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NATURAL REGENERATION OF POST FIRE LOWLAND TROPICAL FORESTS IN THE GRAND FOREST PARK SULTAN THAHA SYAIFUDDIN JAMBI

NURSANTI[1)], ZUHRATUS SALEH[2)] AND MARIA ULFA[1*)]

[1)]Fakultas Pertanian, Jurusan Kehutanan, Universitas Jambi, Jl. Raya Jambi-Muara Bulian KM.15, Mendalo Darat, Jambi 36361, Indonesia
[2)]Balai Konservasi Sumber Daya Alam Jambi, Jl. Arief Rachman Hakim No. 10B Lantai II, Telanaipura, Jambi 36122, Indonesia

**Email: maria.ulfa@unja.ac.id*

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ABSTRACT

Indonesia's lowland tropical rain forests are rich in endemic species. One of the problem is lowland forests often experience degradation due to excessive exposure and forest fire. Sultan Thaha Syaifuddin Grand Forest Park or Tahura STS is a part of tropical lowland forests which often experience fires, thus reducing its quality so it needs to be restored with regeneration efforts. The purpose of this study is to get data and information about the potential for lowland forest regeneration in Tahura STS after forest fires. This research was conducted for 8 months from March to October 2021 with location in Tahura STS and Jambi University. Researchers were carried out by making a 20x20 meter nested plot placed on 5 transects along 300 meters for each transect. Each transect contains 6 plots with a placement of 50 meters between plots. From research in the field obtained as many as 143 plant species from various growth stages ranging from seedlings, stakes, poles, trees and basic ground vegetation. Analysis of the Shannon-Wiener diversity index showed that the plant diversity in the STS Tahura was high (Seedling: 3.77; Sapling: 3.28; Tree: 3.17) to moderate (Pole: 2.11). The evenness index shows that the plant community in Tahura STS is a stable community. This early stage research shows the conclusion that the potential for regeneration with natural regeneration in the STS Tahura is very possible. This hope will be realized if the existing forest destruction process is reduced and eliminated.

Key words: *Diversity, forest fire, forest regeneration, lowland forest, Tahura STS*

INTRODUCTION

Tropical forests have various types of large woody trees that have very high economic value. As a result, the tropical rain forest has decreased its total area which is estimated at around 16.9 million hectares/year. This is not only the need for wood production but also because of environmental changes that are decreasing (Kobayashi, 1994). Currently, tropical rain forests are in a state of danger because they are still being damaged so that most of these forests are experiencing rapid extinction. This happens due to illegal logging and forest fires that often occur (Tamin *et al.,* 2019; Tamin *et al.,* 2021). This process occurs due to a lack of government oversight and public awareness of the function of the forest. Forests as an ecosystem unit must be managed and treated comprehensively and not only paying attention to one aspect (Goldsmith *et al.,* 2006).

The management of tropical secondary tropical forests which are rapidly developing around the world will be one of the key factors in conservation. The fast-growing, short-lived and softwood of secondary tree species have attracted many ecologists (Richard, 1976). Brown & Lugo (1990) re-explained the species richness, primary productivity and nutrient cycle of a secondary tropical forest ecosystem, and also provided an overview of the structure and function of the ecosystem. The regeneration process, however, is greatly influenced by local conditions so that data analysis of the regeneration process takes a long time (Kohyama *et al.,* 1994; Yoneda, *et al.*, 1999).

Seeedlings and saplings are the beginning of a regeneration process in an ecosystem where the process is strongly influenced by the level of disturbance to the ecosystem. Knowledge of the ecology of saplings is vital. Not only for understanding the community processes of new and succession but also for developing strategies for the conservation of biodiversity and restoration of tropical forests (Kuusipalo *et al.,* 1996; Khurana & Singh, 2001). Knowledge of natural regeneration, especially from several potential species, will be very helpful in predicting future forest changes (Gutierrez *et al.*, 2004; Tamin *et al.,* 2021).

Sultan Thaha Syaifuddin Grand Forest Park (Tahura STS) is one of the Tahura in Indonesia located in Batanghari Regency, Jambi Province. Tahura STS was established based on the Decree of the Minister of Forestry Number: 94/kpts-III/2001. The consideration for establishing this area as a Tahura was to protect exotic and endemic flora and fauna that are nearing extinction. Tahura STS is known for its distinctive feature, namely the habitat of the bulian plant (*Eusideroxylon zwageri*) in the area. Tahura STS administratively is surrounded by several villages, namely: Bungku Village, Pompa Air, Mekar Jaya, Singkawang, Tenam, Jebak, Ampelu, Jangga Baru, Bulian Baru and Sridadi Village (Budiandrian *et al.*, 2017).

Tahura STS is a forest area that is often hit by fires so that the potential of the area cannot be maximized and used properly. The Tahura STS recently experienced severe fires in 2015 and 2019. Nursanti & Adriadi (2018) reported that there are many invasive alien plants species that grow in areas where forest fires were affected, so it is feared that they will disrupt the function of forest areas in the future.

As a conservation area, efforts need to be made to maintain the function of the forest. One of the efforts that can be done is to find out the natural succession and regeneration processes that occur in the burned forest so that the restoration and rehabilitation efforts that will be carried out have a strong scientific basis. In this case, the formulation of the objectives in this research that was raised was to find out how the structure and composition of plants in burnt areas directly adjacent to unburned forest areas and how many species were identified as seed banks/natural tillers and seed soil banks/seeds in the forest land in Tahura STS.

RESEARCH METHOD

This research was carried out for 8 (eight) months from March to October 2021. This research was carried out in the Sultan Thaha Syaifuddin (Tahura STS) Forest Park, Batang Hari Regency and further analysis was carried out in Forest Management Laboratory, Herbarium and Nursery of Forestry Department, Faculty of Agriculture, Jambi University.

Administratively, Tahura STS is located in Batanghari Regency, Jambi Province. THRSTS was previously a forest production area. Based on the Ministerial Decree Forestry Number : 94/Kpts-II/2001 dated March 15 2001 with a land area of ± 15,830 ha, the area turned into a Grand Forest Park. Geographically, Tahura STS is located between 1º 47' 55"- 1º 57' 31" South Latitude and 103º 08' 30"-103º 16' 40" East Longitude. The topography is a hilly area with an altitude ranging from 11-500 m above sea level with a partially undulating and partially flat landscape. The average monthly rainfall ranges from 175 mm to 222 mm with an average daily air temperature of 28oC. The dominant soil types were red-yellow podzolic (70%), some alluvial (18%), granosol (3.24%) and others (8.58%). Tahura STS area is included in four sub-districts, namely Muara Bulian District, Bajubang District, Muara Tembesi District and Batin XXIV District (Nursanti and Adriadi, 2019). Administratively, Tahura STS area has the following regional boundaries:

- North side: Bordered by Muara Bulian District
- South side: Bordered by Bajubang District, and XXIV Batin District
- East side: Bordered by Bajubang District
- West side: Bordered by Muara Tembesi District and Batin XXIV District.

Tahura area of Sultan Thaha Syaifuddin is in the middle of the capital of Batanghari Regency, namely the city of Muara Bulian, with road access that connects Muara Bulian with several other villages around the Tahura area. The distance from Muara Bulian City to the location of Tahura STS area is about 17 kilometers with a travel time of 50 minutes. Only 10% of Tahura's area is still forested, it is located in section 15 around the Tahura Integrated Service Unit (UPTD) office (Figure 1). The forest area of the Sultan Thaha Syaifuddin Grand Forest Park has been encroached on by the community as agricultural and plantation land. Rubber and oil palm plantations are almost 70% of the area of Tahura. Critical land is about 18% of the area due to forest fires and land that is intentionally burned by the community to open plantation land by stakeholders. In the Tahura area there are also residential areas of about 2% of the area of the Tahura area and the people who live in that forest area use the plants as medicine (Albayudi & Saleh, 2020). Besides that, the condition of springs such as lakes and swamps has been surrounded by critical and damaged forest conditions (Batanghari District Forestry Service, 2016). In general, the land cover condition of the STS Tahura is dominated by shrubs which appeared mainly due to repeated fires in 2015 and 2019 (Figure 2).

In this study, the tools and materials used were in the form of stationery (pens and books), handphone cameras for documenting the data results, cuttings, plastic, label paper, pencils, newsprint, Global Positioning System (GPS) Garmin Map 64S, ropes and measuring tapes are used for field activities. The materials used in the collection of samples are tally sheets, materials that have the characteristics of plant organs and 70% alcohol as a preservative.

Sampling in the field using the field exploration method. For example, the unit placement method uses a systematic method with a position of 150 meters towards the forest and 150 meters out of the forest where the starting point is the edge of the forest so that one path will contain 6 observation plots with a length of 300 meters and carried out as many as 5 lanes. Observation plots for tree stages (20 m x 20 m), for pole observation (10 m x 10 m) and for sapling stages (5 m x 5 m) was established in form of nested plot while seedling observations will be carried out on plots measuring 2 m x 2 m which are placed at each corner of the observation plot.

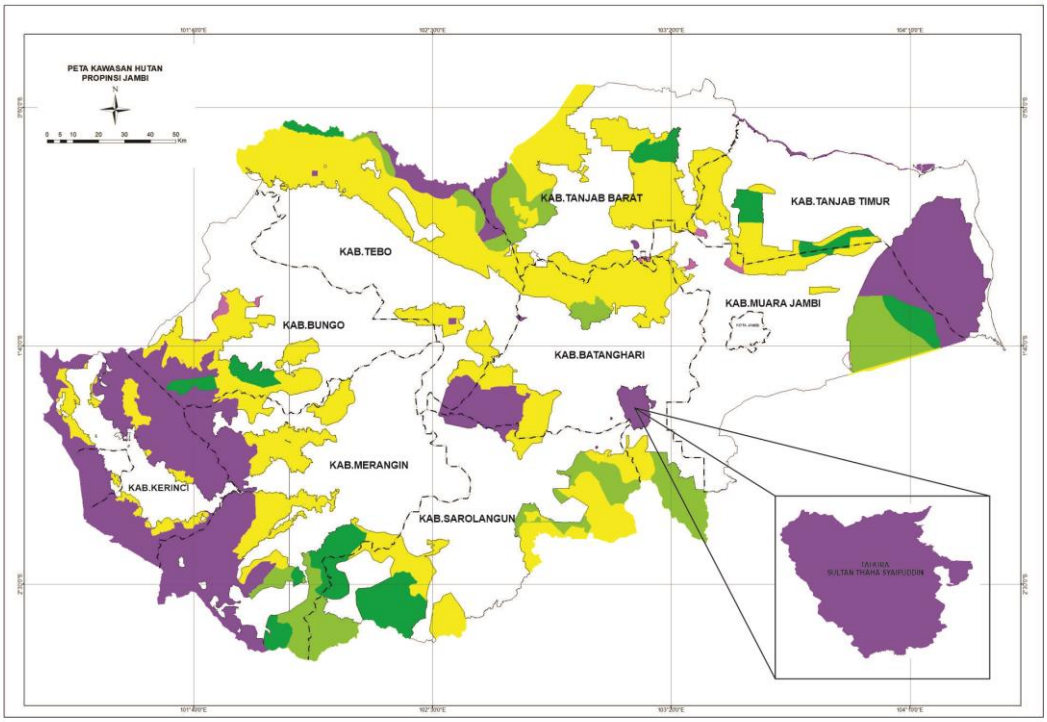

Figure 1. Research Site Map

Figure 2. Conditions of Tahura STS landscape after 2019 forest fire

The diversity index uses the following formula (Indriyanto 2006) :

H' = $\sum_{t=1}^{s}(pi)\ln pi$

H' = Shannon diversity index
S = number of species
Pi = the proportion of the number of individuals I
Ln = log natural

The range of diversity index values is H'≤1 = low diversity, 1≤H'≤3 = moderate diversity, H'>3 = high diversity. Meanwhile, the evenness index is determined by the formula (Indriyanto, 2006):

J = H'/ln(S)
J= Evennes index

H'= Diversity index

S= number of species

The evenness index criterion is if 0<J<0.5 then the community is depressed, if 0.5<J<0.75 then the community is unstable and if 0.75<J, then the community is stable.

The similarity index uses the following formula (Indriyanto, 2006):

IS= 2C/A+B

IS : Similarity/Similarity Index

C : The same number of species and found in two communities

A : Number of species in the community A

B : Number of species in the community B

The criteria for community similarity refer to Adelina *et al.*,(2016) as follows:

1-30%= Low category

31-60%= Medium category

61-90%= High category

>91%= Very high categoryn.

RESULT AND DISCUSSION

Based on the results of the vegetation analysis conducted at the research site, a total of 139 species of plants from various growth stages were obtained, starting from seedlings, saplings, poles and trees. Furthermore, the plant species were separated and analyzed based on their growth stage.

Analysis data for the seedling and basic vegetation stages were obtained from 120 plots measuring 2x2 m or with a total sampling area of 0.48 Ha. In the exploration results obtained as many as 1,270 individuals from 117 plant species. There are several types that are quite commonly found, such as kesit rimbo, keramunting and senanit. The data for the sapling stage comes from 30 observation plots measuring 5x5 so that the area is 0.075 Ha. Based on the exploration results, 50 plant species were found at the sapling stage with a total of 228 individuals. The data analyzed for the pole stage came from 30 observation plots with a size of 10x10m so that an area of 0.3 Ha was obtained. Based on the exploration results obtained as many as 13 species of plants with a total of 45 individuals. The data analyzed for tree stadia came from 30 observation plots with a size of 20x20 m or with an area of observation 1.2 Ha. Based on the exploration results found 40 species of trees with the number of individuals as many as 97 individuals. The 5 plant species with the highest important value index (IVI) in every growth stages are presented in Table 1.

From the contents of Table 1, it can be seen that the seedling observation plots were mostly filled with ground vegetation in the form of grass and shrubs such as senanite, kesit rimbo, keramunting and lisau. Of the top 10 seedlings with the most individuals, only balam sundik and mengkirai were included in the seedling category. There are seedlings that come from several other tree species such as bulian/ironwood (*Eusideroxylon zwageri*), jangkang (*Xylopia* sp.), berangan (*Castanopsis* spp.) and siluk (*Gironniera nervosa*) but there are not many of them so that they do not enter into the 10 species with the most individual seedlings.

It can be seen that in the sapling phase, many saplings have been found that have grown to the sapling phase. There are many individuals of the bulian saplings as the main icon of Tahura STS. There are also other species that are known to be frequently found in forest ecosystems that are undergoing early stages of succession, such as mengkirai and semantung. Mengkirai also identified in previous research (Aciana et al., 2017; Nursanti & Adriadi, 2018) and grouped into pioneer trees that play a role in the early stages of forest regeneration.

Tempinis (*Sloetia elongata*) became the dominant plant in trees stages plot followed by bulian/ulin/ironwood. The discovery of bulian is also evidence that bulian does live and grow and develop in the STS Tahura area. The small number of species and individual trees found was also influenced by the location of the plots, half of which were in an open condition.

The data in Table 2 shows that the diversity index at the seedling, sapling and tree stages is in the high category (values >3) while the pole stage is at the moderate category (value 1-3). Furthermore, it is also seen that the evenness index of all stages of growth shows a value above 0.75 which means that the community is in a stable condition (Indriyanto 2006).

Similarity indes is used to analyze the similarity of communities from two different habitat types. In this study, plant habitats were divided into open burnt land and secondary forest that still had tree stands. The results of the similarity index are shown in table 3 below. The results of the analysis show that the similarity index between two different habitats is at 0.33 according to the criteria used for the similarity index (Adelina *et al.,* 2016) where this value is in moderate/medium criteria.

The results of the study also showed that the open land habitat after the fire was dominated by pioneer tree species (mahang/*Macaranga* spp., balik angin/kedumpuk/*Mallotus* sp., mengkirai/*Trema orientalis*) which served as the beginning of succession. Several species of invasive categories such as acacia (*Acacia* spp.), alang-alang (*Imperata* cylindrica) and senduduk bulu (*Clidermia hirta*) are also quite a lot found in this location. Several species of the acacia group have long been known as invasive species and population development must be considered, especially in conservation areas. *Acacia nilotica* has long been known to be an invasive species and is one of the main problems in managing the Baluran National Park conservation area (Zahra *et al.*, 2020). Meanwhile, in this Tahura STS, *Acacia mangium* population development became concerning. This type has always appeared in previous research (Nursanti & Adriadi, 2018; Nursanti & Adriadi, 2019) and this is an indication that this species will spread in Tahura STS area.

Table 1 5 (Five) species with the highest important value index in the growth stage of seedling, sapling, poles and trees.

No.	Local name (seedlings)	Scientific name	Number of individuals	Important Value Index (%)
1.	Senanit	*Scleria sumatraensis*	219	25.99
2.	Keduduk Rimbo	*Clidermia hirta*	182	23.30
3.	Keramunting	*Rhodomyrtus tomentosa*	120	16.23
4.	Lisau		103	14.46
5.	Amplas Kijang	*Tetracera scandens*	66	8.26
No.	Local name (saplings)	Scientific name	Number of individuals	Important Value Index (%)
1.	Mengkirai	*Trema orientalis*	81	48.66
2.	Amplas Kijang	*Tetracera scandens*	20	13.82
3.	Bulian	*Eusideroxylon zwageri*	13	12.77
4.	Lisau		14	10.18
5.	Tempinis	*Sloetia elongata*	9	8.99
No.	Local name (poles)	Scientific name	Number of individuals	Important Value Index (%)
1.	Bulian	*Eusideroxylon zwageri*	8	86.47
2.	Tempinis	*Sloetia elongata*	6	78.53
3.	Kayu Lilin		2	22.90
4.	Kedumpuk	*Mallotus* sp.	2	18.85
5.	Siluk	*Gironniera nervosa*	2	18.81
No.	Local name (trees)	Scientific name	Number of individuals	Important Value Index (%)
1.	Tempinis	*Sloetia elongata*	13	75.63
2.	Berangan Babi	*Castanopis* sp.	4	18.24
3.	Bulian	*Eusideroxylon zwageri*	5	15.95
4.	Bakil	*Artocarpus* sp.	3	12.65
5.	Bayung	*Dacryodes laxa*	3	11.94

Table 2 Diversity Index and Evennes

Growth Stages	Number of species	Diversity Index	Evennes
Seedling	114	3.77	0.79
Sapling	50	3.28	0.84
Pole	13	2.11	0.82
Tree	42	3.17	0.85

Table 3 Similarity index

Number of species in open burnt land (A)	Number of species in secondary forest (B)	Number of species found in both habitats (C)	Similarity Index (2C/A+B)
72	99	28	0.33

In secondary forest habitat, there are species that are quite promising in the regeneration process. At this location, bulian/ironwood (*Eusiderixylon zwageri*) was found at all stages of growth. Various types of forest trees such as jangkang (*Xylopia* sp.), jelutung (*Dyera costulata*), balam (*Palaquium* spp.), kelat (*Syzygium* spp.) and medang (*Litsea* spp.) are also still found. These various types of trees are typical of lowland tropical forests (Nursanti & Hardiyanti, 2020), so they have great potential as mother trees in efforts to regenerate natural forests and with human assistance (Tamin *et al.,* 2019; Tamin *et al.,* 2021). The potential for natural regeneration can also be seen from the number of forest tree species found in both habitat types. Of the 28 species found at both locations, 21 of them were forest trees. Species such as bulian, jering/jengkol (*Archidenderon pauciflorum*) , kelat and medang were also found in the burnt area as seedlings, indicating that the natural regeneration process had actually occurred.

CONCLUSION

Based on the results of this study, it can be concluded that the STS Tahura still has a high number of species, which can be seen from the value of H' which indicates a moderate value in the pole phase (H'= 2.11) and high value in the seedling (H'= 3.77), sapling (H'= 3.28) and tree phases (H'= 3.17). There were 28 plant species which were both found growing in burnt areas and secondary forest areas. This result is an indication of regeneration in Tahura STS naturally. is to keep this process uninterrupted. The disturbances such as repeated forest fires must be avoided, as well as population management for invasive species must be carried out continuously so that all natural regeneration efforts do not fail.

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