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The Filtering Effect of Oil Palm Plantations on Potential Insect Pollinator Assemblages from Remnant Forest Patches

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Abstract: Extensive oil palm plantations worldwide are dependent on insect pollination, specifically by introduced African weevils (*Elaidobius* spp.). The effectiveness of these weevils has been questioned following poor pollination and yield loss in Malaysia. Indigenous thrip (Thysanoptera) species, and moths (Lepidoptera) in the genus *Pyroderces*, may also be pollinators of oil palm, while the role of bees (Hymenoptera) and flies (Diptera) is unknown. The potential of native pollinators remains uncertain because of the almost total clearing of forest habitat from oil palm landscapes. In this study, we investigate the value of small high conservation value (HCV) forests as sources of potential native insect pollinators of oil palm in northern Sarawak. We further examine the filtering effect of oil palm-dominated landscapes on the species assemblages of six potential pollinator insect orders: Blattodea, Coleoptera, Diptera, Hemiptera, Hymenoptera and Lepidoptera. Orders differed in both species composition and abundance between forest and oil palm plantations, with an average of 28.1% of species unique to oil palm. Oil palm presented a soft permeable boundary to Coleoptera, Hymenoptera and Lepidoptera. Their species richness and abundance differed little between habitats with distance, despite species turnover. In contrast, oil palm presented a harder boundary to Diptera with a decline in both species richness and abundance with distance into oil palm. The abundance of the oil palm weevil (*Elaedobius kamerunicus*) was low compared to the native dominants, but similar to levels displayed by native thrips that may be pollinators of oil palm. The functional diversity of well-known pollinator guilds—bees and flies—was similar in forest and oil palm, suggesting that potential pollinators may yet exist among native orders of insects. Contrary to the prevailing opinion, even small forest patches in oil palm landscapes may provide native pollinator pressure.

Keywords: pollination biology; boundary effect; ecological filter; fragmentation ecology; functional diversity; introduced weevil; landscape ecology; native pollinators

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1. Introduction

The increasing global demand for palm oil (*Elaeis guineensis*) has caused landscape-scale deforestation and expansion of oil palm estates in Malaysia since 1917 [1], such that Malaysia and Indonesia retain only 3% of their primary forest [2]. Oil palm establishment since the 1980s in Sarawak, Malaysian Borneo, has mostly replaced secondary forest [3,4], and 33.4% (from 2005–2010) of Sarawak's peatland [5–7]. Between 1990 and 2005, plantation area increased from 1.8 mil. to 4.2 mil. ha in Malaysia, and as of 2015 Malaysia is the second largest producer of oil palm globally, with 5.4 mil. ha of oil palm producing 25 mil. tons of palm and kernel oil annually with a value of RM63.62 bil. [8]. The palm oil market is not yet saturated and increasing diversification of uses and its value as biodiesel portents further increases in the production [9]. It is estimated that by 2050 a further 12 million ha of oil palm will have to be planted to meet demand [10]. Extensive clear-felling and