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THE ABUNDANCE OF KARST-RIPARIAN FOREST IN THE CATCHMENT AREA OF SAMPOLAWA RIVER BAUBAU, SOUTHEAST SULAWESI

La Ode Muhammad Erif[1], and Tjut Sugandawaty Djohan[2*]

[1] Department of Environmental Science, Graduate School of Universitas Gadjah Mada,
[2] Department of Biology, Universitas Gadjah Mada, Yogyakarta 55281, Indonesia.
*Correspondence author: tdjohan95@yahoo.com

ABSTRACT

Riparian forest is a source energy and matter for the aquatic ecosystem. The abilities of riparian forest are to control and recycle the allochthonous inputs from the upland drainage basin and the river itself. This processess are a fundamental aspect of river ecology. We studied the riparian forest in karst ecosystem setting, at the protected forest of Sampolawa headwaters river, Baubau, Southeast Sulawesi. We focussed on the structure and composition of species richness of the forest. Data were collected using quadrate methods, 20mx20m, with 4 replicates placed at each river side. Results reveal that the forest compossed of 7 growth-forms, trees, saplings, seedlings, palm, herbs, liana, and spike moss. The tree species richness of tree and sapling was 33 and 37 species in consecutively. The tree species of *Sphatolobus* sp., *Aglaia silvestris*, and *Canarium asperum* dominated this riparian forest. Similarly the sapling dominance were *Sphatolobus* sp., *Aglaia* sp., and *Chrysophyllum lanceolatum,* as well as the seedlings of *Sphatolobus* sp., *Palaquium obovatum* and *Chrysophyllum lanceolatum*. Thus, the *Sphatolobus* sp. will be the future tree. However, *Anthocephalus macrophyllus* saplings were not found, thus this tree was endangered. Soil nutrients of NO_3, NH_4, PO_4, and C organic were high, which indicated that the litterfall decomposition occurred at the forest riparian floor. The Riparian forest was a primary forest and very diversed in species richnes but had low densities. All the tree, sapling, and seedling species characterized the riparian forest of karst ecosystem at the headwaters of Sampolawa River in the karst ecosystem setting.

Keywords: *Anthocephalus*, karst-riparian forest, headwaters

INTRODUCTION

The protected forest of headwater Sampolawa river is the karst ecosystem in Baubau Sorawolio District of Southeast Sulawesi (Fig.1). Their present is important as a source of allocthonus input in the headwaters of Sampolawa River. The forest is as a densed forest. As a karst ecosystem, this forest is very fragile, therefore their present is protected (Achmad 2011). This proctected forest was composed of tree, sapling, seedling, palm, herbs and spike moss. The riparian forest determined both stream flows and riparian processes as allochthonous input of organic matters for the headwaters of the river (Richardson & Danehy 2007).

As mention earlier, headwaters of the river depends on allochtonous input from the forest as source of organic matters. Therefore, the present forest of Sampolawa is significant to the healthy of this river. Thus in this research we questioned: 1. What was the kinds of species of riparian forest presents and which one was the dominance?, 2. How was the soil quality,nitrate, phosphate, C-organic, pH, soil temperature and soil humidity. The aims were to study the riparian forest at the protected forest of Sampolawa headwater river and also to study the the soil qualities of nitrate, phosphate, C-organic, pH, soil temperature, and soil humidity.

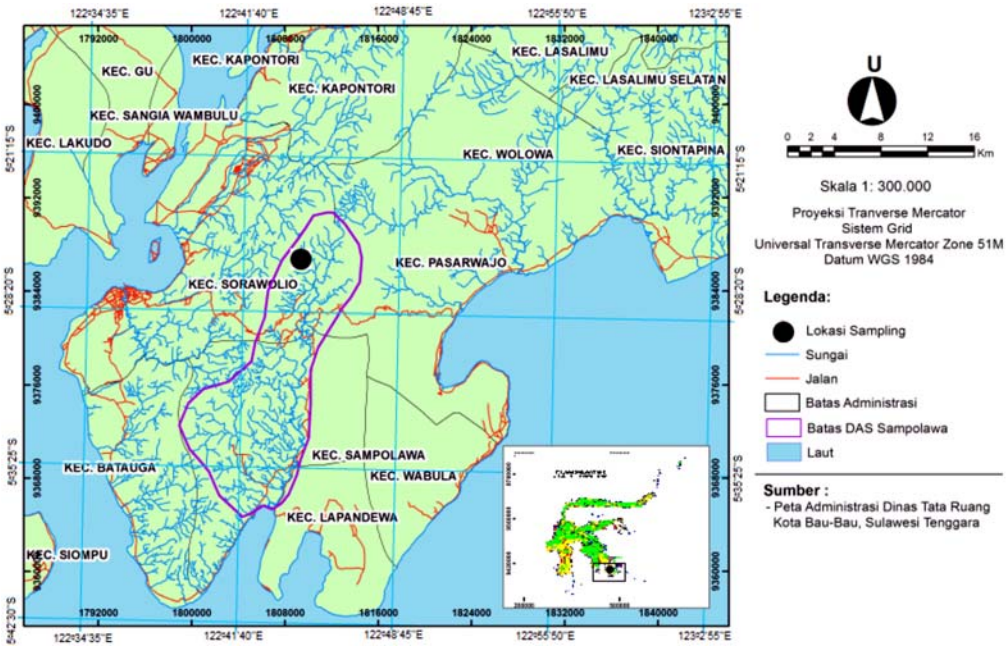

Fig. 1. The study areas at the headwater of Sampolawa River

MATERIALS AND METHODS

Description of the study area

The physiography of Baubau area consists of 3 hills and lowlands, and which has two units of *limestone* and *ultramafic rocks*. The study location was a densed forest at both sides at the riparian forest of Sampolawa River. This riparian forest was part of the protected forest. This protected forest was a primary forest with steep cliff, hilly and mountainous, and which hasd slope between 30^0 - 45^0. The soil structure was sand-clay, stony and calcareous. The air temperatures were between 21 - 26^0C , and soil humidity were between 44% to 85% (BPS, 2008).

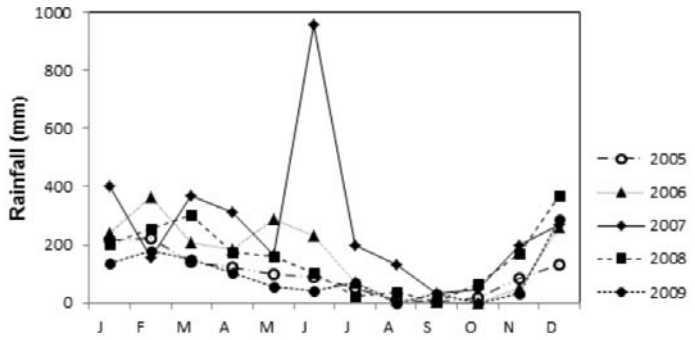

Fig. 2. Annual rainfall of Sampolawa protected forest (BPS 2006-2010).

It was reported that the forest of Sampolawa consisted of Kayu nona (*Metrosideros petiolata*), wola (*Vitex cofassus*), bayam (*Intsia palembanica*), bangkali (*Nauclea orientalis*), rumbei (*Pterospermum colobicum*), angsana (*Pterocarpus indicus*), which were dominant in this protected forest (BPS 2008). In the 2009, the rainfall was 1093 mm per year, with monthly average 273 mm. The highest was in Desember, 288.2 mm, and the lowest at October, 1.0 mm (Fig. 2). Rainfalls were varied between 440 to 0.0 mm monthly, with excepted at

June 2007 was 957 mm. as the tropical rain forest in the karst ecosystem setting. The Sampolawa forest had rain all the time, excepted in the October 2006, there was almost no rainfall. The temperatures were between 21.3-34.5 ^{0}C, and the humidities were between 44 % - 85 % (Stasiun Meteorologi Betoambari 2007).

Data collection

Data vegetation were collected using quadrate plots of 20mx20m with 4 replicates, and was placed at each side of the river at the headwaters. In each plot, the parameter measures were number of individual of species, and diameter at breast height (DBH). These plant species were categoried into the growth-form of tree, sapling, seedling, palm, herb, liana, and spike-moss. From each tree and sapling, we measured the hight and the width. For density of herb, palm and spike moss we used sub-quadrate plot of 2mx0.5m with 5 replicates. The plant specimens were collected for the sientific-name and identifiied at the Laboratory of Forest Conservation, Universitas Hasanuddin, Makassar.

Soil quality

The soil sample was collected as a composite samples from 8 quadrate plots of 20mx20m. The parameter measures were NO_3, and NH_4 using Kyeldahl methods, PO_4^- using Olsen methods, and C organic using spectrophotometry methods. The soil pH, soil temperature, and soil humidity was measured insitu with 3 replicates in each quadrate plots.

RESULTS AND DISCUSSIONS

Growth-form and Species richness

The results reveal that the riparian forest was consisted of 7 growth-forms, trees, saplings, seedlings, palm, herbs, liana, and spike moss with the number of species per 0.32 ha were 33; 37; 35; 1; 1; 3; 1, and 1, in consecutively.

The abundance number of tree individual

Total of d tree densities were 818 tree per 0.32 ha. The riparian-tree dominant was *Sphatolobus* sp., *Aglaia silvestris*, and *Canarium asperum,* 121; 87; 59 indiv. per 0.32 ha inconsecutively, and had basal area of 18.27 m^2 per 0.32 ha (Fig 3). Similarly the sapling dominance were *Sphatolobus* sp., *Aglaia* sp., and *Chrysophyllum lanceolatum,* as well as the seedlings of the *Sphatolobus* sp., *Palaquium obovatum* and *Chrysophyllum lanceolatum*. The *Pterospemum diversifolium, Parkia sumatrana* and *Myristica malaccensis* had very low density each was 3 indiv, per 0.32 ha. The soil nutrient of NH_4, NO_3, PO_4, and C organic contents were relatively low during the dry season in comparison to the rainy season (Fig. 5b). However, these nutrients supported the present of these riparian forest. The present of the spike-moss at the forest floor with coverage almost 85% prevented the litter-fall of the forest carried away by the surface run-off into the river, and these leaved litters decomposed at the forest floor. Therefore, the headwaters of Sampolawa River only received the allochtonous input as fine particulate organic matters (FPOM).

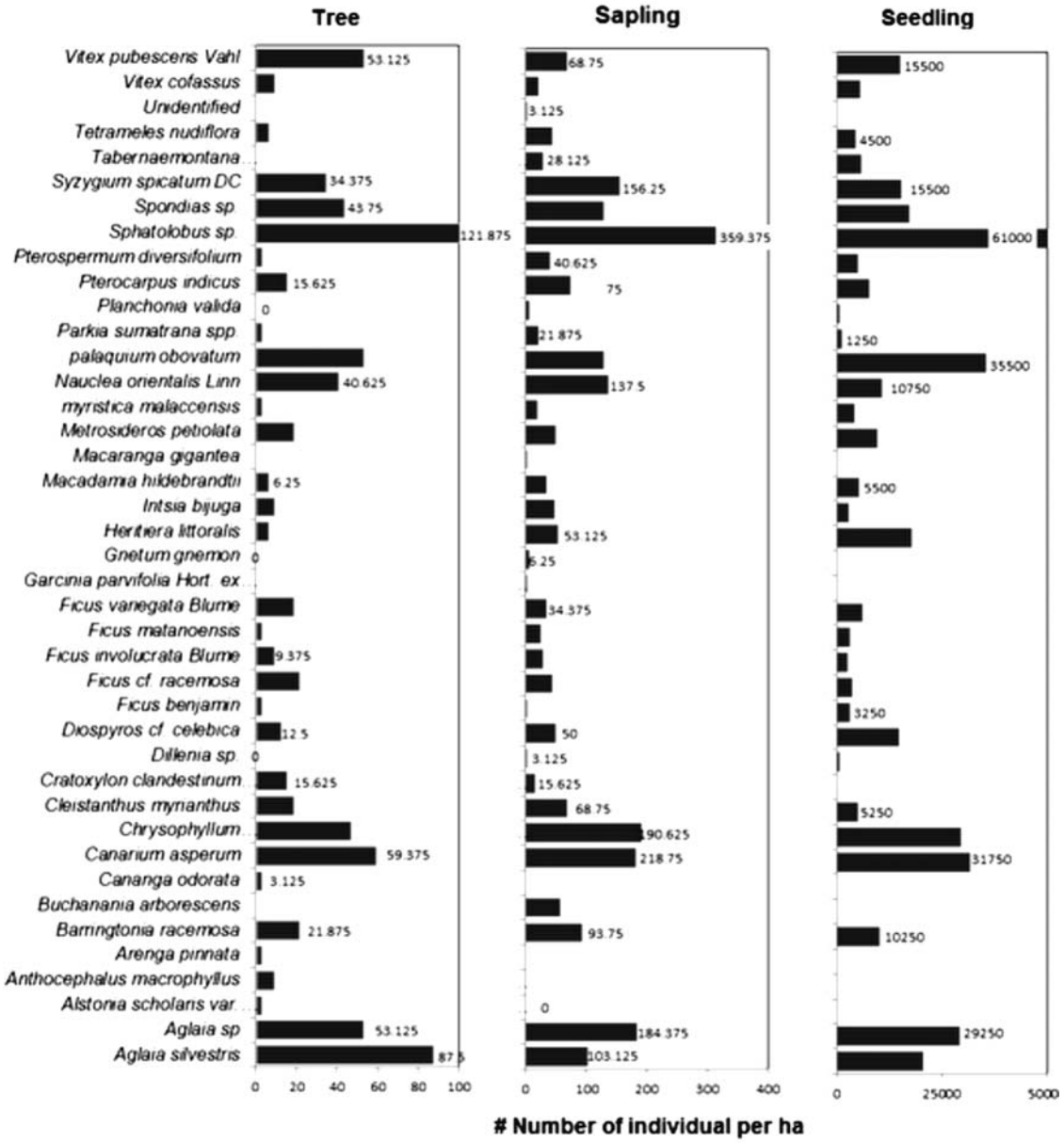

Fig. 3. Number of individual of 41 species trees at riparian-karst forest of headwater Sampolawa River. The dominan of tree, sapling, seedling was *Sphatolobus* sp.

The tree species with high density have good capabilities to adapt to their environment, and also the difference in ability to produce their generation. The tree sapling dominance at the riparian forest of headwaters of Sampolawa was *Sphatolobus sp.,* 359 indiv. per 0.32 ha, and *Canarium aspermum*, 218 indiv. per 0.32 ha. In contrast, the sapling with very low density was *Garcinia parvifolia* dan *Macaranga gigantea*. Their densities were 3 indiv. per 0.32 ha. The low density of *M. gigantea* indicated that the riparian forest at the headwaters of Sampolawa River was in healthy condition. Because the high density of of *M.Gigantea* represented that the forest was disturbed. *Macaranga gigantea* preferred the open areas or gap canopy of the forest, due to either logging or forest fire (Slik et al. 2003; Slik 2005; Zakaria et al. 2008).

Frequency

The frequency of species between quadrate plots were varied between 0.78 – 6.25 % per 0.32 ha. The *Canarium asperum*, *Chrysophyllum lanceolatum*, and *Palaquium obovatum* had high frequency, 6.25 %, and was followed by *Aglaia silvestris*, *Barringtonia racemosa*, *Ficus variegata*, and *Nauclea orientalis* , each was 5.35% (Fig. 4). In Sulawesi, *Palaquium* only had 8 species, but the *P. obovatum* was a common species and widely spread (Pitopang 2012). This was similar to the statement of Ahmad (2011) that *P. obovatum* was one of 7 species indicators of karst forest community at Maros-Pangkep. The indicator species was a plant that repeated found and recognized easily or dominated the forest community. The frequency of species was directly influenced by their density and distribution. At the Sampolawa riparian forest, the lowest frequency represented by the *Arenga pinnata*, *Parkia sumatrana* spp., and *Pterospermum diversifolium,* which each of this species had frequency of 0.89%. Therefore, the highest the frequency of the species, it means that this species had very wide distribution.

Moreover, the species had very high frequency at the riparian forest of Sampolawa, it means that the species had wide tolerance to various environmental factors. The species of riparian forest at headwaters of Sampolawa River had very low frequency values. However this species had very high densities, varied between 33 – 37 plant species with total density of trees and saplings were 3371 indiv. per 0.32 ha. It reveals that this riparian forest at the headwaters of Sampolawa were very site specific at their habitats in karst ecosystem setting. These number of species of specific sites were reflected by the index similarities' Sorenson between plot were 48% - 69%. Due to their site specific habitat which characterized the karst forest ecosystem, therefore, this riparian forest of Sampolawa River are very vulnerable to forest cover-loss.

Dominance

The *Aglaia silvestris* tree had very high dominance, 200 m^2 per 0.32ha, *Canarium asperum* was186 m^2/0.32ha, *Anthocephalus macrophyllus* was 161 m^2/ha, In contrast, the *Cananga odorata* had very low dominance, 2 m^2 per 0.32ha, and *Ficus matanoensis*, 2 m^2 per 0.32ha. It is interesting to notes that, *Anthocephalus macrophyllus* (Maniaga) was the trees which had diameter of 1.2 meter, and 9.38 indiv. per 0.32 ha (Fig. 4). The Maniaga tree (*Anthocephalus macrophyllus*), Robhari (*Nauclea orientalis*), Sahempa (*Pterosperum diversifolium*), and Wola (*Vitex cofassus*) were cultivated tree by the people of Southeast Sulawesi. These trees had high economic values.

The value of dominant tree was calculated based on the basal area of the tree. Therefore, this value depended also to its densities and diameter at breast height (DBH) of the tree or sapling species. Thus dominant tree did not reflect that the forest had high density, because the tree dominance were determined by the tree basal area. Thus, the *Anthocephalus macrophyllus* had density only 9.38 indiv. per 0.32 ha with basal area of 6.44 m^2. In contrast, the *Canarium asperum* had 39 individu per 0.32, but it basal area was 7.43 m^2. The third tree with high dominance was *A. macrophyllus*, although this tree had low density, 9.38 inidiv per 0.32 ha, but its basal area was 6.45 m^2. The seedlings of *A. Macrophyllus* had 250 individu per 0.32 ha, but we did not find any saplings of this tree. It

means that the present of *A. Macrophyllus* for future tree in the riparian of Sampolawa forest was in question, and also why the sapling was not found? The further question was did the Maniaga (*A. Macrophyllus*) had the high mortality of seedlings, or did these seedlings were harvested as a source for cultivated at people orchard? If yes, it means that there were no chance of these seedlings became the sapling trees. It seemed that the *A. Macrophyllus* seedlings were harvested by people, since this tree species had high economic value, and were planted in the orchad. Furthermore, the present of the tree with very high basal areas in headwaters of Sampolawa River, it means that this riparian forest was a primary forest community or undisturbed forest.

Importance value

The *Aglaia silvetris* tree *had* the importance value (iv) was 29.28%*, Canarium asperum*, 25.82%*,* and *Palaquium obovatum*, 17.52%. In contrast, the tree species with low iv was *Ficus Benjamin*, 1.42%, *Cananga odorata* was 1.41%, and *Ficus matanoensis* was 1.40%. The high density of species indicated that this species was found many at almost all the quadrate-studied plots. The high dominant value indicated that the species had very high basal area compared to other species. Thus the important value indicated that the species with high value played significant role in their riparian forest at the headwaters of Sampolawa River (Fig. 4).

Forest floor vegetation

The Growth-form of forest floor vegetation consisted of tree *seedling*, herb, pandan, palm, and spike moss. Their species richness was very low and varied between 1 - 3 number of species (Fig. 5a). However in this riparian forest floor, there were one species of spike moss, *Sellagenella flabellate,* with the number of individual was 14300 per 0.32 ha (Fig. 5a), and their coverage was around 85%. The present of spike moss *S. flabellata* with high density and coverage implied that the litter-falls (detritus) of this forest were stuck in the forest floor and were not carried by the surface run-off away into the river. Thus, the litter fall of the Sampolawa forest decomposed in the forest floor. Therefore, as mentioned before, the allochtonous input from the riparian forest into the headwaters of the Sampolawa River was as fine particulate organic matters (FPOM). The spike-moss in the forest floor of riparian forest at Sampolawa River play significant role in water conservation of the forest, and reflected in the soil humidity was 75%. This humidity was good for the decomposition of the litter fall to occur.

CONCLUSIONS

The riparian forest at the headwaters of Sampolawa River was an undisturbed a karst-primary forest, which consisted of various species with low density. Their present indicated that the tree species was very site specific of karst ecosystem. Thus, the tree species were rare and vulnerable to the forest cover change. Even though, the forest was karst ecosystem, but the present of spike-moss, *Selaginella flabellata*, cause the litter-fall decomposition occurred at the forest floor. Thus, the allochtonous input from this undisturbed primary forest into the headwater Sampolawa River was fine particulate organic matters (FPOM).

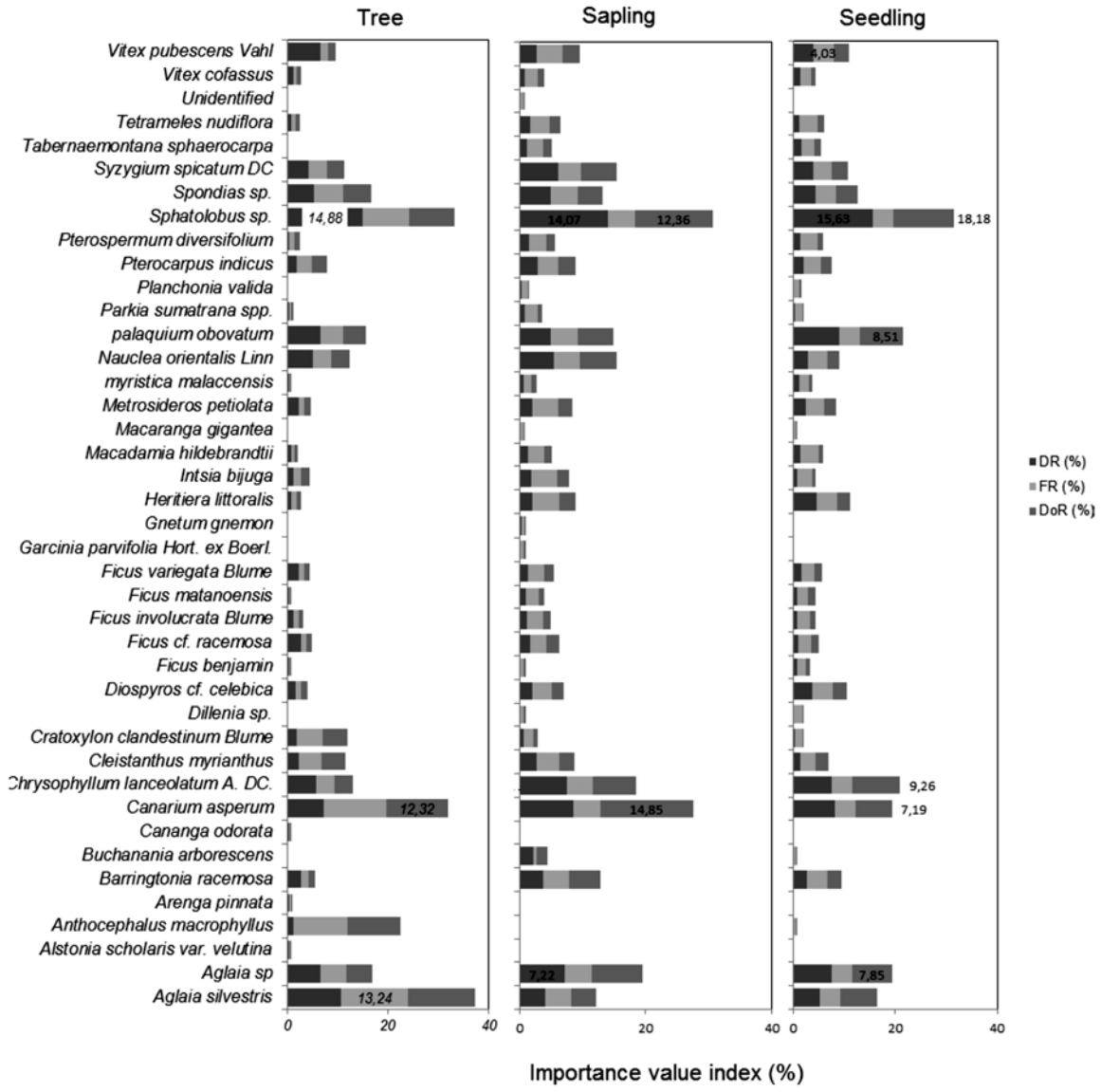

Fig. 4. Important value in the karst-riparian forest of Sampolawa catchment area

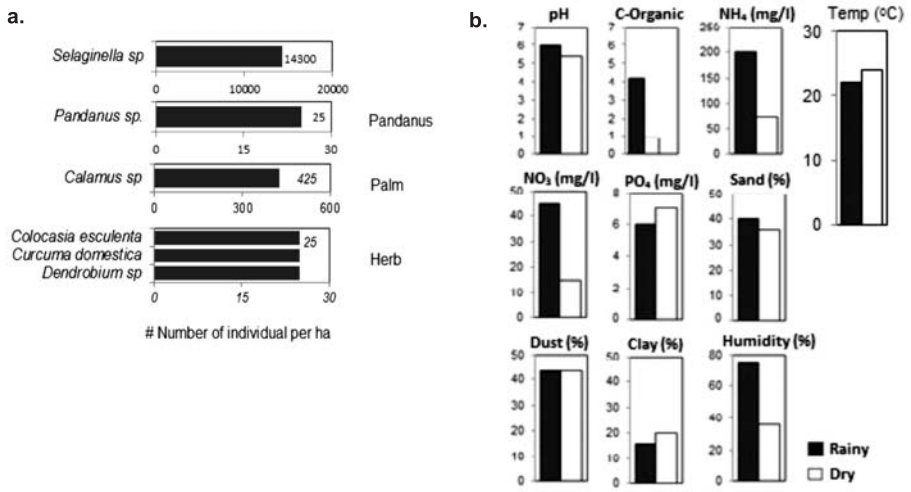

Fig. 5. a. The abundance of forest floor riparian- vegetation in the headwaters of Sampolawa River, and *Sellaginella flabellata* was dominant species; b. Soil qualities, humidity, and temperature at riparian forest of headwaters Sampolawa River.

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