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Short Communication: Effect of skid trails on the regeneration of commercial tree species at Balah Forest Reserve, Kelantan, Malaysia

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ABSTRACT

Razali N, Ismail MH, Kamarudin N, Zaki PH. 2014. Effect of skid trails on the regeneration of commercial tree species at Balah Forest Reserve, Kelantan, Malaysia. Biodiversitas 15: 240-244. Skidding operation has been reported as a factor to forest soil degradation and vegetation disturbance. Assessing tree regeneration by the effect of the skid trail from harvest operation is important to determine the recovery rate of the forest stand. A study was conducted to accomplish the following objectives, (i) to measure the tree regeneration rates at different distance from skid trails, and (ii) to evaluate the dominance and species diversity of regenerated trees. A total of five plots with size of 50 m by 2 m were established in two skid trails of natural forest that has been logged in 2012. Each plot contains five sub-plots of 2 m by 2 m in different locations namely skid track, edge and forest. The number of seedlings and saplings, species richness and diversity, and dominance regeneration were analyzed. Results showed that the number of species regeneration was not significantly different in both skid trails. For skid trail 1 the number of seedling and saplings was highest on skid trail tracks (mean species diversity = 0.45). Meanwhile skid trail 2 showed the greatest species regeneration at edges (mean species diversity =0.65). Frequency value for *Elateriospermum tapos* was high due to the existence of mother tree in the area that providing a great number of seedlings. The dominance regeneration in both skid trails originated from non-dipterocarp families. There were 42 non-dipterocarp seedling and saplings in skid trail 1, and 182 in skid trail 2. While only 2 dipterocarp seedling and saplings in skid trail 1, and 8 in skid trail 2. Enrichment planting is suggested as dipterocarp species have low growth rate compared to the non-dipterocarp species.

Key words: Malaysia, species diversity, skid trails, tree regeneration.

INTRODUCTION

Roads have become prominent landscape features in forest concession. Road construction is important in assessing any area in the forest. The effect of a road upon the environment is complex, and includes disturbance during construction, and pollution both from the road material itself and from the traffic of an established road (Angold 1997). In Malaysia several studies of forest road impacts have been reported by Mohd Hasmadi and Norizah (2010), Pinard et al. (2000), Kamaruzaman and Nik Muhammad (1992), and Kamaruzaman (1988). However no studies have been done on skid trails.

A skid trail is a temporary track to extract logs from felled trees to log a forest stand and requires no road construction. A forest skid trail is created without earthworks to give access for a skidding machine to reach a log. Frequent passes at similar trails may cause severe impacts to the soil and vegetation (Kamaruzaman and Nik 1992). The impacts on forest vegetation predominantly occur after frequent machinery passes during the timber extraction operation. However, an impact to the soil surface is supposedly minimal since there are no earthworks (Pinard et al. 2000). Nevertheless, Demir et al. (2007) reported that back and forth passes by particular skidding machine to take timber from stump site into identical exit points still originate impacts to the soil surfaces. In addition, Wan Mohd and Mohd Paiz (2003) and Dykstra and Heinrich (1996) pointed out that trails clearance by skidding machine creates impacts and damages on the residual vegetation.

At the end of timber harvesting operation, the trail is left out and residual vegetation starts. Natural forest reserve areas can sustain themselves of their valuable species through an effective regeneration system. Natural regeneration of forest species ensures their survival, but some species have very small populations of seedlings. According to Marcus and Robbins (2003), the natural regeneration in the forest is often very poor, especially for the desirable or commercial species. Post-harvest assessment on the skid trails is required to determine the regeneration potential of the forest and to design appropriate silvicultural treatments. On the other word, without any silvicultural treatment it is possible that the damage and impact is retained and no regeneration occurs. Therefore, the objectives of this study are to measure the tree regeneration rates at different distances from the skid trails, and to evaluate the dominance and species diversity of the regenerated seedlings and saplings.

Materials and Methods

Description of study area

This study area is located at Compartment 47, Balah Forest reserve in Kelantan state, Malaysia (Figure 1). The natural forests are owned by the Kelantan State Economic Development Corporation (SEDC) and cover an area of 239 ha. This compartment was harvested since 2010, and completely closed from timber harvesting operation in 2012. The second cutting will be commenced after 30 years later under selective management system(SMS) practice .The length of skid trails constructed is about 1640 m/ha. The system practiced for the whole operation in this compartment was conventional ground base timber harvesting.

Plot establishment and data collection

A total of five sampling plots with size of 50 m by 2 m were established at two abandoned skid trails in order to estimate the intensity of expected regenerated species after skidding operation. The sampling plots were 100 m apart, with five parallel subplots each sized 2 m x 2 m (4 m^2), covering the tracks of skid trail (subplot 1), the edges of skid trail (subplot 2) and forests (subplot 3).

The distance of each plot is 100 m to cover the regenerated species along the alignment of abandoned skid trails from the exit points of skid trails, the middle of skid trails, and the end which is the farthest point of skid trails from exit points. Meanwhile the distance of each subplot is 10 m. Subplot 1 lays in between subplot 2 and 3 which vegetation is completely removed and have wide canopy opening. Vegetation in subplot 2 is expected to be moderately disturbed subjected to unexpected skidding operation occurred out of the original planned skid trails. Subplot 3 is undisturbed areas adjacent to skid trail tracks and edges and serve as baseline to compare the status of regeneration rate occur within subplot 1 and subplot 2. Figure 2 illustrates the layout of sampling plots and its subplots establishment for trees regeneration collection. Seedlings with height >0.05 m, and saplings heights from 1.5 cm to 10 cm in diameter size were measured, and species identification was conducted in Herbarium of Faculty of Forestry, University Putra Malaysia. The regenerated species collected are woody plants of both dipterocarp and non dipterocarp species.

Two index were measured in this study to estimate regeneration rate namely Shannon diversity index (eq. 1) by Shannon (1948) and species richness index (eq. 2) by Menhinick (1964).

$$H^1 = \sum \left(\frac{n_i}{N}\right) ln \left(\frac{n_i}{N}\right) \quad \text{..... (1)}$$

Where H^1 is Shannon's index of species diversity, n_1 is importance value index of species *i*, and *N* is importance value index of the population.

$$d = \frac{S}{\sqrt{n}} \quad \text{..... (2)}$$

Where *d* is the species richness index, *S* is the number of species, and *n* is the number of individuals. Both indexes were tested by two-way analysis of variance (ANOVA) for differences in tree regeneration among various tree species.

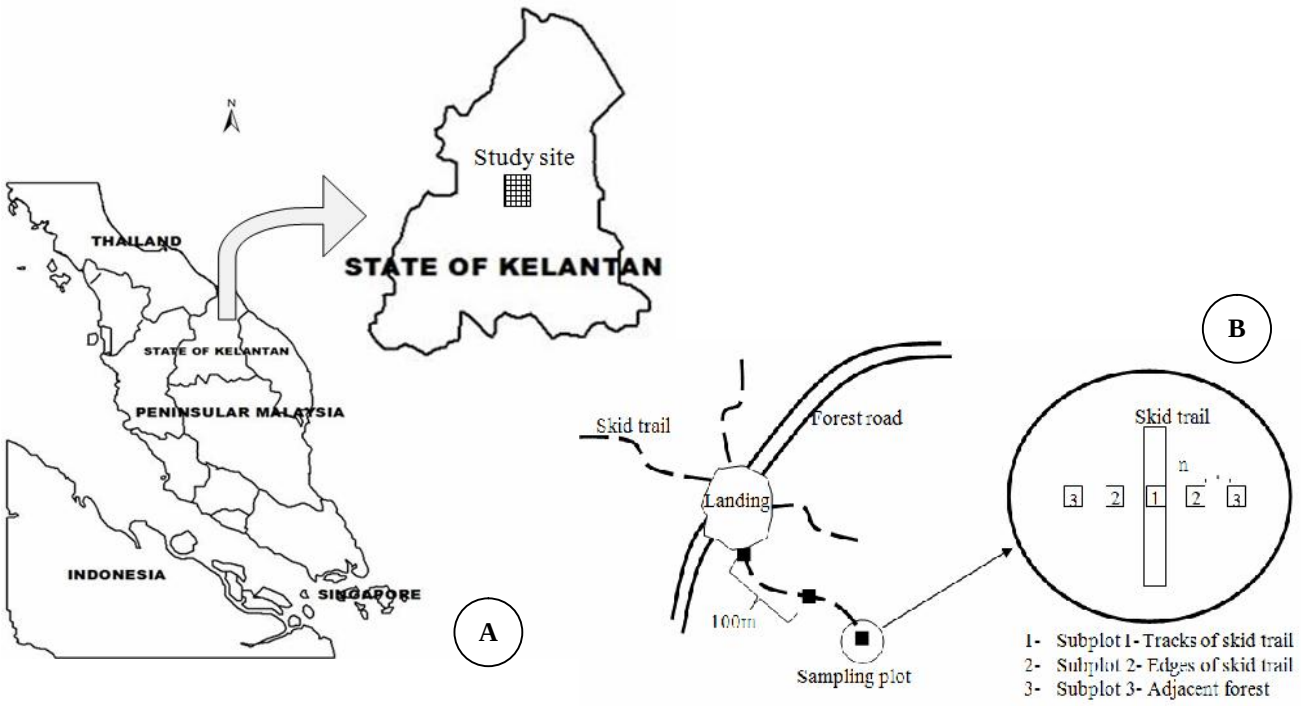

Figure 1. A. Location of study area (compartment 47) in Kelantan state. B**.** Layouts of sampling plots and subplot of subplot 1, 2 and 3.

Results and Discussion

A total of 150 seedlings and 93 saplings of 17 species from 15 families were recorded from two skid trails. Results showed that the number of species regeneration were not significantly different in both skid trails. For skid trail 1 seedlings and saplings are found to be greater on skid trail tracks with mean recorded for species diversity are 0.45, than edges and adjacent forests (Figure 3). Meanwhile skid trail 2 shows a greater species regeneration at edges with mean recorded are 0.65 (Figure 4). A total of 43 seedlings and saplings were found in skid trail 1, while a total of 190 seedlings and saplings were found in skid trail 2, respectively.

A topographical condition is probably influence for seedlings regeneration in this area. It observed that when slope become steep, regeneration became lesser. Skid trail 1 has lower slope where the trail move downwards to the hill. This indicated by a result where regeneration is higher on the track compared to skid trails 2 because the trails is located or move toward upward to the hill.

Table 1 shows the ANOVA results for both skid trails (skid trail 1 and skid trail 2) on the different location (Track, edge and forest). The P value of Shannon's index was 0.76 on the skid trails, while on the track, edge and forest was 0.70, respectively. Results showed that, the diversity of tree species were not occurred in both skid trails, and the diversity of species are not significant. This has resulted the species richness on skid trail 1 and 2 does not differ from each other.

The species diversity calculated by using the Shanon index in skid trail 1 and 2 were shown in Figure 5 and Figure 6. In skid trail 1, the highest diversity is *Eugenia* sp 0.44, followed by *Macaranga* sp. 0.31 and *Canarium* sp. 0.25. Both *Cinnamomum* sp. and *Goniothalamus* sp. gave the same results 0.22. *Nephelium* sp. diversity was 0.14 while the other species, *Pometia* sp., *Ficus* sp., *Vitex* sp., *Anthocephalus chinensis, Hopea pubescens, Baccaurea kunstleri*, and *Mangifera foetida* share the similar value 0.09.

Table 1. ANOVA results for two skid trails and different locations.

Source	Category	Mean values	F	P value	Level of significant
Shanon's index					
Area	Skid trail 1	0.563	0.089	0.768	NS
	Skid trail 2	0.627			
Location	Track	0.600	2.957	0.70	NS
	Edge	0.916			
	Forest	0.270			
Species richness					
Area	Skid trail 1	0.063	1.703	0.203	NS
	Skid trail 2	-0.170			
Location	Track	-0.260	1.338	0.280	NS
	Edge	0.045			
	Forest	0.055			

Note: *0.05 level; **0.01 level; *** 0.001 level; NS- non significance

In skid trail 2, *Elateriospermum tapos* is the highest diversity value with 1.41, followed by *Goniothalamus* sp. 0.13, *Macaranga* sp. 0.21 and *Eugenia* sp. 0.19. The diversity for *Shorea* sp. is 0.1, *Canarium* sp. 0.07, while *Cinnamomum* sp. 0.02. Other species such as *Durio sp., Artocarpus* sp., *Anthocephalus chinensis, Intsia* sp. and *Baccaurea kunstleri*, shared the similar value with 0.01. By observation probably the major cause for the high number of diversity for some species in the area is due to the existing of a mother tree. The mother trees produced seeds throughout the year and disperse within the region. The abundance population of tree seedlings and saplings in this forest showed that the status of regeneration for every species is varies. This may be due to microclimate variation or poor regeneration capacity of the seed.

Dominant regeneration is focused at the dipterocarp and non-dipterocarp families. Figure 7 and Figure 8 were presents the total number of tree from dipterocarp and non-dipterocarp tree. There are 42 non-dipterocarp trees in skid trail 1, and 182 non-dipterocarp trees in skid trail 2. While there are only 2 dipterocarp trees in skid trail 1, and 8 dipterocarp trees in skid trail 2. Non-dipterocarp trees are light demanding species that able to develop faster, especially in high penetration of sunlight. While shades tolerant species of dipterocarp trees need to grow under the canopy area during the adolescent stage and high light penetration will effects their growth at early stages. The tolerant of other species can generate, adapt and survive faster compare to the dipterocarp species. The flowering time of this species almost successful and seeds can be collected throughout the year. The flowering pattern of the dipterocarp trees usually irregular and unpredictable which make difficult to collect sufficient seeds for raising the seedlings (Sasaki 2008).

Successful forest regeneration is critical for the sustainable management of natural forests. As conclusion the numbers of species regeneration were not significantly different in both skid trails. For skid trail 1 seedling and saplings are found to be greater on skid trail tracks with mean recorded for species diversity are 0.45, than edges and adjacent forests. Meanwhile skid trail 2 shows a greater species regeneration at edges with mean recorded are 0.65, respectively. The diversity of tree species were not occurred in both skid trails, and the diversity of species are not significant. This has resulted the species richness on skid trail 1 and 2 does not differ from each other. In skid trail 1, the highest diversity value is *Eugenia* sp. 0.44, followed by *Macaranga* sp. 0.31 and *Canarium* sp. 0.25. Both *Cinnamomum* sp. and *Goniothalamus* sp. gave the same results 0.22. *Nephelium* sp. diversity was 0.14 while the other species, *Pometia* sp., *Ficus* sp., *Vitex* sp., *Anthocephalus chinensis, Hopea pubescens, Baccaurea kunstleri*, and *Mangifera foetida* share the similar value 0.09.In skid trail 2, *Elateriospermum tapos* is the highest diversity value 1.41, followed by *Goniothalamus* sp. 0.13, *Macaranga* sp. 0.21 and *Eugenia* sp. 0.19. The diversity for *Shorea* sp. is 0.1, *Canarium* sp. 0.07, while *Cinnamomum* sp. 0.02. Other species such as *Durio* sp., *Artocarpus* sp., *Anthocephalus chinensis, Intsia* sp. and *Baccaurea kunstleri*,

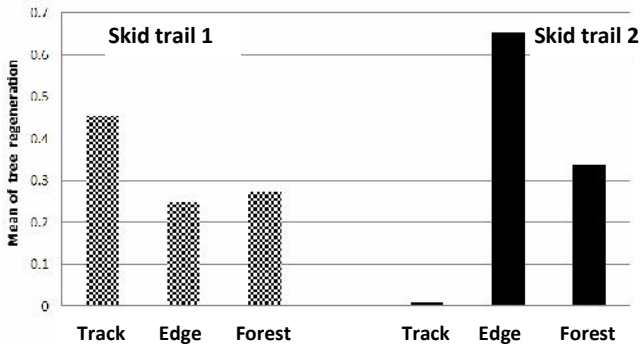

Figure 2. Mean of regeneration at skid trail at Track, Edge and Forest.

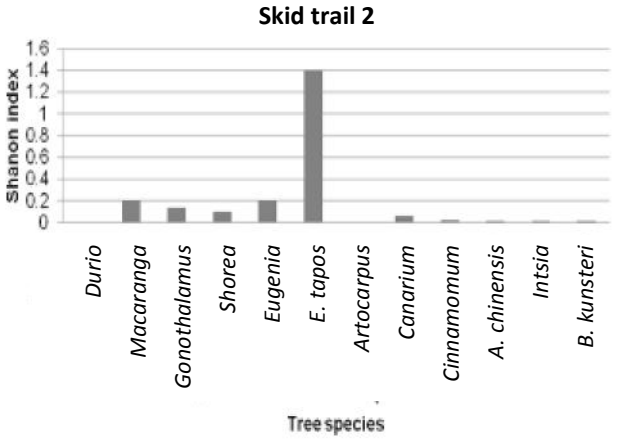

Figure 4. Species diversity in skid trail 2.

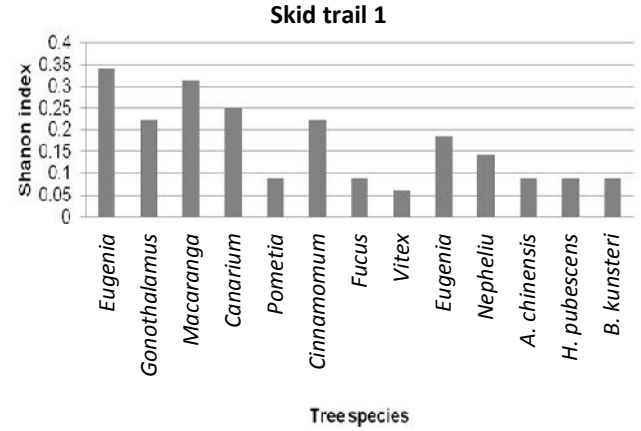

Figure 3. Species diversity in skid trail 1.

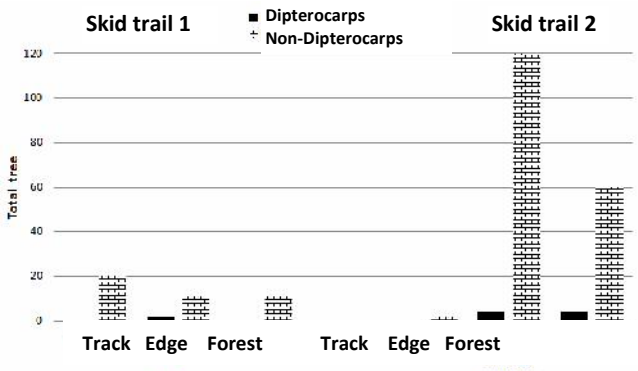

Figure 5. Dominant tree family in skid trail 1 and 2.

share the similar value 0.01. The dominant regeneration in both skid trail is a non-dipterocarp families. There are 42 non-dipterocarp trees in skid trail 1, and 182 non-dipterocarp trees in skid trail 2. While there are only 2 dipterocarp trees in skid trail 1, and 8 dipterocarp trees in skid trail 2. Silvicultural treatment should be conducted on the disturbed area. Enrichment planting is suggested as dipterocarp species have low growth rate compare to the non-dipterocarp species.

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