The impact of fire in palm oil estate on the bird and butterfly species diversity: case study in RAJ Oil Palm Estate, South Sumatera

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Abstract. RAJ oil palm is one of the oil plantation estates in South Sumatera that experienced land fires in 2018 with the burning estimated around 110 ha, and are believed to have a negative impact reducing on species diversity of birds and butterflies in the area. The study was conducted to identify and analyze the comparison of species diversity of birds and butterflies, loss and gain of the species in burnt and unburnt areas after one year of fire. Data collection was carried out in two types of land cover (grass and gelam) in pairs for burnt and unburnt lands after one year of fire. To inventory, the birds and butterfly species were done at the active time of animals, by using strip transect method, parallel in burnt and unburnt areas with a total of 3 repetitions in each type of land cover. The estimation of the impact was obtained by reckoning the loss and gain of birds and butterfly species from the burnt and unburnt area, the level of species richness, evenness, and similarity. The results showed that the total number of animal species found in both observation lines for each type of land cover (grass and gelam) for unburnt and burnt areas were 29 species of birds and 6 species of butterflies. Generally, it can be stated that the values of H and Dmg for birds were relatively greater in the burnt area compared to in the unburnt area. On the contrary, the values for butterflies were greater in the unburnt area than in the burnt area. The percentage of species loss for the bird was smaller than the gain in the burnt area compared to unburnt land, 24% of species loss and 28% of species gain in the grassland, and 14% of species loss and 33% of species gain in the gelam land. For butterflies, the percentage of species loss was relatively greater than the percentage of species gain due to fire, 67% for the species loss and 33% for the species gain.

Keywords: Impact of fire, Palm Oil Plantation, Bird and Butterfly Species Diversity, Species Loss and Gain.

1. Introduction

One of the interesting issues when we talk about forest land and environmental problems is the development of oil palm plantations because it is related to a general opinion that oil palm plantations cause habitat destruction and loss, as well as biodiversity loss in the tropics [1]. Another issue that is most highlighted about oil palm plantations is the issue of fires that often occur on oil palm lands. The expansion of oil palm plantations is considered as one of the factors causing the occurrence of land fires
that occurred in Indonesia in the last few decades [2]. Besides that, land fires are a routine event in Indonesia, even according to data from the Ministry of Environment and Forestry showing that the area of forest and land fires in Indonesia in 2018 reached 4,666.39 hectares [3]. One area of oil palm plantations that experienced a fire in 2018 is the RAJ oil palm plantation in South Sumatra with an estimated area of burning area of 110 hectares or according to estimates of the Ministry of Environment and Forestry even reaching 500 hectares. Generally, forest and land fires can directly or indirectly have a negative impact on environmental quality and are also strongly suspected of having an impact on biodiversity at the location of the fire and post-fire. Goodman and Mulik (2015) states that fires increased air pollutants, caused health decrease and respiratory disturbances, economic losses, decreased biodiversity, and even death [4]. Reference from WWF also states that forest and land fires have negative impacts such as climate change, disrupt human health, harm the country economically and eliminate wildlife habitat [5], and also cause direct death in wildlife [6], but in another case, fires have a positive impact on increasing land productivity because it can destroy pests, stimulate dormant shoots and help spread seeds [7]. Land fires are also considered to be able to influence the succession process which will have an impact in the form of changes in vegetation [8].

Based on the theory of adaptation and habituation of wildlife, basically, every type of wild animal will adapt as part of efforts to maintain its life when facing changes in environmental conditions. Therefore, it is strongly suspected that at the time of the fire many of the wild animal species that have the ability to mobilize will move places to other habitats to avoid these fires. Meanwhile, for wild animals that have limited mobilization or movement, it is expected to experience death threats from the fire or may be able to survive in the habitat. In addition, after a fire, naturally, the condition of the former fire habitat will undergo an ecological recovery process with the growth of new plant species and gradually the wild animals will respond to changes in these conditions by re-utilizing the former fire area as their habitat. Under these conditions, there is the potential for new wild species (gain) to make the former fire habitat their habitat. In the perspective of the ecological situation as above, it can be stated that besides fires can have a negative impact on the potential loss of diversity of wildlife species, there is also the potential of species that are able to survive in these habitats and may even have the potential gain of new types of wildlife that make the former fire area as their habitat. As a case example, a research states that after a fire, insects such as butterflies can adapt in response to environmental changes [9]. Furthermore other research mentions that butterflies are insects that have strong flight capabilities with large wings so that they can respond quickly to changes in vegetation after fire [10].

To prove the hypothesized ecological phenomenon as in the case of the butterfly, it is important to conduct a comprehensive study. To see the extent of changes that occur in the potential loss, gain or change in the composition of the population due to and after a fire. The results of this study can also be practically used as a more scientific and fair reference in establishing lawsuits at a company where the concession area has experienced a fire as in the case of the RAJ oil palm plantations. Based on that explanation, this research was conducted with the aim of identifying and analyzing the comparison of diversity and composition of birds and butterfly species, loss and gain of the species in the burnt area and unburnt area after one year of fire.

2. Research Method

Data were collected at the RAJ oil palm plantation in the area of Kayu Agung District, Ogan Komering Ilir Regency, South Sumatra. The time of data collection is 10 days (August 29 - September 9, 2019). Data collection was carried out one year after the fire in two types of land cover in pairs for post-burn land and unburnt land, each in pairs for grass and gelam land cover type (Figure 1).

In each type of land cover in pairs, an observation strip in the form of a transect strip was made (Figure 2), respectively for bird inventory (lane length 1 km and width 100 m), and butterfly inventory (lane length of 1 km). Data were collected at the active time of animals: at 06.00-08.00 and 16.00-18.00 for birds, and at 09.00-11.00 for butterflies, with three observations respectively. For the purposes of identifying and recognizing species of animals, several individual animals were captured using nets and...
traps for butterflies. To help introduce species of animals directly in the field, a guidebook for birds was used [11]. For the purpose of further identification of butterfly species were used the Butterfly Practical Guide in the Bogor Botanical Gardens [12] and the Identification Guide for Butterflies of West Java [13].

![Figure 1. Map of research location PT RAJ and transect strip for animal observation](image)

**Figure 1.** Map of research location PT RAJ and transect strip for animal observation

![Figure 2. Transect form for animal observation. (Remarks: p (average visibility for observers at a particular location); o (observer position); s (animal position)](image)

**Figure 2.** Transect form for animal observation. (Remarks: p (average visibility for observers at a particular location); o (observer position); s (animal position))

Obtained data include general land cover conditions for each type of habitat, burnt and unburnt land, in pairs for each type of grass cover and gelam cover. In addition, the main data related to wild animals are the diversity of species of animals (birds and butterflies) including the number of species, the number of individuals, richness, and evenness of species, as well as the composition of species of animals on burnt and unburnt land one-year post-fire. The collected data was then analyzed to determine the comparison of the number of species, Diversity Index (H), Margalev Species Index (Dmg), Evenness Index (E) [14], and Sorensen Community Similarity Index (IS) [15], percentage loss, and percentage gain.
3. Result and Discussion

3.1. General Conditions of Burnt and Unburnt Land After One Year of Fire

The results of observations of the general condition of burnt and unburnt land after one year of fire in the grassland cover showed that in general the condition of land cover was dominated by grass vegetation. The post-burn land was overgrown with grass and had experienced a fire in 2018. On the left side of the observation lane on this land, there was a small canal with a width of 1-2 meters. The average temperature was 26.1°C, and the average humidity was 59%. For unburnt land where the grass was also overgrown without fire incident in 2018, there was a small canal to the left of the observation track with an average temperature of 25.9°C and average humidity of 56% (Figure 3).

![Figure 3. Post-burnt grassland (b) and unburnt grassland (a)](image)

Figure 4 shows the post-burn and unburnt land in the gelam land cover. In the burnt land, there was a small canal measuring 1-2 meters on the left side of the observation track with an average temperature of 29.8°C and average humidity of 64%. As for unburnt land, there was a canal with a width of 4-5 meters on the left side of the lane whereas on the right side of the lane was a land overgrown with a variety of plants including gelam with an average temperature of 28.2°C and average humidity of 62%.

![Figure 4. Post-burnt gelam land (b) and unburnt gelam land (a)](image)

3.2. Birds and Butterfly species Diversity and Composition

3.2.1. Bird species Diversity

The results of observations and identification of bird species in burnt and unburnt land indicate that the number of bird species found in the track was 29 species with a total of 209 individuals found. Based on its protection status according to the IUCN Red List, 27 species out of the 29 bird species are categorized the Least Concern (LC), one species which is *Leptoptilos javanicus* as Vulnerable (Vu), and one species which is *Anhinga melanogaster* categorized the Near Threatened (NR). There were
differences in the number of species and the number of individuals found in burnt and unburnt land (Table 1).

Table 1. Bird species found in burnt and unburnt land covered in grass and gelam after one year of fire at RAJ Oil Palm Plantation in South Sumatra

| No | Species name/Conservation Status (IUCN Red List) | Family           | TTR | PTR | TTG | PTG |
|----|-----------------------------------------------|------------------|-----|-----|-----|-----|
| 1  | Ixobrychus cinnamomeus/LC                      | Ardeidae         | 0   | 2   | 0   | 1   |
| 2  | Ixobrychus eurhythmus/LC                       | Ardeidae         | 1   | 2   | 2   | 1   |
| 3  | Lanius cristatus/LC                            | Laniidae         | 0   | 2   | 0   | 0   |
| 4  | Lanius schach/LC                               | Laniidae         | 1   | 2   | 0   | 0   |
| 5  | Ardea speciosa/LC                              | Ardeidae         | 1   | 5   | 8   | 2   |
| 6  | Halcyon smyrnensis/LC                          | Alcedinidae      | 0   | 2   | 0   | 1   |
| 7  | Nectarinia jugularis/LC                         | Nectariniidae    | 1   | 2   | 13  | 0   |
| 8  | Centropus sinensis/LC                          | Cuculidae        | 1   | 1   | 0   | 1   |
| 9  | Ardea cinerea/LC                               | Ardeidae         | 0   | 1   | 0   | 0   |
| 10 | Ardea purpurea/LC                              | Ardeidae         | 1   | 0   | 0   | 0   |
| 11 | Pycnonotus aurigaster/LC                        | Pycnonotidae     | 1   | 2   | 1   | 1   |
| 12 | Elanus caeruleus/LC                            | Accipitridae     | 0   | 2   | 0   | 1   |
| 13 | Merops philippinus/LC                          | Meropidae        | 1   | 1   | 3   | 1   |
| 14 | Pycnonotus goiavier/LC                         | Pycnonotidae     | 1   | 0   | 1   | 4   |
| 15 | Phalacrocorax carbo/LC                         | Phalacrocoracida | 0   | 2   | 15  | 0   |
| 16 | Phalacrocorax sulcirostris/LC                   | Phalacrocoracida | 0   | 7   | 2   | 1   |
| 17 | Anhinga melanogaster/NR                        | Anhingidae       | 1   | 2   | 3   | 3   |
| 18 | Pelargopsis capensis/LC                         | Alcedinidae      | 1   | 0   | 0   | 0   |
| 19 | Geopelia striata/LC                             | Columbidae       | 1   | 0   | 0   | 1   |
| 20 | Treron sphenurus/LC                            | Columbidae       | 2   | 1   | 0   | 0   |
| 21 | Alcedo coeruleus/LC                            | Alcedinidae      | 1   | 0   | 0   | 0   |
| 22 | Streptopelia chinensis/LC                       | Columbidae       | 2   | 6   | 4   | 2   |
| 23 | Nisaetus cirrhatus/LC                           | Accipitridae     | 0   | 0   | 0   | 1   |
| 24 | Leptoptilos javanicus/VU                       | Ciconiidae       | 0   | 0   | 0   | 2   |
| 25 | Amaurornis phoenicurus/LC                       | Rallidae         | 0   | 2   | 0   | 0   |
| 26 | Caprimulgus affinis/LC                         | Caprimulgidae    | 2   | 2   | 10  | 1   |
| 27 | Cisticola junci/dis/LC                         | Sylviidae        | 4   | 12  | 6   | 1   |
| 28 | Hirundo rustica/LC                             | Hirundinidae     | 10  | 0   | 22  | 1   |
| 29 | Aethopyga siparaja/LC                          | Nectariniidae    | 0   | 0   | 2   | 0   |

| Number of Individuals | 33   | 58   | 92   | 26   |
| Number of species     | 18   | 20   | 14   | 18   |

Remarks: TTR (unburnt grassland); PTR (burnt grassland); TTG (unburnt gelam land); PTG (burnt gelam land)

In general, the number of bird species found in the burnt land both covered in grass and gelam was more than that in the unburnt land. In the burnt grassland (PTR), the number of species found was 20 species with a total number of individuals as much as 58 individuals whereas in the unburnt grassland (TTR) 18 species were found with a total of 33 individuals. In burnt gelam land (PTG), the number of species found was 18 species with a smaller number of individuals (26 individuals) compared to unburnt
gelam land (TTG) with 14 species and 92 individuals. Table 1 also shows that there are bird species that occupy grass and gelam post-fire habitat and are not found in unburnt land, that is, 8 different bird species in the type of land cover and 6 different bird species in the type of land cover of gelam. This shows that after one year of fire, the condition of the land has recovered with the growth of new vegetation that allows it to be used by birds as their habitat (Figure 3 and Figure 4). This condition also shows that each bird species has a different response to changes in habitat conditions after the fire. There are bird species that show a positive response by making the post-fire area their habitat, but there are also those who respond negatively by not making it their habitat. This depends on the potential availability of supporting factors both biotic elements such as the availability of food and cover, as well as abiotic elements such as the suitability of temperature and humidity. This fact also means that the fire can cause changes in vegetation conditions in a very complex and diverse ecosystem post burnt, including potentially of food availability for some bird species. Reference [16] state that fires can trigger changes in the type and structure of vegetation, and can maintain healthy ecosystems. O also states that some birds will fly away from their habitat when there is a fire and there are several species of birds that return to the post-burnt land [17].

Based on the total number of individuals and the number of bird species found in each type of land cover for unburnt and burnt land, the calculation results were obtained for each Diversity Index (H), Evenness Index (E), and Margalev Species Index (Dmg) as shown in Figure 5.

![Figure 5. Species Diversity Index (H), Evenness Index (E) and Margalev Species Richness Index (Dmg) of bird species in burnt and unburnt land covered by grass and gelam after one year of fire at RAJ Oil Palm Plantation in South Sumatra. (Remarks: TTR (unburnt grassland); PTR (burnt grassland); TTG (unburnt gelam land); PTG (burnt gelam land))](image)

The species diversity index (H) in post-burnt lands was relatively greater (H = 2.7 for grassland; H = 2.75 for gelam land) than that in unburnt lands (H = 2.504 for grassland; H = 2.253 for gelam land). This means that the relative diversity of bird species in post-burnt land is higher compared to unburnt land after one year of fire. In addition, the results of the analysis also showed that the value of the Evenness Index (E) in the post-burnt lands (E = 0.901 for grassland; E = 0.954 for gelam land) was also relatively greater than in the unburnt lands (E = 0.866 for grassland; E = 0.853 for gelam land). In general, the Evenness values are classified as high, which is between 0.85-0.95 and close to 1, which means that the evenness of bird species spreads evenly on both post-burnt and unburnt areas after one year of fire. The Margalev Richness Index (Dmg) showed the same relative value between the unburnt grassland of 4.861 compared to 4.679 of the burnt grassland. Conversely, the values of the Margalev Richness Index
in the burnt gelam land (Dmg=5.217) was greater than that in the unburnt gelam land (Dmg=2.874) (Figure 5). The phenomenon found in this study implies that the degree of species diversity, the degree of evenness of the individuals and the richness of bird species in post-burnt land are relatively higher and equitable compared to unburnt land. Therefore, it can be stated that land fires in oil palm plantations especially found in the case of fires in RAJ oil palm plantations do not always have a total negative impact, but one year after the fire there will be a process of restoration of habitat conditions that allow the diversity of bird species to re-use the area as their habitat.

The results of the analysis of the Community Similarity Index (CI) of bird species in burnt and unburnt lands after one year of the fire showed not so different values (Table 2). The Community Similarity Index value was relatively the same at the value of 0.52 or 52% in almost all unburnt and burnt lands, except in unburnt grassland (TTR) and burnt grassland (PTR) with a community similarity value of 0.46 or 46%. These values of community similarity index showed that the rate of similarity of bird species was low to moderate. That means the rate of species similarity of birds in unburnt and burnt land after one year of fire is relatively low just about 46%-52%. Also, the condition of unburnt land and burnt land after one year of fire are significantly different, and this condition causes an impact on the rate of bird species similarity index is relatively low. There are small changes of individual species migrating to the nearest unburnt area and being used as a refuge and returning to the location to help the recolonization of animals after the condition of the burnt area has recovered. These condition can be linked to states of reference [19] that the distribution and population of birds in a habitat are influenced by physical of environmental factors such as soil, water, temperature, sunlight, and biological factors that include vegetation and other animals so that the existing bird species will adjust.

|    | TTR    | PTR   | TTG    | PTG    |
|----|--------|-------|--------|--------|
| TTR| 0.461538 | 0.526316 | 0.521739 |        |
| PTR|         | 0.5    |        | 0.52381 |
| TTG|         |        |        |        |
| PTG|         |        |        |        |

Remarks: TTR (unburnt grassland); PTR (burnt grassland); TTG (unburnt gelam land); PTG (burnt gelam land)

3.2.2. Butterfly Species Diversity

The results showed that the total number of species of butterflies found in the observation lane of burnt and unburnt grass and gelam were 6 species of butterflies with a total of 11 individuals, included four families (Nymphalidae, Hesperidae, Lycaenidae, and Pieridae). These six butterfly species are not classified as protected animals according to the IUCN Red List, Appendix CITES and according to Indonesian laws and regulations. Even so, it must be watched out for its existence as one of the important elements in maintaining the ecological balance of the ecosystem.

There were differences in the number of species and the number of individual butterfly species found in burnt and unburnt lands (Table 3). It is generally known that the number of butterflies found in burnt grassland or burnt gelam land after one year of fire was fewer than that of unburnt lands of both cover types. In the unburnt grassland (TTR), the number of species found was greater (4 species) with a total number of 4 individuals compared to the burnt grassland (PTR) with 2 species and a total number of 2 individuals. In unburnt gelam land (TTG), as many as 2 species with a total of 4 individuals were found compared to the burnt gelam land (PTG) with only 1 type of butterfly and only 1 individual.

Table 3 also shows that the species of butterflies that inhabit grass and gelam post-fire lands are different species found in unburnt land; 2 species of butterflies in the grassland and 1 butterfly species in gelam land. This condition can be interpreted that after one year of fire, the condition of the post-fire land has begun to recover with the growth of new vegetation that allows it to be used by new butterfly species as its habitat (Figure 3 and Figure 4). Similar to bird species, each butterfly species has a different
response to changes in habitat conditions after the fire. Some butterfly species are able to respond to it positively by making the post-fire area their habitat. On the other hand, some others may show negative responses to fire negative by not making it as its habitat. This may depend on the potential availability of supporting factors both biotic elements (e.g., the availability of food and cover) and abiotic elements (e.g., the suitability of temperature and humidity, water availability). This fact also indicates that the fire can cause changes in vegetation conditions into a very complex and diverse post-burnt ecosystem, including in the potential of food availability for some butterfly species.

Table 3. Butterfly species found in burnt and unburnt land covered in grass and gelam at RAJ Oil Palm Plantation in South Sumatra

| No | Species name     | Family     | TTR | PTR | TTG | PTG |
|----|------------------|------------|-----|-----|-----|-----|
| 1  | Melanithis leda  | Nymphalidae| 0   | 1   | 0   | 1   |
| 2  | Potanthus omaha  | Hesperidae | 1   | 0   | 0   | 0   |
| 3  | Pelopidas conjunctus | Hesperidae | 1   | 0   | 1   | 0   |
| 4  | Pelopidas subochracea | Hesperidae | 0   | 1   | 0   | 0   |
| 5  | Rapala airbus    | Lycaenidae | 1   | 0   | 0   | 0   |
| 6  | Appias lybithea  | Pieridae   | 1   | 0   | 3   | 0   |

Number of individuals | 4 | 2 | 4 | 1 |
Number of species     | 4 | 2 | 2 | 1 |

Remarks: TTR (unburnt grassland); PTR (burnt grassland); TTG (unburnt gelam land); PTG (burnt gelam land)

The low number of species and individual butterflies found in burnt lands also shows that land fires that occur in RAJ oil palm plantations have a significant impact by the reduced number of butterfly species in their habitat, because butterflies are an animal whose life is very dependent on plants and very susceptible to environmental changes [20]. Several sources also mentioned that the richest species of butterflies are in forested areas, followed by unburnt land and the lowest in post-burnt land [10]. The research findings of reference [21] about the diversity of butterfly species in several habitat types also showed that the post-burnt habitat types and shrubs have the lowest species diversity of butterflies compared to other habitat types, such as lowland forest, coral forest, swamp forest, forest peat swamps and nursery camps.

The species diversity index (H), Species Evenness Index (E), and Species Richness Index (Dmg) also showed differences, in which unburnt lands show relatively higher values than burnt lands (Figure 6). Figure 6 shows that the value of the Diversity Index (H) of butterfly species is relatively higher in unburnt grass and gelam lands (TTR and TTG) compared to burnt grass and gelam lands (PTR and PTG). Generally, the obtained value of the Diversity Index was 0-1.38, which means that the diversity of butterflies in both types of land cover (grass and gelam) in burnt and unburnt lands is classified as low. The obtained value of Species Evenness Index was 0-1, indicating that the butterfly species spread unevenly, and the dominance of certain species found or occupy a certain habitat type. Observation results show that the butterfly species of Family Nymphalidae namely Melanithis leda only occupy post-burnt habitat both in the grassland (PTR) and in the land gelam (PTG). The highest butterfly species richness index value was found in unburnt gelam land (TTG) of 2.73 compared to unburnt grassland (TTR) of 2.164. The index values above indicate a bio-ecological phenomenon of each butterfly species in responding to land fires after one year of fire in occupying an area as its habitat. Reference [22] states that the spread of butterfly species is limited by environmental factors including suitable ecological factors and the distribution of feed vegetation of adult butterflies and butterflies in the larval phase. Reference [23] state that butterflies like bright and open places in the forest. And other also state that abiotic and biotic factors that influence the diversity of butterfly species include environmental conditions of temperature and humidity, the presence of open spaces, and the presence of water sources and feed vegetation [21].
Figure 6. Species Diversity Index (H), Evenness Index (E) and Margalev Species Richness Index (Dmg) of butterfly species in burnt and unburnt land covered by grass and gelam after one year of fire at RAJ Oil Palm Plantation in South Sumatra

The low level of species diversity, species evenness, and species richness found in the burnt area after one year of fire in this study is also in line with the statement of reference [24] that the species richness of butterflies will increase with the passage of years since the fire occurred due to the potential for increased species diversity plants and ecological niches.

The results of the Community Similarity Index also showed a small value, except in unburnt grassland and unburnt gelam land which showed a higher value of 0.5 (Table 4).

Table 4. Community Similarity Index of butterfly species in burnt and unburnt land covered in grass and gelam at the RAJ Oil Palm Plantation South Sumatra

|        | TTR  | PTR  | TTG  | PTG  |
|--------|------|------|------|------|
| TTR    | 1    | 0    | 0.5  | 0    |
| PTR    |      |      | 0    | 0    |
| TTG    |      |      |      | 0    |
| PTG    |      |      |      |      |

Remarks: TTR (unburnt grassland); PTR (burnt grassland); TTG (unburnt gelam land); PTG (burnt gelam land)

The Community Similarity Index value above shows that the level of similarity of the butterfly species community between grass and gelam habitat types both unburnt and burnt is relatively low. Moreover, the butterfly community is not the same, except between the unburnt grassland (TTR) and unburnt gelam land (TTG) which have a community similarity value of around 50%. In this case, it can be stated that basically, each butterfly species has a unique habitat type. Also, it can be said that there is a categorization of butterfly types as generalists and specialists. Generally, the results of this study indicate that fires in oil palm plantations have an impact on changes in the condition of butterfly species diversity after one year of fire, both on species diversity, species evenness, and species richness and the community similarity between burnt and unburnt land. This means that butterflies have a fairly high sensitivity to land fire events that function as their habitat.
3.3. Losses and Gains of Species in Land After Fire

Referring to the basic assumption that unburnt land is the initial condition of burnt land before a fire occurs, the changes in the condition of species diversity of butterflies in both land conditions can be used as a basis to calculate the estimated loss, gain, and survival of butterfly species due to land fires. Based on those assumptions, the results of this research show that land fires in the RAJ oil palm plantations do not only give the negative impact on the losses of several species of birds and butterflies but also give the positive impact on the gain of new species of birds and butterflies after the fire and the survived species in the burnt and unburnt areas both in grassland and gelam land. In general, the results of the study showed that after one year of fire in the RAJ oil palm plantations the number of species survived was 23 species (41.82%), followed by the number of species gain of 17 species (30.91%), and the species loss of 15 species (27.27%) (Table 5). Considering the type of land cover, the number of the species loss of birds in grassland is less (6 species or 24%) compared to the number of species obtained (7 species or 28%). In gelam land, the number of species loss is only 3 species (14.29%) compared to the number of species gain as many as 7 species (33.33%). As for butterfly species, the number of species loss is relatively more (4 species or 66.67% in grassland; 2 species or 66.67% in gelam land) compared to the number of species gain (2 species or 33.33% in grassland; 1 species or 33.33% in gelam land).

Table 5. The number of species survived, loss, and gain after the fire for grass and gelam land in RAJ Oil Palm Plantations South Sumatra

| Category   | Land Categories | Survived | Loss | Gain |
|------------|-----------------|----------|------|------|
| Aves       | Grassland       | 12       | 6    | 7    |
|            | Gelam Land      | 11       | 3    | 7    |
| Butterfly  | Grassland       | 0        | 4    | 2    |
|            | Gelam Land      | 0        | 2    | 1    |
| Total (%)  | 23 (41.82)      | 15 (27.27)| 17 (30.91)|

Table 5 also shows that for bird species, the number of bird species that survived is 23 species, while the number of species loss (9 species) is less than the number of species gain (14 species). As for the types of butterflies, there were no species that can survive due to fire, while for the number of species loss (6 species) was higher than the number of species gain (3 species). This fact shows that species of birds are relatively able to survive and can adapt to land fires, while butterflies have relatively little resistance to land fires and their adaptability in occupying post-fire land to serve as their habitat.

The phenomenon of loss and gain of species in bird species as a result of land fires indicates a complex and dynamic condition that is influenced by many factors including the severity of the fire, which results in damage or changes in habitat conditions. Reference [25] stated that in general an animal habitat can experience changes or damage, and the change or destruction of that habitat is the main factor that causes the movement of birds to other habitats. It is also generally known that some bird species might take advantage of the post-fire habitat, causing population increase, while others might experience population decrease.

According to reference [20], butterflies are animals whose lives are highly dependent on plants and are very susceptible to environmental changes, so fires will have an impact on the reduced number of butterfly species and individuals. However, the fact of the field shows that there are types of butterflies obtained after the fire even though there are several types of butterflies lost due to the fire.

Based on field facts as described above, it can be stated that land fires in oil palm plantations such as those in RAJ oil palm plantations do not always have a negative impact on the loss of diversity of wildlife species, but also have a positive impact after a fire by acquiring wild species and new species occupying the land as their habitat. Of the two types of burnt land, grass and gelam, it turns out there are differences in the types of wildlife species that were survived, disappeared, and obtained after a fire. This means that after natural land fires, the process of ecosystem recovery will occur with the growth of new types of vegetation and/or life of other animal species that are potentially used as sources of food.
for other wild animals, among others, marked by occupation of land after the fire into their habitat, both for a place to look for food (feeding site), shelter (cover) or a breeding site. Ecologically among the important habitat components and even a limiting factor is the availability of feed components in the habitat, besides the availability of water and the suitability of temperature and humidity conditions. As a case example, the results of reference [26] show that there are several environmental factors that influence the use of a post-fire habitat by butterflies, namely the availability of larvae and butterfly feed plants, water sources, temperature and humidity, and altitude.

In the perspective of ecological evolution, fire events can cause indirect effects such as the succession process [27], namely the process of changing the composition of vegetation and environmental factors towards the climax community in response to disturbances such as fire [28]. In the context of the existence of a post-fire land as an ecosystem undergoing a process of succession, to a certain extent with the development of its biophysical characteristics, the ecosystem may be able to be occupied and used as habitat by a variety of birds and butterfly species, and in such conditions, there is potential for acquisition (gains) new species, or also the types of old animals that had previously lived in the area returned to use the land after the fire as their habitat.

4. Conclusion
Land fires do not always result in negative impacts by losses in total diversity of wildlife species, especially birds and butterfly species diversities, but also have a positive impact with gains of new species of birds and butterflies in addition to the presence of species that are able to survive in the burnt area after one year of fire.

The total number of species found in the two observation lanes for each type of land cover (grass and gelam) for unburnt and burnt land, namely 29 species of birds and 6 species of butterflies. The Species Diversity Index (H), the Evenness Index (E), the Species Richness Index (Dmg) and the Community Similarity Index (IS) are different for each group of animals (bird and butterflies) and between burnt and unburnt land. The values of H, E, Dmg and IS for bird species are relatively greater in the burnt area after one year of fire than in the unburnt area. On the other hand, the index values for butterfly species are greater in the unburnt areas compared to burnt areas.

The percentage of species loss due to land fires for bird species, in grassland there is 24% lost species compared to 28% species gain whereas in gelam land there is 14.29% lost species compared to 33.33% species gain. For butterfly species, the percentage of species loss is relatively greater than the percentage of species gain by fire, that is, 66.67% of species gain and 33.33% of species loss in grassland and gelam land.

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