EPIPHYTIC ALGAE OF AQUATIC MACROPHYTES FROM SOME OXBOW LAKES OF CENTRAL KALIMANTAN.

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Abstract

Epiphytic algae of aquatic macrophytes were studied in Lake Tabiri, Lake Takapan and Lake Rengas in 2002. The study was conducted to reveal the composition and abundance of epiphytic algae in immersed parts of some aquatic macrophytes in humic lakes. Epiphytic algae were studied from *Salvinia molesta*, *Eichhornia crassipes*, *Cyrtococcum sp* as representatives of floating aquatic macrophytes and *Polygonum lapathifolium* as a submerged macrophytes that grow from the bottom reaching to the surface of the lake. Diatoms or Bacilllariopyceae group dominated the epiphytic algae community. Beside diatom, a group of desmids are commonly found in this community of epiphytic algae. The abundance of epiphytic algae collected on *E crassipes* range from 1,790,036 to 286,898,867 cell/m^2, while the abundance of epiphytic algae collected on *Cyrtococcum* sp range from 2,793,424 to 123,984,278 cell/m^2. The abundance of epiphytic algae colleted on *S. molesta* and *P. lapathifolium* were 1,731,767 and 119,022,754 cell/m^2 respectively. The abundance of epiphytic algae is higher in Lake Tabiri compared to the abundance of epiphytic algae collected from the same species of aquatic macrophytes found in Lake Takapan and Lake Rengas. The highest abundance of epiphytic algae in Lake Tabiri may be influenced by some environmental factors such as pH, conductivity and Secchi depth that were found in higher in that lake. The architecture of aquatic macrophytes seems influence the abundance of epiphytic algae in Lake Tabiri.

Key words: *epiphytic algae, aquatic macrophytes, humic, oxbow lake.*

Introduction

Aquatic macrophytes such as water hyacinth (*Eichhornia crassipes) and* water fern *(Salvinia molesta)* are common found blooming in eutrophic inland waters of Java and Sumatera. These aquatic macrophytes are also found in humic floodplain and oxbow lakes of River Kahayan such as Lake Tabiri, Lake Takapan and Lake Rengas in Central Kalimantan. These lakes have the range of pH value from 5.50 to 5.80, 5.01 to 5.55 and 4.50 to 5.31 respectively.

Study on phytoplankton abundance in some humic oxbow lakes of Central Kalimantan such as Lake Lutan, Takapan and Rengas showed that the abundance of phytoplankton was relative low, with the range of phytoplankton abundance 441-3495 individuals/L, 149 -3337 individual/L and 293 - 2948 individual/L respectively (Sulastri & Hartoto, 2000). It is possibly that the direct contribution of phytoplankton as food resources for aquatic organism such as fishes is low in that humic oxbow lake ecosystem. Beside the insects, food resources of aquatic organisms also come much from allochthonous material and aquatic macrophytes in that humic oxbow lake ecosystem. Aquatic macrophytes are also habitat for macroinvertebrates and epiphytic algae because of the plant partly play as a kind of detritus filter and rich in nutrient. Gallanti and Romo as cited in Cattaneo (1998) reported that epiphyton contribute significantly to supply the carbon and food resources of fish in Italian lake ecosystem. This study was conducted to reveal the composition and abundance of epiphytic algae in immersed parts of some aquatic macrophytes found in Lake Tabiri, Lake Takapan and Lake Rengas.

Material and Methods

The study was conducted in Lake Tabiri, Lake Takapan and Lake Rengas, as a part of the floodplain system of River Kahayan (Figure 1). Samples of epiphytic algae were collected from the submerged part of aquatic macrophytes such as *Eichhornia crassipes; Salvinia molesta* and a member of Poligonaceae family that is locally refer as *"Kumpai lengo"* (*Polygonum lapathifolium* L) and *"Kumpai batu"* (*Cyrtococcum sp*) in Lake Tabiri, Lake Takapan and Lake Rengas, June 2002. *Eichhornia crassipes, Salvinia molesta* and *Cyrtococcum* SP are floating aquatic macrophytes. *P. Lapathifolium* is a submerged of aquatic macrophyte that grow from the bottom reaching to the lake surface. Epiphytic algae were collected from a part of root especially for *Eichhornia crassipes and Cyrtococcum sp.* and all part of aquatic macrophytes for *S. molesta*. Epiphytic algae collected from *P. laphatifolium* were from the part of plant that immersed in the water.

Samples of epiphytic algae were collected by harvesting all individual of aquatic macrophytes in 50 x 50 cm plots, and then the plant is weighed to know the total biomass. Sub samples were taken from the total biomass. Immersed parts of the plant sub samples are cut and washed with 1000 ml of tap water and then shaken manually for around ten minute. After shaking of samples, the water was filtered using plankton net no 25 (40 □m mesh size) and the sample was preserved with 1 % Lugol solution for identification in the laboratory.

Total number of cells of epiphytic algae at each sub sample of plant was accounted using Lackey Drop Microtransect Method (Anonymous, 1976). Epiphytic algae species was identified according to Prescott (1951), Prescott (1963) and Scott and Prescott (1961). The total cell of epiphytic algae at each square meter of aquatic macrophytes was accounted by some calculations as follow:

1. Epiphytic algae collected from part root of plant
   The first is determining the total cell of epiphytic algae from total sample of root (total weight of root/g sub sample of root x total cell at each sub sample of root = y cell/L). The following step is determining the percentage of total weight of root from total weight of plant (total weight of root/total weight of plant x 100% = x %). From this calculation would obtain the total cell of epiphytic algae /g of biomass of plant (Y x X = Z). Therefore the total cell of epiphytic algae at one square meter of macrophytes (cell/m^2) = 10,000/2500 x Z x total weight of plant at each plot.

2. Epiphytic algae collected from all part of plant.
   The first is determining total cell of epiphytic algae from sub sample of plant (y cell/L). The following step is determining the percentage of sub sample of

plant from total weight of plant (total weight sub sample of plant/total weight of plant x 100% = X %). From this calculation would obtain total cell of epiphytic algae/g of biomass of plant (Y x X = Z). Therefore total cell of epiphytic algae at one square meter of macrophytes (cell/m^2) = 10,000/2500 x Z x total weight of plant at each plot.

The water quality parameter such as water temperature, turbidity, conductivity, pH and dissolved oxygen (DO) was measured using Water Quality Checker Horiba U-10. The data for nutrient concentration in the water column was obtained from examination of water samples collected from the lake. Analyses of ammonium, nitrite, nitrate, total nitrogen and total phosphorous were performed according to the method proposed by Anonymous (1995).

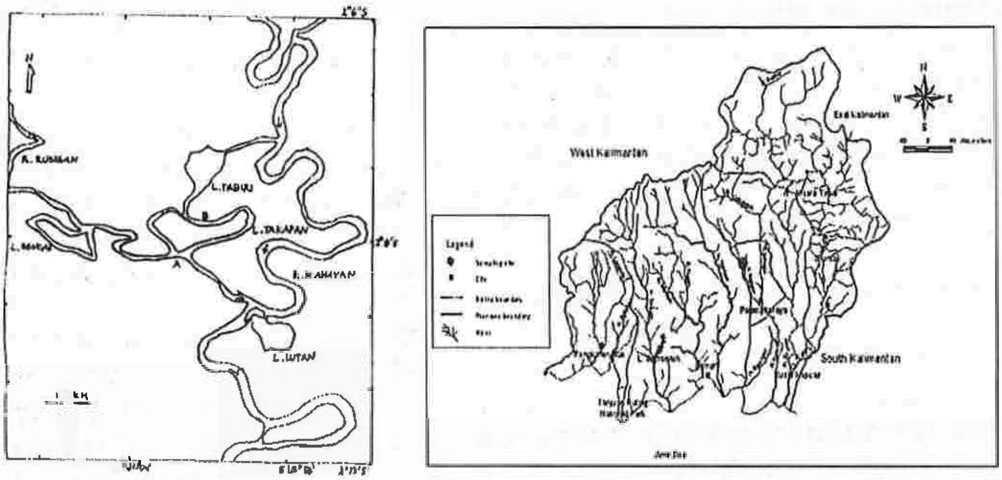

Figure 1. Position of sampling sites.

Result and Discussion

Some water quality parameters of Lakes Tabiri, Lake Takapan and Lake Rengas were presented in Table 1 and 2. The water quality condition showed a little different between these lakes, especially pH, conductivity and Secchi depth. In Lake Tabiri, the pH, conductivity and Secchi Depth values were higher than those parameters in Lake Takapan and Lake Rengas. Lake Tabiri is a floodplain lake of Kahayan River that exchange water with River Kahayan and River Rungan River through Lake Takapan. Lake Takapan is always exchanging water with River Rungan, a tributary of the Kahayan River, but in the high water time the lake also exchange water with River Kahayan. Lake Rengas is located south west of L. Takapan and exchange water with River Rungan. Rungan River is a humic river with the average of pH and conductivity 4.72 and 0.005mS/cm respectively (Hartoto, 2000). The higher value of pH and conductivity of Lake Tabiri is may affected by the position of Lake Tabiri that receive the water beside from Rungan also receive from Kahayan river with the higher value of pH and conductivity 5.48 and 0.014

mS/cm (Hartoto, 2000). The average value of nutrient content such as nitrite, ammonium, and total nitrogen and total phosphorous was higher in Lake Takapan than those parameters found in Lake Tabiri and Lake Rengas. The higher level of nutrient concentration in Lake Takapan is presumably due to the existence of cage aquaculture system in the lake and the water it receives from River Kahayan.

The composition and abundance of epiphytic algae is presented in Table 3 and 4. Diatom or Bacillariophyceae group dominated the community of epiphytic algae. This group is commonly found in humic lake ecosystem because the cell wall is more resistant to acid water. It was also reported that there is a relationship between pH and composition of diatom (Harris, 1986). Furthermore it was reported that the remains of diatom population preserved in the lake sediments have been used to reconstruct the history of acidification. Beside diatom, the group of desmids such as *Cosmarium, Closterium, Gonatozygon* and *Euastrum* are commonly found in this community of epiphytic algae. Payne (1986) have reported that another group of green algae common in rather acidic water are desmids that often have constrictions at the centre of the cells.

The abundance of epiphytic algae found on the stand of E. *crassipes* range from 1,790,036 to 286,898,867 cells/m^2, while the abundance of epiphytic algae found on *Cyrtococcum sp* stand range from 2,793,423 to 123,984,278 cells/m^2. The abundance of epiphytic algae on *P lapathifolium* stand that was only found in Lake Tabiri are 119,022,754 cells/m^2, while on *S. molesta* that was only found in Lake Rengas 1,731,767 cells/m^2.

In Lake Tabiri, the abundance of epiphytic algae found on *E. crassipes* was higher at Station B compared to the abundance found on *E. crassipes* located at Station C. In station C of Lake Tabiri, the value of Secchi Depth was lower compared to the ones found in station B. The lower value of Secchi Depth indicates a lower light penetration into the water column and suspected to limit photosynthesis activity and growth of epiphytic algae in station C.

In station C of Lake Tabiri, the abundance of epiphytic algae was higher on *Cyrtococcum sp* compared to the abundance found on *E. crassipes* and *P. lapathifolium*. Cattaneo *et al.* (1998) have reported that architecture of aquatic macrophytes significantly affects the abundance and communities of epiphytic alga.

Table 1. The average values of some physical and chemical parameters in Lake Rengas, Lake Takapan and Lake Tabiri.

Station and position of sampling site	pH	Conductivity mS/cm	Turbidity NTU	DO mg/L	WT °C	Secchi Depth cm
Lake Rengas						
A:S02°08'55.1"; E 113°53'48.3"	5.11	0.009	25.1	4.95	29.6	16.0
B : S 02°08'55.6" ; E 113°53'39.1"	5.18	0.010	14.3	3.00	29.1	17.0
C : S 02°09'08.3"; E 113°53'16.1"	4.50	0.010	17.0	3.94	29.4	17.5
D : S 02°08'54.9"; E 113°53'15.7"	5.40	0.008	33.2	5.28	29.2	12.0
E : S 02°08'54.1": E 113°53'23.9"	5.31	0.007	31.5	5.5	29.3	13.5
Average	5.25	0.008	24.2	4.53	29.3	15.2
Lake Takapan						
A : S02°09'14.0"; E 113°54'48.1"	5.30	0.008	29.6	4.55	29.7	15.5
B:S02°08'33.9"; E 113°55'26.1"	5.55	0.010	14.7	4.28	29.5	19.0
C:S02°08'47.9";E 113°54'49.6"	5.27	0.009	8.6	3.40	29.8	22.0
D:S02°08'44.0";E 113°54.'15.7"	5.01	0.029	6.3	3.19	29.4	33.5
E:S02°09'01.9":E 113o54'32.2"	5.05	0.009	12.1	3.10	29.6	27.0
Average	5.24	0.013	14.3	3.70	29.7	23.4
Lake Tabiri						
A : S 02°08'33.7"; E 113°55'21.7"	5.55	0.016	14.9	0.69	30.4	33.0
B : S 02°08'32.7"; E 113°55'18.0"	5.53	0.013	12.8	1.56	31.3	30.1
C : S 02°08'28.0" ; E 113°55'18.3"	5.80	0.015	17.7	3.87	33.8	21.0
Average	5.61	0.014	2.04	2.08	31.8	28.2

Table2. Average value of nutrient concentration in Lake Rengas, Lake Takapan and Lake Tabiri.

Sampling site and position	$N\text{-}NO_2$ mg/l	$N\text{-}NO_3$ mg/l	$N\text{-}NH_4$ mg/l	TN mg/l	TP mg/l
Lake Rengas					
A : S02°08'55.1"; E 113°53'48.3"	0.031	0.043	0.078	0.079	0.065
B : S02°08'55.6"; E113°53'39.1"	0.032	0.486	0.194	0.690	0.076
C: S02°09'08.3"; E 113°53'16.1"	0.035	0.490	0.102	0.759	0.063
D: S 02o08'54.9"; E113°53'15.7"	0.042	0.046	0.164	1,413	0.047
E: S 02°08'54.1" ;E 113°53'23.9"	0.048	0.312	0.141	2,132	0.034
Average	0.038	0.275	0.136	1.015	0.057
Lake Takapan					
A:S 02°09'14"; E 113°54'48.1"	0.038	0.358	0.189	1,188	0.072
B: S 02°08'33.9"; E 113°55'26.1"	0.081	0.301	0.276	1,249	0.045
C: S 02°08'47.9"; E 113°54'49.6"	0.026	0.477	0.211	0.978	0.082
D: S 02°08'44.0"; E 113°54'15.7"	0.021	0.343	0.273	1,114	0.078
E: S02°09'01.9"; E 113°54'32.2"	0.031	0.449	0.278	2,492	0.071
Average	0.039	0.386	0.245	1.404	0.069
Lake Tabiri					
A: S 02°08'33.7'; E 113°55'21.7"	0.048	0.472	0.088	1,258	0.036
B: S 02°08'32.7"; E 113°55'18"	0.036	0.397	0.13	1.09	0.037
C: S02°08'28.0"; E 113°55'18.3"	0.017	0.372	0.107	1.30	0.050
Average	0.034	0.413	0.109	1.216	0.042

Cyrtococcum sp is a floating aquatic macrophyte that has leaves that are thin, providing sufficient light for photosynthesis and the growth of epiphytic algae attached in its root. The root has a role to filter excess detritus and provides suitable nutrient-rich habitat for epiphytic algae, while *E. crassipes* have wider leaves cause limited light intensity penetrating into the water. The light mainly utilized by the plant's leaves for photosynthesis. *P. lapathifolium* is a plant with different architecture compared with *E. crassipes* and *Cyrtococcum sp.* The part of *P. lapathifolium* immersed into the water is mostly the stem. It means that epiphytic algae attached on the stem have little supply of detritus and nutrient. This condition might have caused lower of abundance of attached algae on the *P. lapathifolium* than on *Cyrtococcum sp.*

In Lake Takapan, the abundance of epiphytic algae from *E crassipes* was lower compared with the abundance of epiphytic algae from the same species found in Lake Tabiri. In Lake Takapan, especially in Station B showed that the value of Secchi Depth and conductivity is lower compared to those parameters found in station Band C in Lake Tabiri (Table 1). The lower of Secchi depth in Lake Takapan indicate lower light penetration into the water that in its turn also limit photosynthesis activity of epiphytic algae On the other hand the value of conductivity in Lake Takapan was also lower compared with the value of conductivity found Lake Tabiri. The value of conductivity show lower level of ion that also can influence the abundance of epiphytic algae in Lake Takapan.

Table 3. The abundance of epiphytic algae from some aquatic Macrophytes in Lake Tabiri.

Station B		Station C		
Plant species	*E. crassipes*	*E. crassipes*	*P. lapathifolium*	*Cyrtococcum sp*
Taxonomical group	Abundance cells/ m^2	Abundance cells/m^2	Abundance cells/m^2	Abundance cells/m^2
Chrysophyta		cell/m^2	cell/m^2	cell/m^2
Cymbella	932492	75947	397839	7956777
Diatoma	71842706	310449	47500341	65245579
Ephitemia	731261	555538		
Eunotia	70483264	133690	13799687	11068762
Fragillaria	75089834	411988	7284511	7956777
Frustulia	297150	131702	90918737	
Navicula	58133937	541952	9764103	7956777
Pinnularia	1215947	40260	2417886	3182711
Synedra	752508	91411	4070947	3182711
Suriella	2219	26512	4959184	

	29			
	6268			
Pleurosigma	2			
Chlorophyta				
	1109			
Ankistrodesmus	3			3182711
	8993			
Cosmarium	19	2938		
	3038			
Cladophora	63		1591356	
	1132			
Closterium	614	40265	3306122	
	2102			
Euastrum	48	3573		
Gonatozygon				
	5904			
Netrum	12			
	7151			
Meugotia	97			
	5904			
Scenedesmus	12	7089		
	5904			
Spirogyra	12			3182711
Staurastrum		3358		
	1317			
Ulotrix	847	20612	1591356	
Cyanophyta				
	4762			
Oscillatoria	19	67341	8013973	11068762
Hapalosiphon		2626		
Euglenophyta				
	2348			
Euglena	39	35818	826531	
Phacus		23028	826531	
	2868			
	9886			
Total cell/m^2	7	2547881	119227754	123984278

Table 4. The composition and abundance of epiphytic algae from some aquatic macrophytes in Lake Takapan and Lake Rengas.

	Lake Takapan	Lake Rengas	
	Station B	Station D	
Plant species	*E. crassipes*	*S .molesta*	*Cyrtococcum sp.*
Taxonomical group	Abundance cells/m^2	Abundance cells/m^2	Abundance cells/m^2
Chrysophyta			
Cymbella	24094	49091	76255
Diatoma	133564	107079	517439
Ephitemia	204671		
Eunotia	71979	122147	36892
Fragillaria	138313	148436	341909
Frustulia	41252	605091	174191
Navicula	157293	101282	199382
Pinnularia	13079	32727	76256
Synedra	31391	26273	67160
Suriella	6027		
Chlorophyta			
Ankistrodsmus	16072		
Cosmarium		42679	83112
Cladophora	672777	35509	
Closterium	23688	47587	429741
Euastrum	26368	28389	
Gonatozygon	30134		
Netrum	3767	32727	
Meugotia	42959		
Cyanophyta			
Oscillatoria	116236		461274
Hapalosiphon		215430	215430
Euglenophyta			
Euglena	28838		
Phacus	7523		38127
Trachelomonas			76256
Total cell/m^2	1790036	1731767	2793424

There were two species of aquatic macrophyte *Salvinia molesta* and *Cyrtococcum sp* found in Lake Rengas. The abundance of epiphytic algae grew on *Cyrtococcum sp* was higher compare to the ones live in *S. molesta* in this lake. *S. molesta* has wider leaves, which are probably affect the existence of epiphytic algae.

The abundance of epiphytic algae in Lake Tabiri was higher compared with the abundance of epiphytic algae in Lake Takapan and Lake Rengas especially the epiphytic algae attach on the same species of aquatic macrophytes. Lake Tabiri has higher value of pH, conductivity and Secchi Depth compared with those value parameters found in Lake Takapan and Lake Rengas (Table 1). Higher level of these parameters probably causes higher influence of epiphytic algae in Lake Tabiri.

Conclusion

Diatom or Bacillariophycea group dominated the community of epiphytic algae in the three humic lakes. Beside diatom, a group of desmids are also commonly found in the epiphytic algae community of the lakes. The highest epiphytic algae abundance was found on *E crassipes* collected from Lake Tabiri. The abundance of epiphytic algae in Lake Tabiri was higher compared to the abundance of epiphytic algae collected from the same aquatic macrophyte species found in Lake Takapan and Lake Rengas.

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