

Monitoring the Outcomes of Rehabilitation and Reforestation for Biodiversity Conservation

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Content:

- Background and Objectives
- Methodology
- Results (The occurrence of Large Mammals in the Sebulu Experimental Forest)
- Conclusions and Future Directions

Background problem

- The main goals of rehabilitation and reforestation schemes in Indonesia ideally are addressed the problems of **land degradation, environmental recovery, and habitat restoration**
- Even a well-managed rehabilitation area has been performed, the valuation of its success is **problematic**
- Some projects only reported technical and organizational outcomes, such as **area planted** and **labor-days expanded**
- There has never been a formal scheme to monitor the progress of rehabilitated sites that would inform us about progressive changes in land cover and their possible implication for biodiversity



Background concept (ecological point of view)

- Following the time, habitat heterogeneity in rehabilitation areas occurs over time and space showed by better land coverage
- Wild animal species will respond to the running habitat changes in various ways, as resources also become available
- Information about selected species in this area could function as a baseline for biodiversity data which could be periodically monitored

Background (objectives)

- This study is meant to acquire information about the presence of selected group of wild animal species and inform their ecological characteristics in order to understand habitat development within rehabilitation sites → can be an indicator for the success of rehabilitation effort

Methodology

- Observation of some selected species is considered to be sufficient to make an analysis which is based on ecological knowledge on selected species that could reflect the progress of rehabilitation areas (large mammals)
- **Large mammals** → direct observation, signs searching and camera trapping



The occurrence of large mammals in the Sebulu Experimental Forest

Species	Common name
Order: PRIMATES	
Family: CERCOPITHECIDAE	
<i>Macaca fascicularis</i>	Crab-eating Macaque, Cynomolgus Monkey, Long-tailed Macaque
<i>Macaca nemestrina</i>	Pig-tailed Macaque
Family: HOMINIDAE	
<i>Pongo pygmaeus morio</i>	Northeast Bornean Orangutan
Order: RODENTIA	
Family: HYSTRICIDAE	
<i>Hystrix brachyura</i>	Malayan Porcupine
Order: CARNIVORA	
Family: VIVERRIDAE	
<i>Viverra zangara</i>	Malay Civet
<i>Paradoxurus hermaphroditus</i>	Common Palm Civet
<i>Hemigalus derbyanus</i>	Banded Civet, Banded Palm Civet

The occurrence of large mammals in the Sebulu Experimental Forest

Species	Common name
Family: HERPESTIDAE	
<i>Herpestes brachyurus</i>	Short-tailed Mongoose
Family: FELIDAE	
<i>Prionailurus bengalensis</i>	Leopard Cat
Order: CETARTIODACTYLA	
Family: SUIDAE	
<i>Sus barbatus</i>	Bearded Pig
Family: TRAGULIDAE	
<i>Tragulus kanchil</i>	Lesser Oriental Chevrotain, Lesser Malay Chevrotain, Lesser Mousedeer, Mouse Deer
<i>Tragulus napu</i>	Greater Oriental Chevrotain, Greater Mousedeer, Larger Malay Chevrotain, Larger Mousedeer, Napu
Family: CERVIDAE	
<i>Muntiacus muntjak</i>	Barking Deer, Bornean Red Muntjac, Sundaland Red Muntjac
<i>Rusa unicolor</i>	Sambar Deer

Primates



Pig-tailed macaque
(*Macaca nemestrina*)

- The density of *Macaca fascicularis* could temporarily increase and tend to invade early successional forest (Johns & Johns 1995)
- *Macaca nemestrina* are less commonly observed in the slightly disturbed forest compared to the undisturbed forest (Meijaard et al. 2005)



Long-tailed macaque
(*Macaca fascicularis*)



Primates

- The ability to change the relative proportions of different food types in the diet, specifically to exploit available young leaves in the absence of fruit (Meijaard et al. 2005)
- The degree of terrestriality (Meijaard et al. 2005), where most Old World Monkey species (incl. macaques) capable of colonizing secondary forest are at least semi-terrestrial inhabitants, which must facilitate survival in small patches
- Macaques are opportunistic feeders and take a much more full range of foods in their diet than most monkey species; they occupy a broad niche (MacKinnon et al. 1996)



- Orangutan population has attempted to occupy and survive in the 'artificial' habitats which have been modified by humans such as rehabilitation areas
- The Orangutan presence in SEF has shown the fact that the area is part of Orangutan's remaining range and as a refugee when Orangutan's habitats have been destroyed and converted into oil-palm plantations





- SEF is one of Orangutan's remaining habitat, although, the quality itself is still questionable as habitat. The area are connected with some villagers' fruit plantation
- Some fruits that have been planted are durians *Durio zibethinus*, rambutans *Nephelium lappaceum*, mangoes *Mangifera indica* and kelengkengs *Litchi chinensi*, and they are considered as important foods of Orangutan. Orangutan attack the fruit plantation when mass fruiting period comes

Rodentia

- Porcupine is considered to be the most dispersed rodent species across their habitat, both in natural covers and cultivated areas
- They had never encountered in the plantation forest in two sampling occasion. This occurrence seems to correlate with food abundance. They mainly consume fallen fruits (Payne et al. 1985)



Malayan porcupine
(*Hystrix brachyura*)

Carnivora



Leopard Cat
(*Prionailurus bengalensis*)

- The Leopard Cat is the most frequently recorded small cat across most of its wide range (Sanderson et al. 2008), but secondary forest might be the preferred habitat of the Leopard Cat (Santiapillai & Supraham 1985)
- Among other small Asian felids, the Leopard Cat is more tolerant of disturbed areas. It can inhabit areas with human settlements. It is also a generalist, feeding on the most available prey.
- Higher survival rates (92%) were recorded in a protected area with little human influence, compared with lower rates in areas with greater human activity (53-82%) (Sanderson et al. 2008)

Carnivora



Malay civet
(*Viverra zibellina*)



Common palm civet
(*Paradoxurus hermaphroditus*)



Banded palm civet
(*Hemigalus derbyanus*)




Short-tailed mongoose
(*Herpestes brachyurus*)



Carnivora

- Some species of Viverridae represent more opportunistic predator group. Despite their taxonomic status within the Carnivora, some civets feed almost exclusively on fruit, generally favoring sugar-rich and soft-pulped fruit (Heydon & Bulloh 1996; Rabinowitz 1991)
- Short-tailed mongoose *Herpestes brachyurus* has wide distribution, presumed large population, tolerance to some degree of habitat modification (Widmann et al. 2008). It is found near rivers, in lowland primary and secondary forest and plantations (Payne et al. 1985; Heaney et al. 1998)



Barking deer
(*Muntiacus muntjac*)



Sambar deer
(*Rusa unicolor*)



Greater mousedeer
(*Tragulus napu*)



Bearded pig
(*Sus barbatus*)





Cetartiodactyla

- Four species of ungulates that were detected in research area are common in a plantation, secondary forest, forest edges, riverbanks, grassy clearings, secondary scrub and open farmlands (Nowak 1999). They can inhabit in both open and dense interior forest. They can be categorized by general feeding behavior and habitat selection
- Both species of mouse-deer are mainly dependent upon the fallen fruit of strangling figs (*Ficus* spp.), although they also feed on other items, such as leaves (e.g., *Octomeles sumatrana*) or mushrooms (*Russula* sp.) (Matsubayashi et al. 2003).



Cetartiodactyla

- The Bornean Red Muntjak feeds primarily on fruits and browse, being selective for plant parts, and remain within one or a few vegetation types throughout the year
- Sambar deer are generalist grazers and browsers that feed on a range of grasses and plant parts. They appear to be a species that benefits from forest conversion (Meijaard et al. 2005 and Payne et al. 1985)
- Bearded Pigs *Sus barbatus* utilize a wide variety of habitat types.

Conclusions

- Vegetative growth in the rehabilitation area provides multiple niches and habitat components for particular fauna populations, but any species may or may not come back upon restoration of the habitat, depending on the ecology of that species
- Generally, they mostly are omnivore and generalist with wide range of ecological amplitude. These characteristics seem to be the factors that make them could occupy the rehabilitation area (Sebulu Experimental Forest)
- When they start to occupy the areas is a critical point that indicates their response to habitat change.

Future Directions

- Rehabilitation areas could be a good model in studying the response of large mammal species, populations, and communities to dynamic conditions. Future research could emphasize the high ecological value of retaining remnant forest patches within highly human-dominated and managed landscapes for large mammals by:
 - Examine forest connectivity and the opportunities provided by rehabilitation techniques
 - Investigate the spatial distribution and size of wildlife source and sink areas; what inhibits and encourages the movement of particular species into post-rehabilitation
 - Consider the forest-agriculture boundary, its impact on wildlife, and how people view and respond to wildlife



Secondary forest around the Sebulu Experimental Forest



Interior situation under the stand of *Shorea* spp.

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