The community structure of epiphytons on Utricularia sp. and Hydrilla sp. plants at Situ Alam FMIPA Universitas Indonesia, Depok, West Java

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Abstract. Water plants will affect abundance and diversity of epiphytons in the community structure. The purpose of this research is to know the difference between the community structure of epiphytons on Utricularia sp. and Hydrilla sp., also periphytic planktons at Situ Alam FMIPA UI. Abundance and diversity of epiphytons community are the main discussion in this research. Research was carried out from March 2018 until May 2018. Using the purposive sampling method, samples were taken from Utricularia sp. and Hydrilla sp. Each sample was taken three times, one repetition, once every 2 weeks. Research showed that 67 genera, including 1 planktonic genus were found on the object glass. Utricularia sp. had higher abundance of epiphytons (84609 cells/mL) than Hydrilla sp. (74392 cells/mL). Both diversity indices are categorized as low diversity (H’ < 2.302). Different diversities were found between epiphytons on both plants (P < 0.05), but there was no difference between abundance of epiphytons on both plants (P > 0.05).

Keywords: Epiphyton community, Hydrilla sp., Utricularia sp.

1. Introduction
Situ Alam FMIPA UI is a pond (1–1.5 m depth) isolated from other water sources, thus supporting growth of typical biota. Therefore, research about biotas that reside in this lake can determine conservation value of this lake. The Epiphyton’s main role in an aquatic ecosystem consist of primary producers and contributors to nutrient cycles in maintaining the stability of an aquatic ecosystem. The structure of substrate affects abundance and diversity of epiphyton community. Utricularia sp. and Hydrilla sp. are two macrophytes with different morphological structures that potentially could become habitat for epiphytons [1]. Utricularia’s bladders are suitable habitats for epiphyton growth such as Euglena, Phacus, Spirulina, and Anabaena sp. In return, Utricularia obtains Nitrogen source from the captured epiphytons [2]. Meanwhile, the leaves arrangement of Hydrilla around each node of the stem are easily attached by epiphytons [3].

There has not been any comparative study between epiphyton communities on Hydrilla sp. and Utricularia sp. at Situ Alam FMIPA UI yet. The aim of this study is to know the difference between community structures of epiphyton on Utricularia sp. and Hydrilla sp., also to discover planktons that have the potential to become epiphytons in Situ Alam FMIPA UI, Depok, West Java. The hypothesis of
this research is that there is difference between community structure of epiphytons on *Utricularia* sp. and *Hydrilla* sp.

2. Materials and method

2.1. Study area
Research was conducted in Situ Alam FMIPA UI with the coordinates of 6° 22'05.9" S and 106° 49'31.0" E, Depok. Situ Alam does not have inlet and outlet, and is isolated from several situ in UI. Sampling stations were determined based on location of *Utricularia* sp. and *Hydrilla* sp. using purposive sampling method. Research was carried out March 2018 until May 2018. Coordinates for each sample location was taken with GPS (figure 1).

2.2. Physic-chemical water assessment
Some parameters like temperature, pH, and DO were measured *in situ*. The content of carbon dioxide, nitrate and phosphate were measured in laboratory Mutu Agun. Measured water parameters were temperature by thermometer, pH by pH paper indicator, Dissolved Oxygen with DO meters and CO₂ using titration method. TDS and TSS were measured based on the results of filtering 50 mL of water sample with Whatman filter paper according to the method in [4, 5]. The color of situ Alam water was documented with the camera.

![Figure 1. Research location](image-url)
2.3. Sampling, identification, and analysis of epiphyton and plankton samples
Epiphyton on object glass were acquired by binding to 3 threads at 10 cm, 77 cm, and 154 cm depths. After 1 week, epiphytons were taken based on [6]. Planktons in water are obtained by filtering water with planktonet. Epiphyton in *Utricularia* and *Hydrilla* was obtained by shaking the *Utricularia* and *Hydrilla* in a plastic bag filled with water [7]. All samples were preserved in 10 % formaldehyde. Enumeration and identification of samples was carried out under a microscope using the subsample method. The observed cells were counted with counter, documented with camera, and identified.

Abundance of epiphyton in cell/mL (N) was calculated using the formula:

\[
N = \frac{n}{V_{m}} \times V
\]

where \( n \) is number of individuals per millilitre in subsample; \( V \) is and \( (V_m) \) is plant volume [8].

Abundance of planktons in cell/mL (N):

\[
N = Z \times \frac{T}{Y} \times \frac{1}{V}
\]

The number of individuals \( Z \) was multiplied by filtrated water (T) then divided by subsample volume (Y), then the result was divided with sample volume (V) [9].

Shanon-Wiener Diversity Index (H'):

\[
H' = -\sum p_i \ln p_i
\]

with \( p_i \) is the proportion of the \( i \)th genus. The samples were compared to see the potentially periphytic epiphyton. The result was computed into PAST v3 software for Sorensen similarity index.

Data results between epiphyton on *Hydrilla* sp. and *Utricularia* sp. were then compared with t-test based on p-value of 0.05 (5 %) with formula:

\[
t\text{-value of diversity} = \frac{H_1' - H_2'}{s_1^2 + s_2^2}
\]

Decrease diversity indices (H') between both plants and divide it with square root of quadrat of variance (S) of first plant plus quadrat of second plant equal t-value of diversity:

\[
t\text{-value of abundance} = \frac{D}{SD}
\]

\[
SD = \frac{sd}{\sqrt{n}}
\]

\[
Sd = \sqrt{\sum_{i=1}^{n} d_i^2 - \frac{(\sum_{i=1}^{n} d_i)^2}{n}}
\]

with \( D \) is the difference between the \( i \)th pair and \( n \). \( Sd \) is the value of Standard deviation, and \( SD \) means Standard error [10, 11].

3. Results and discussion

3.1. Abundance and diversity of epiphyton in Situ Alam FMIPA UI, Depok, West Java
Data of epiphyton communities in Situ Alam are presented in table 1. Percentage of phytopepiphyton
was higher than zooepiphyton due to nature of predator plant of *Utricularia*, the bladder selects zooepiphyton as prey rather than epiphyton [12].

There were 67 genera of epiphyton on *Hydrilla* sp., *Utricularia* sp., on object glass, and water at Situ Alam. The results are categorized into Chlorophyta, Glaucophyta, Rapidophyta, and Bacillariophyta, Cyanophyta, Protozoa, Trochelminthes, and Arthropods (table 2).

### Table 1. Percentage of epiphyton in Situ Alam FMIPA UI, Depok, West Java.

| Sample       | Phytoepiphyton | Zooepiphyton | Unidentified genus |
|--------------|----------------|---------------|--------------------|
| Object glass | 96.7 %         | 2.8 %         | 0.50 %             |
| *Hydrilla* sp.| 98.2 %         | 1.6 %         | 0.10 %             |
| *Utricularia* sp.| 98.9 %         | 1 %           | 0.10 %             |
| Water        | 98.1 %         | 1.7 %         | 0.20 %             |

### Table 2. Epiphyton on object glass, *Hydrilla*, *Utricularia*, water at Situ Alam.

| No  | Division/genus | Object glass | *Hydrilla* | *Utricularia* | Water |
|-----|---------------|--------------|-------------|---------------|-------|
| I. Chlorophyta |
| 1   | *Gloeocystis*  | +            | +           | +             | +     |
| 2   | *Characium*    | +            | +           | +             | +     |
| 3   | *Dictyosphaerium* | -        | +           | +             | +     |
| 4   | *Scenedesmus*  | -            | +           | +             | +     |
| 5   | *Microspora*   | -            | +           | +             | -     |
| 6   | *Bulbochaete*  | -            | +           | -             | -     |
| 7   | *Geitlerinema* | +            | +           | +             | +     |
| 8   | *Spirogyra*    | -            | +           | -             | -     |
| 9   | *Mougeotia*    | +            | +           | +             | +     |
| 10  | *Pleurotaenium*| +            | +           | +             | +     |
| 11  | *Triploceras*  | +            | +           | -             | -     |
| 12  | *Micrasterias* | +            | +           | +             | +     |
| 13  | *Cosmarium*    | +            | +           | +             | +     |
| 14  | *Staurastrum*  | +            | +           | +             | +     |
| 15  | *Closterium*   | +            | +           | +             | +     |
| 16  | *Gonatozygon* | +            | +           | +             | +     |
| 17  | *Monoraphidium*| -           | +           | +             | +     |
| 18  | *Botryococcus* | -            | +           | +             | -     |
| 19  | *Pandorina*    | +            | +           | +             | +     |
| II. Glaucophyta |
| 20  | *Glaucocystis* | +            | +           | +             | +     |
| III. Rapidophyta |
| 21  | *Gonyostomum*  | -            | -           | +             | -     |
Table 2 (continued). Epiphyton on object glass, *Hydrilla, Utricularia*, water at Situ Alam.

| No | Division/genus | Sample |
|----|----------------|--------|
|    | Object glass   | *Hydrilla* | *Utricularia* | Water |
| IV. cyanophyta |                 |         |         |         |
| 22 | *Tetrabaena*   | -       | +       | -       | -      |
| 23 | *Spirulina*    | -       | +       | -       | -      |
| 24 | *Lyngbya*      | +       | +       | +       | +      |
| 25 | *Chroococcus*  | +       | +       | -       | -      |
| V. bacillariophyta |               |         |         |         |
| 26 | *Discostella*  | +       | -       | -       | +      |
| 27 | *Tabellaria*   | +       | -       | +       | +      |
| 28 | *Diatoma*      | +       | +       | +       | +      |
| 29 | *Synedra*      | +       | +       | +       | +      |
| 30 | *Coconeis*     | -       | -       | +       | -      |
| 31 | *Frustulia*    | -       | -       | +       | -      |
| 32 | *Pleurosigma*  | -       | +       | +       | +      |
| 33 | *Pinnularia*   | -       | +       | +       | +      |
| 34 | *Navicula*     | +       | +       | +       | +      |
| 35 | *Gomphonema*   | +       | +       | +       | +      |
| 36 | *Amphora*      | +       | +       | +       | +      |
| 37 | *Cymbella*     | +       | +       | +       | +      |
| 38 | *Eunotia*      | +       | +       | +       | +      |
| 39 | *Nitzschia*    | -       | +       | +       | +      |
| 40 | *Cyclotella*   | -       | -       | +       | -      |
| VI. protista |                 |         |         |         |
| 41 | *Peridinium*   | -       | +       | +       | +      |
| 42 | *Euglena*      | +       | +       | +       | +      |
| 43 | *Phacus*       | +       | +       | +       | +      |
| 44 | *Lepocinclis*  | +       | +       | +       | +      |
| 45 | *Trachelomonas* | +       | +       | +       | +      |
| 46 | *Diffugia*     | +       | +       | +       | +      |
| 47 | *Arcella*      | +       | +       | +       | +      |
| 48 | *Paramecium*   | +       | +       | +       | +      |
| VII. trochelminthes |             |         |         |         |
| 49 | *Rotaria*      | -       | +       | -       | -      |
| 50 | *Trichocerca*  | +       | +       | +       | -      |
| 51 | *Anuraeopsis*  | +       | +       | -       | +      |
| 52 | *Lepadella*    | +       | +       | -       | +      |
| 53 | *Cephalodella* | -       | -       | +       | -      |
| 54 | *prorocentrum* | -       | +       | +       | +      |
| 55 | *Lecane*       | +       | +       | +       | -      |
Table 2 (continued). Epiphyton on object glass, *Hydrilla, Utricularia*, water at Situ Alam.

| No | Division/genus | Sample |
|----|----------------|--------|
|    | Object glass   | Hydrilla | Utricularia | Water |
| VIII. Arthropoda                      |        |        |            |     |
| 56 | *Bosmina*      | -       | +        | -       | +    |
| 57 | *Acroperus*    | -       | -        | +        | -    |
| 58 | *Pleurotrocha* | -       | +        | -        | -    |
| 59 | sp 1           | -       | -        | +        | -    |
| 60 | sp 2           | -       | -        | +        | +    |
| 61 | sp 3           | -       | +        | -        | -    |
| 62 | sp 4           | +       | +        | +        | -    |
| 63 | sp 5           | -       | -        | -        | +    |
| 64 | sp 6           | -       | -        | +        | -    |
| 65 | sp 7           | +       | +        | +        | +    |
| 66 | sp 8           | -       | +        | -        | -    |
| 67 | sp 9           | -       | +        | -        | -    |

Symbol on table 2: + symbolize present genus and – symbolize not presentable genus.

Data from table 2 were then grouped based on same genus presentable on each sample (table 3). Based on observation (table 3), sp 5 is the only planktonic genus found in water sample. The 31 genera attached to object glass on *Utricularia* sp., and *Hydrilla* sp. were *Gloeocystis*, *Characium*, *Geitlerinema*, *Mougeotia*, *Pleurotaenium*, *Micrasterias*, *Cosmarium*, *Staurastrum*, *Gonatozygon*, *Pandorina*, *Glaucocystis*, *Lyngbya*, *Diatoma*, *Navicula*, *Gomphonema*, *Amphora*, *Cymbella*, *Eunotia*, *Euglena*, *Phacus*, *Lepocinclis*, *Trachelomonas*, *Difflugia*, *Arcella*, *Paramecium*, *Trichocerca*, *Lecane*, sp 4, and sp 7. The 10 genera attached specifically to *Utricularia* sp. and *Hydrilla* were *Prorocentrum*, *Peridinium*, *Nitzschia*, *Pinnularia*, *Pleurosigma*, *Botrococcus*, *Monoraphidium*, *Microspora*, *Scenedesmus*, and *Dictyosphaerium*. Meanwhile, *Triploceras*, *Chroococcus*, *Anuraeopsis*, and *Lepadella* attached to object glass and *Hydrilla* sp. Only genus *Tabellaria* attached to *Utricularia* sp. and only *Discostella* was attached to sample object glasses. The 10 genera attached only to *Hydrilla* sp. were *Bulbochaete*, *Spyrogyra*, *Tettrabaena*, *Spirulina*, *Rotatoria*, *Bosmina*, *Pleurotrocha*, sp 3, sp 8, and sp 9. The 9 genera attached to *Utricularia* sp. were *Gonyostomum*, *Cocconeis*, *Frustulia*, *Acroperus*, *Cyclotella*, sp 2, sp 1, sp 6, and *Cephalodella*. Similiarity between epiphytons on *Hydrilla* sp. and *Utricularia* sp. are compared using Sorensen index.

Based on analysis (table 4), similiarity between epiphyton in *Hydrilla* sp. and *Utricularia* sp. is 77 %, indicating relatively high similarity. Dissimiliarity by 23 % result by different structure of the two plants on the leaves and stems.

Based on observation (table 5), epiphyton on *Utricularia* sp. had higher abundance than epiphyton on *Hydrilla* sp. *Utricularia* lives free-floating on water and shade *Hydrilla*. Sunlight can increase growth rate and photosynthesis of epiphyton and plant [13].

Based on observation (table 6), all samples had low diversity (H’ < 2.302) [14]. Epiphyton on *Hydrilla* sp. had higher genus and diversity than epiphyton on *Utricularia* sp. Leaves arrangement (verticillata) and stem structure of *Hydrilla* are firmer than *Utricularia*, making it suitable for the growth of various microalgae such as diatoms [3]. Result shows diferent diversities (table 7) between epiphyton on both plants (P < 0.05), but there is no difference between abundance of epiphyton on both plants (P > 0.05).
Table 3. Epiphyton genus found at Situ Alam FMIPA UI.

| Sample | Genus found |
|--------|-------------|
| OG     | 1           |
| H      | 10          |
| U      | 9           |
| W      | 1           |
| OG+H   | 4           |
| OG+U   | 1           |
| OG+H+U| 31          |
| H+U    | 10          |

OG means glass object, H means *Hydrilla*, U *Utricularia* sample, W means water.

Table 4. Matrix of sample similarity value based on substrates.

| Object glass | *Hydrilla* sp. | *Utricularia* sp. |
|--------------|----------------|------------------|
| Object glass | 1              | 0.72             |
| *Hydrilla*   | 0.76           | 1                |
| *Utricularia*| 0.72           | 0.77             |

Table 5. Epiphyton abundance on *Utricularia* sp., *Hydrilla* sp., water, and object glass.

| No | Sample          | Mean (0.04 mL) | Mean (1 mL) | Abundance (cell/mL) |
|----|-----------------|----------------|-------------|---------------------|
| 1  | Object Glass    | 161            | 4029        | 3123                |
| 2  | *Hydrilla* sp.  | 1066           | 26673       | 74392               |
| 3  | *Utricularia* sp.| 1738           | 43448       | 84609               |

Table 6. Diversity indices of epiphyton in Situ Alam UI.

| No | Sample      | $H'$ | Genus |
|----|-------------|------|-------|
| 1  | Object glass| 2.2  | 37    |
| 2  | *Hydrilla* sp.| 1.5  | 56    |
| 3  | *Utricularia* sp.| 1.2  | 51    |

Table 7. Different diversity indices of epiphyton in Situ Alam UI.

| No | Sample                              | T-table | t-value | Difference          |
|----|-------------------------------------|---------|---------|---------------------|
| 1  | Diversity of epiphyton on *Hydrilla* and *Utricularia* | 1.96     | 35.1897 | Significant difference |
| 2  | Abundance of epiphyton on *Hydrilla* and *Utricularia* | 1.90     | 1.20    | No Difference       |
Table 8. Physical-chemical water assessment of Situ Alam FMIPA UI.

| No. | Parameter                                      | Sample | Mean  |
|-----|-----------------------------------------------|--------|-------|
| 1   | pH                                            | 3      | 5     |
| 2   | Temperature (°C)                              | 3      | 26.83 |
| 3   | TDS (Total Dissolved solids) (mg/L)           | 2      | 74.80 |
| 4   | TSS (Total Suspended Solids) (mg/L)           | 2      | 17.75 |
| 5   | DO (mg/L)                                     | 2      | 7.02  |
| 6   | Nitrate (mg/L)                                | 2      | 0.0812|
| 7   | Phosphate (mg/L)                              | 2      | 0.0043|
| 8   | CO₂ (mg/L)                                    | 2      | 22.30 |

3.2. Physical-chemical water assessment of Situ Alam FMIPA UI, Depok, West Java
The physical-chemical water assessment of Situ Alam were measured on the sides and middle area of the lake, which represent the condition of the lake. Result showed (table 8) that Situ Alam had acid pH, temperature suitable for Cyanophyta [15], low TSS and TDS, high DO, was an oligotrophic lake [16] and had a tolerable range of CO₂ for Scenedesmus, Spirulina dan Euglena [17].

4. Conclusion
There were 67 genera of epiphytons in Situ Alam FMIPA UI, including 1 planktonic genus (sp 5). Both diversity indices are categorized as low diversity (H’ < 2.302). Result shows different diversities between epiphytons on both plants (P < 0.05), but there is no difference between abundance of epiphytons on both plants (P > 0.05).

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