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Nocturnal bird composition in relation to habitat heterogeneity in small scale oil palm agriculture in Malaysia

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ABSTRACT

The expansion of oil palm cultivation is recognised as a major cause of tropical biodiversity loss. In contrast to large-scale plantations, oil palm smallholdings being more heterogeneous may support greater biodiversity. This study examined the effects of local and landscape level variables on the composition of nocturnal bird species in Malaysian oil palm smallholdings. Using visual and aural point sampling, we made 1408 encounters with nine owl and two nightjar species. The Biota-Environment-Stepwise matching analyses (BEST) indicated four predictor variables (three local variables; number of crop species, widths of roads and trenches, and one landscape variable; distance to the nearest main road) significantly influenced the community assemblages of nocturnal bird species in the smallholdings. Generalized Linear Models (GLMs) further indicated seven predictor variables (numbers of palms and houses, widths of roads and trenches, distances to the nearest forest and house, as well as palm height) significantly influenced the abundances of certain nocturnal species. These findings not only improve our understanding on habitat preference of nocturnal birds in the Sunda region but also support the argument that habitat complexity in cultivated areas may aid in biodiversity conservation, at least for nocturnal birds.

1. Introduction

Originating from West and Central Africa, oil palms (*Elaeis guineensis*) have been planted on a vast scale throughout many developing countries in humid tropical regions (Wakker et al., 2004; Koh and Wilcove, 2007, 2008; Corley and Tinker, 2008; Fitzherbert et al., 2008; Tan et al., 2009). Triacylglycerol (or palm oil) derived from the palms is a main ingredient for a huge variety of edible, cosmetic and industrial products (Pearce, 2008) and it has become a major component of the national economy in many developing countries (e.g. Malaysia, Indonesia and Brazil) (Koh and Wilcove, 2008; Shuit et al., 2009). In Southeast Asia, millions of hectares of forested land have been converted into oil palm cultivation over the last few decades (Koh and Wilcove, 2007; Groom et al., 2008).

Malaysia and Indonesia are two leading countries in the global palm oil trade (FAO, 2015). By 2005, the two countries accounted for about 83% of the world's palm oil production and dominated 89% of the global exports of palm oil (Brown and Jacobson, 2005). Currently, Malaysia alone contributes about 39% of global palm oil production and 44% of the world exports (MPOC, 2012). To date, oil palm cultivation makes up 77% of the total agricultural area of Malaysia covering about 15% of the total 33 million ha land area of the country (MPOC, 2012). In Malaysia, there are two main types of oil palm management, namely plantations and smallholdings. Plantations are industrial scale monoculture planting systems of typically more than 500 ha. They are managed mostly by companies or government owned corporations. On the other hand, smallholdings are owned by local farmers who practice small-scale planting strategies involving intercropping with other cultivated plants, within an area sometimes as little as 5 ha (Ismail et al., 2003; Azhar et al., 2011; Jambari et al., 2012).

Undeniably, the existence of this monoculture landscape has altered the biological communities that were present before cultivation was established. Yet, in spite of rigorous agricultural management, even homogeneously structured, big oil palm

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plantations have been shown to serve as habitat for some fauna species (Azhar et al., 2011; Jambari et al., 2012). Despite the number of species found in oil palm cultivation being far below that found in natural forests, oil palm cultivation supports considerable species numbers, e.g. in the case of birds (Koh, 2008; Azhar et al., 2011, 2014a; Jambari et al., 2012), mammals (Azhar et al., 2014b) and insects (Krooss and Schaefer, 1998; Wickramasinghe et al., 2004; Koh, 2008; Turner and Foster, 2008). Such findings indicate the possibility of cultivated areas functioning either as a main or an alternative habitat for species which are able to adapt to this environment.

Unusual features of the oil palm agro-ecosystem give its nocturnal avifauna special interest. An abundant year-round oil-rich crop can attract many rodents, e.g. squirrels and treeshrews by day, which are replaced by high population densities of various rat species by night (Wood, 1968; Medway, 1983; Puan, 2013). Oil palms contain almost no cavities suitable for hole-nesting owls and hence opportunities for predatory birds are constrained by the scarcity of nest sites. Further, the continuous canopy of palm fronds may interfere with typical bird foraging methods and there are risks from management practices such as rodent poisoning (Puan, 2013). Previous studies in Malaysian oil palm plantations have suggested that Common Barn-owls (*Tyto alba*) may provide biological control of rats in oil palm plantations (Lenton, 1984; Hafidzi and Naim, 2003; Puan et al., 2012; Puan, 2013 Puan, 2013). Besides Barn-owls, oil palm plantations frequently serve as habitats for other owls, i.e. Spotted Wood-owl (*Strix seluputo*) and Sunda Scops-owl (*Otus lempiji*) (Puan, 2013), and a study conducted in oil palm smallholdings in Malaysia recorded several other species that are more typically associated with forest habitats (i.e. Brown Wood-owl (*Strix leptogrammica*) and Dusky Eagle-owl (*Bubo coromandus*) (Atikah et al., 2013). This raises questions about nocturnal avian community structure, the relative importance of predators and insectivores in such a habitat, the significance of oil palm cultivation as supplemental habitat for otherwise forest-dependent species, and the effects of landscape scale influences such as distance from forest. Other than food availability (Atikah et al., 2013), local and landscape level habitat structure may influence the composition of nocturnal birds particularly in smallholdings that practice intercropping. Both local and landscape level structure found in smallholdings are different from those of large-scale plantations (Azhar et al., 2011, 2015). Hence, this study examined the effects of local and landscape level variables on the composition and abundance of nocturnal bird species in oil palm smallholdings in Peninsular Malaysia, with prior knowledge on the occurrence of these birds in these areas (Atikah et al., 2013).

2. Methods

2.1. Study sites

We conducted the study in the oil palm smallholdings (approximately 5300 ha) located at Banting (2°47′48″N, 101°31′10″E), Tanjung Karang (3°24′24″N, 101°15′26″E) and Sabak Bernam (3°50′50″N, 100°53′19″E), Selangor state, Peninsular Malaysia (Fig. 1). The three sites were selected for this study to increase the range of potential habitat variability sampled. On average at each site, there were about 20–30 smallholders who individually owned an area that ranged from 1 to 50 ha. All study sites were located in the western part of Peninsular Malaysia and had similar topographical features (a flat coastal area with an altitude ranged from 4 to 11 m above sea level and the surrounding landscape matrices comprised mangrove forests, peat swamp forests and/or paddy fields). The study sites were primarily planted with oil palms which were intercropped with banana (*Musa* spp.), coconut (*Cocos nucifera*) and/or jackfruit (*Artocarpus heterophyllus*), and other subsistence crops. Unlike large scale plantations, the planting systems employed by the smallholders varied resulting in a non-uniform pattern of palm age (1–15 years old), palm spacing and arrangement as well as openness of understory stratum and availability of frond piles. Palm stands of three years old and above typically start producing fruit bunches throughout the year. The average daily temperature and humidity were similar at all sites and ranged from 24 to 33 °C and 65 to 70%, respectively (MET, 2014). There were roads (being frequently used by smallholders to transport fruit bunches and/or carry out daily activities) and trenches (as part of the irrigation system that was usually

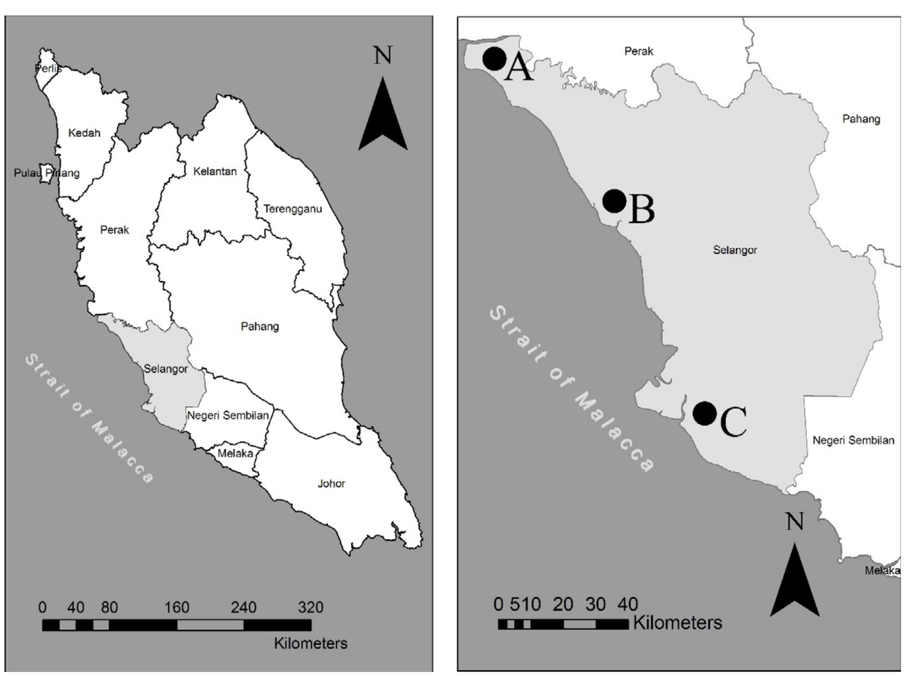

Fig. 1. Location of study sites; (A) Sabak Bernam, (B) Tanjung Karang and (C) Banting.