
Euastrum sp 2	+		12.50
Trebouxiophyceae			
Oonephris obesa (W.West) Fott.	+		6.25
Westella bortryoides (W.West) De Wildman	+	+	25.00
CYANOPHYTA			
Cyanophyceae			
Chroococus turgidus (kutzing) Naegeli	+	+	18.75
Gleocapsa sp 1	+		12.50
Lyngbya majuscula Harv ez Gomont	+		12.50
Microcystis aeruginosa (Kützing) Kützing	+	+	25.00
Microcystis litoralis (Hansgirg) Forti	+	+	25.00
Microcystis protocystis Crow	+	+	31.25
Microcystis sp 1	+	+	75.00
Nostoc sp 1	+		12.50
Oscillatoria tenuis C.Agardh ex Gomont		+	6.25
Oscillatoria sp	+	+	12.50
Phormidium fragile (Meneglum) Gomunt	+		6.25
Phormidium sp		+	25.00
Spirulina sp		+	6.25
EUGLENOPHYTA			
Euglenophyceae			
Euglena gracilis Klebs	+		6.25
Euglena sp 1	+		31.25
Euglena sp 2	+		25.00
Lepocinclis ovum (Ehrenberg) Lemmermann	+		12.50
Phacus curvicauda Svirenko	+	+	12.50
Phacus longicauda (Ehrenberg) Dujardin	+	+	12.50
Phacus pyrum (Her) Stein	+		6.25
Phacus unguis Pochmann		+	12.50
Trachelomonas amata T. armata var. ovate		+	6.25
Trachelomonas amata var. *steni* Lemm. em. Defi	+		6.25
Trachelomonas volvocina (Ehrenberg) Ehrenberg	+	+	12.50
Trachelomonas oblonga var. *australica* Playfair	+	+	18.75
Trachelomonas volvocina var. *derephora* Conrad	+	+	43.75



1. *Cosmarum vitiosum* Sctt et. Gronbi; 2. Cosmarium geminatum Lund; 3. Cosmarium sp1; 4. *Cosmarium subcucumis*; 5. Cosmarium sp; 6. *Scenedesmus aculeolatus* Reinsch (obliguus) Turp Skutz; 7. *Micrasterias radians* Tuner; 8. *Staurastrum paraoxum* Myen ver. *parvum*; 9. *Straurastrum lanceolatum* var. *compressus*; 10. *Euastrum* sp; 11. *Scenedesmus granulates* West & West; 12. *Cosmarum psuedoretusum*; 13. *Staurodesmus arthrodesmus* Schm; 14. *Micrasterias pinnafitida* Morpha; 15. *Micrasterias foliacea* Bailey ex Ralfs; 16. *Scenedesmus* sp; 17. *Micrasterias crux-melitensis* (EHR) Has f. *minor* Turn.; 18. *Micrasterias zeylanica* Fritsch Forma.



19. *Trachelomonas* sp; 20. *Spirulina* sp; 21. *Sphaerozosma laeve* Nordstedt; 22. *Desmidium coarctatum* Nordstedt; 23. *Lyngbya majuscule* Harvey ex Gomont; 24. *Phacus unguis* Pochmann; 25. *Sphaerozosma* sp; 26. *Spirogyra* sp; 27. *Lepocinclis ovum* (Ehrenberg) Lemmermann; 28. *Eaustrum* sp; 29. *Phacus longicauda* (Ehrenberg) Dujardin; 30. *Phacus monilatus* Stokes; 31. *Dictyosphaerium* sp; 32. *Trachelomonas amata* T. *armat*a var. *ovate*; 33. *Oedegonium* sp

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