Post-Fire Peat Land Understory Plant in Rimba Panjang, Sumatera, Indonesia

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Abstract: The existence of understory plants during early post-fire succession is essential in term of natural post-fire ecological restoration. More than fifty percent of fire incidents in Riau, Sumatera, Indonesia occurred in shallow peat lands which have the huge impact on vegetation damage. This study aims to explore the understory plants species and diversity in post-fire peat land at Rimba Panjang, Kampar Regency, Sumatera, Indonesia. By using survey method, the observations were conducted on 150 plots which were distributed randomly over four locations based on the year after fire: 2009, 2014, 2015 and 2016. We found respectively 12, 14, 19 and 17 species at that sites with respective Shannon Wiener diversity index were 1.72, 2.00, 2.14 and 2.40. All the sites were dominated by Stenochlaena palustris (Burm.). Coverage percentage of understory vegetation were respectively 28.87%, 25.50%, 51.60% and 54.13%. Overall, we found 31 species of 17 familia. The result showed that the species composition, diversity index and coverage percentage of understory plant are likely to decrease in line with the length of time after the fire. Post peatland fires in Rimba Panjang are still having the characteristics of the peat swamp habitat which was dominated by Stenochlaena palustris (Burm.). Ecological restoration of that habitat is still possible, but it is necessary to consider technological and socio-economical aspects of local communities.

Keywords: Diversity index, Post-fire peat land, Understory plants, Vegetation structure, and Composition.

1. Introduction

Forest and land fires are a potential threat to sustainable development because they directly affect ecosystems. Land and forest fires in Riau not only have local impacts but also have attracted global attention, especially the effects of the smoke they generate. Riau Province has 4,221,000 ha of peat land [1] or 28.31% of the total peat area of Indonesia or about 65.54% of the peat area in Sumatra. During the period of June-October 2015, Riau's burning forest area reached 139 thousand hectares [2]. More than 50% of fire incidents in Riau occurred in peat more than 3 meters [3] which is mainly triggered by the breakdown of order hydrological peat [4].

Post-fire ecosystem restoration is dependent upon the regeneration capacity of plant species [5]. Plant communities with specific composition and structure are formed on burned areas [6]. Moser & Wohlgemuth [7] pointed out that the dominant species can act as 'switches' in vegetation development of forest regeneration determining whether or not can establish.

Soerianegara and Indrawan [8] state that the understory as one of the members of the forest community has an important role in forest ecosystems. The understory plants besides having the ecological function; it has also been used as food, medicinal plants, and an alternative energy source [9]. Lower plants have important ecological functions of degraded lands [10,11]. Lower plants need to be conserved because it has the value of environmental services and productive value [12].

Understory plants in a community are plants that live wild and naturally grow. The presence of lower plants in plantations than as a source of biodiversity also serve to protect the soil and soil organisms, helping to create a microclimate in the forest floor, keep the soil from erosion, and can maintain soil fertility [13]. Continuous surface erosion will dilute nutrients in the top soil layer so that the loss of soil fertility on a stand of plantation forest [14]. The existence of undergrowth on the forest floor can serve as a barrier blow rainwater and runoff so as to minimize the danger of erosion [15].

In addition, lower plants also often used as an indicator of soil fertility and litter producers in increasing soil fertility. In addition to ecological function, some lower plant species have been identified as plants that can be used as food, medicinal plants, alternative energy sources, mix / additional fodder, fertilizer, drinks and bedding for cattle [16].

This study aims to explore the understory plants species and diversity in post-fire peat land at Rimba Panjang, Kampar Regency, Sumatra, Indonesia.

2. Materials and Methods

The study was conducted in January-April 2017 on peatland and forest fire in Rimba Panjang Village, Kampar District, Riau Province (**Figure 1**). The research used survey method through direct observation in the field. Vegetation sampling was done by using purposive random sampling on 150 plots of 4 m^2 were distributed randomly at five different locations based on the length of time after which land and forest fires; 1 year (2016), 2 years (2015), 3 years (2014), 4 years (2013) and 8 years (2009) after the fire. Lower vegetation types and plant cover estimations of each species are recorded on each observation plot. The data were analyzed to determine the Importance Value of each species and the Index of diversity of the lower vegetation at each location according to [17]. As for the identification of species by using identification books [18-22].

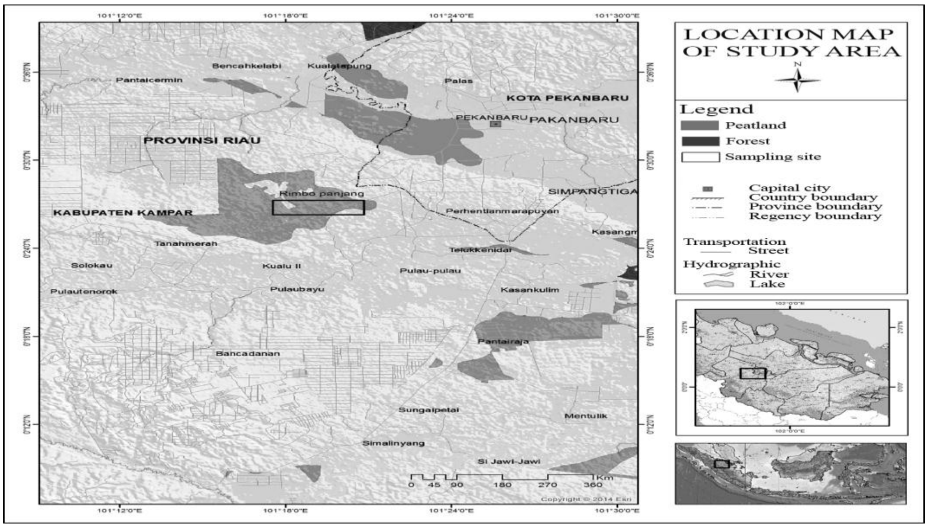

Figure 1. Location of research in the area of the former land of the village land and forest fires of Rimba Panjang-Kampar, Riau Province, Indonesia

3. Results and Discussion

The results of observation of the lower vegetation at 5 observation sites in Rimba Panjang Village showed different species composition and vegetation structure. Overall was found 31 species of understory vegetation from 21 Families (**Table 1**). Based on the composition of the constituent species have been found 5 types of ground vegetation tolerant to environmental changes post land and forest fires which are Stenochlaena palustris (Burm.) Bedd.), Carex phacota Spreng., Melastoma malabathricum L., Cyclosorus sp., Gleichenia linearis Burm., and Dicranopteris linearis Burm. which dominates the observation location.

The development of under vegetation for 8 years after land and forest fires in Rimba Panjang tends to be more fluctuating and dynamic. The number of vegetation types fluctuated from 17 species at the site 1 year after the fire to 12 species at 8 years after the fire. Observation of understory plant in the next 26-230 years after fire at Boreal forest of south east of Canada also showed that the variation of lower plants through a succession of changes is not constant [23]. Instead, Laughlin and Fule [24] reported that the total wealth of species and vegetation cover has not experienced the difference between the area burned and unburned in Grand Canyon National Park. Post-treatment was fire logging Also produced no significant effects on understory vegetation cover, diversity, or community composition 15 years after treatment [25]. Huisinga, et al. [26] states that the composition of the types of locations that burned much different from the location that is not on fire.

Vegetation cover tends to decrease from 54.13% at 1 year after the location of the fire became 28.87% in 8 years after the fire. Decrease in plant cover percentage may be related to light factor. In long-burned peatland, the presence of relatively high trees reduces the light reaching the soil surface so that the growth of understory is relatively slow. The Diversity Index (H ') tends to decrease from 2.40 at the 1-year post-fire location to 1.72 at 8 years after the fire (**Figure 2**). The diversity and abundance of lower plants tend to increase in long-burning sites. Probably this is caused by the opening of the forest canopy to dominate by certain types.

Table 1. Comparison of species Important Value in post-fire peatland, of Rimba Panjang, Kampar District, Riau Province

No	**Species**	**Familia**	**Year of post-fire**				
			2016	**2015**	**2014**	**2013**	**2009**
1	*Stenochlaena palustris* (Burm.) Bedd.	Blechnaceae	**36.44**	**77.53**	**86.68**	**36.06**	**84.48**
2	*Carex phacota* Spreng.	Cyperaceae	**29.67**	**7.81**	13.77	**29.35**	**46.72**
3	*Dianella ensifolia* (L.) DC.	Liliaceae	4.02	-	-	3.95	2.90
4	*Melastoma malabathricum* L.	Melastomataceae	**29.50**	**8.58**	**15.13**	**29.08**	**29.57**
5	*Imperata cylndrica* L.	Poaceae	**24.28**	5.49	-	**23.95**	-
6	*Uncaria* sp	Rubiaceae	-	3.12	-	-	-
7	*Cleome rutidosperma*	Capparaceae	-	**8.20**	3.04	1.74	-
8	*Amaranthus spinosus*	Amaranthaceae	3.83	-	-	3.77	-
9	*Physalis angulata* L.	Solanaceae	1.78	-	-	1.74	-
10	*Physalis minima* L.	Solanaceae	1.96	-	-	2.85	-
11	*Columella discolor*	Vitaceae	-	6.24	-	-	-
12	*Cyclosorus* sp	Thelypteridaceae	**24.51**	**43.00**	**16.05**	**24.24**	**8.35**
13	*Breynia racemosa*	Euphorbiaceae	-	3.55	**19.95**	-	**7.78**
14	*Coelorachis glandulosa*	Poaceae	-	-	-	-	4.64
15	*Gleichenia linearis* (Burm.) Clarke.	Gleicheniaceae	6.93	6.69	**14.79**	6.80	4.06
16	*Dicranopteris linearis* (Burm.)	Gleicheniaceae	6.60	4.32	4.74	6.49	3.48
17	*Nepenthes gracillaria*	Nepenthaceae		4.19	7.39	-	2.90
18	*Cyperus rotundus* L.	Cyperaceae	9.05	2.47	-	8.90	2.56
19	*Ipomoea obscura* L.	Convolvulaceae	-	-	-	-	2.56
20	*Uncaria* sp.	Rubiacee	6.10	-	-	6.00	-
21	*Dicranopteris linearis* (Burm.)	Gleicheniaceae	5.46	-	3.43	5.38	-
22	*Nepenthes ampullaria*	Nepenthaceae	5.34	1.08	-	5.25	-
23	*Leersia hexandra* Swartz.	Poaceae	2.27	4.32	-	2.23	-
24	*Paspalum conjugatum* Berg.	Poaceae	2.27	-	-	2.23	-
25	*Zingiber* sp.	Zingiberaceae	-	-	6.13	-	-
26	*Arundina* sp.	Orchidaceae	-	1.08	4.08	-	-
27	*Piper* sp.	Piperaceae	-	-	3.43	-	-
28	*Zingiber* sp.	Zingiberaceae	-	-	1.39	-	-

29	*Nephrolepis biserrata* Sw. Schott.	Nephrolepidaceae	-	6.30	-	-	-
30	*Cyperus iria*	Cyperaceae	-	3.74	-	-	-
31	*Smilax* sp.	Smilacaceae	-	2.28	-	-	-

Our study has found six importance major vegetation types in 5 locations observation post land and forest fires (Figure 3). *Stenochaena palustris* is a type of fern that grows climbing or creeping, smooth trunk, branching and roots along the stem attached to the supporting tree or on the ground. Spread over tropical Asia, Polynesia and Australia. Found near freshwater, brackish water, tidal forest, in sandy soil and especially along the river banks and water sources. The rod is very strong and not easily broken so it can be used as a strap. The young leaves are eaten as vegetable [27].

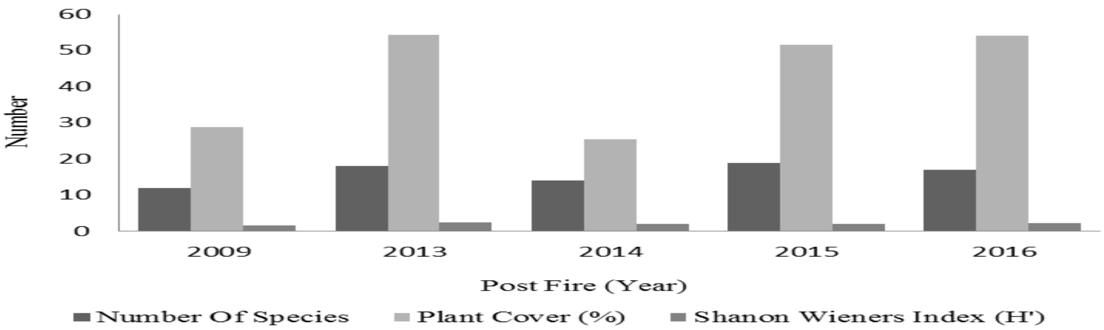

Figure 2. Comparison of species, vegetation cover and vegetation diversity index at five locations under observation

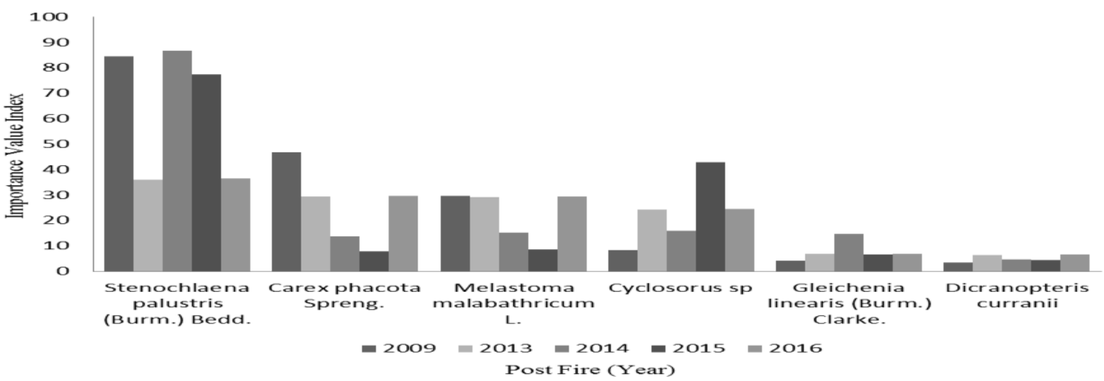

Figure 3. Comparison of Importance six major vegetation types in 5 locations observation post land and forest fires

Carex phacota Spreng is a herb that grows erect, 0,08-1,5m, triangular rods, sharp, long leaves wake up lines with sharp edges, inflorescence in panicles. In Java grow growing at an altitude of 1500-2500 meters above sea level in the wetlands [20] Other types namely *Carex baccans* grown in mountainous areas, especially along the edge of 1100-2400 meters above sea level in the forests and shrubs that shade. Other types of *Carex remota* found in damp places and marsh illuminated in full sunlight [27]. Melastoma species a shrub, upright, high reaches 4 m. In Java, they grows at an altitude of 10-1650 above sea level especially in the field and open areas that are not too arid and sandy. The young shoots and fruit can be eaten [27].

4. Conclusion

The species number, vegetation cover and Vegetation Diversity Index fluctuate and tend to decrease from the first year until the eighth year after the fire. We found respectively 12 (2009**)**, 14 (2014), 19 (2015) and 17 Species (2016) at that sites respectively. Shannon Wiener diversity index were 1.72, 2.00, 2.14 and 2.40. All the sites were dominated by *Stenochlaena palustris* Burm.. Coverage percentage of understory vegetation were respectively 28.87%, 25.50%, 51.60% and 54.13%. Overall, we found 31 species of 17 familia. The result showed that the species composition, diversity index and coverage percentage of understory plant are likely to decrease in line with the length of time after the fire. Post peatland fires in Rimba Panjang are still having the characteristics of the peat swamp habitat.

The types of ground vegetation that can survive and are considered tolerant to changing environmental conditions is *Stenochlaena palustris* Burm., *Carex phacota* Spreng., *Melastoma malabathricum* L., *Cyclosorus* sp., *Gleichenia linearis* Burm. *Dicranopteris linearis* Burm. *Stenochaena palustris*, *Carex phacota* and *Melastoma malabathricum* tend to become dominant and achieve stable for 8 years after the fire. Ecological restoration of that habitat is still possible, but it is necessary to consider technological and socio-economical aspects of local communities.

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