First evidence of mutualism between Pied Fantail (*Rhipidura javanica*) and Bornean Red Muntjac (*Muntiacus muntjak*)

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Introduction

Symbiotic relationship between species is believed to have evolved, because it offers ecological advantage and workable solutions to many of the basic problems of health and survival (Margulis, 1981; Watson and Pollack, 1999). Mutualistic relationships are common across a wide variety of species, such as cleaning relationship between Caribbean cleaning gobies (*Elacatinus evelynae*) and long finned damselfish (*Stegastes diencaeus*) (Cheney and Cote, 2005), aphid insects and the bacterium *Buchnera aphidicola sp*. (Toft et al., 2009), Clown fishes and sea anemones (Fautin, 1991) as well as pelagic thresher sharks (*Alopias pelagicus*) and cleaner fish (*Labroides dimidiatus*) (Oliver, 2011).

Mutualistic relationships between bird and ungulates are very common. Red-billed oxpeckers (*B. erythrorhynchus*) are often seen plucking ticks from a wide range of wild and domestic ungulate (Hart et al, 1990) (Fig.1), although the exact nature of the symbiosis remains poorly understood (Weeks, 2000). Fan-tailed ravens (*Corvus rhipidurus*) and camels (*Camelus dromedarius*), Scrub Jays (*Aphelocoma coerulescens*) and Columbian black-tailed deer (*Odocoileus hemionus columbianus*), Black-billed magpies (*Pica pica*) and Fallow deer (*Dama dama*), Yellow-bellied Bulbuls (*Alophoims phaeocephalus*) and klipspringers (*Oreotragus oreotrugus*), Pale-winged Starlings (*Onychog n. nabouroup*) and mountain zebras (*Equus zebra*) and birds and capybaras are all well-described mutualistic bird/mammal relationships (Genov, 1997; Isenhart and DeSante, 1985; Lewis, 1989; Penzorn and Horak, 1989; Roberts, 1993; Tomazzoni et al., 2005).

There are a lot fewer observations of avian-mammal symbiosis from tropical forests. It remains to be seen, however, whether this should be attributed to the fact that (1) these habitats support far fewer species and lower densities of large-bodied terrestrial herbivores, or (2) far less is known about the behavior and interspecific associations of tropical forest vertebrates. Peres (1996) reported one of the few bird and ungulate interactions from tropical rainforests - in this case the Amazon - where Black caracara (*Daptrius ater*) and Pale-winged trumpeter (*Psophia Zeucoptera*) were observed providing "cleaning" services to lowland tapirs (*Tupirus terrestris*) and gray bracket deer (*Mazama gouazoubira*).

During a study in Kalimantan tropical forest, we recorded a symbiotic relationship between Pied fantail (*Rhipidura javanica*) and Bornean red muntjac (*Muntiacus muntjac*). This paper describes what we believe to be the first evidence of bird-mammal mutualism observed in a Southeast Asian tropical rainforest.

Study Areas and Methodology

The study site is located in Kota Waringin Barat, Central Kalimantan Province, Indonesia. The area consists a mosaic of forest patches and open grassland. The forest patches measured

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Figure 1. Mutualism between birds and mammals is a common phenomenon. Even large birds, such as the Slender-billed crow, *Corvus enca*, are often observed feasting on ectoparasites found on Java deer, *Rusa timorensis*, in Baluran National Park (left). Red-billed oxpeckers, *Buphagus erythrorhynchus*, are common in Sub-Saharan Africa, where they feed almost exclusively on what they can collect from the skin of large mammals (right). © Carl Traeholt / Copenhagen Zoo)

approximately 140ha consisting of a combination of selectively logged *Dipterocarp* and swamp forest habitat. The surrounding grassland is a result of recent deforestation and dominated by grass and fern species such as *Imperata cylindrical* and *Gleichenia linearis*. The altitude ranged from 35-43m asl.

We deployed 13 digital camera-traps (Trail Cam) randomly in two patches of forest between May and July, 2012. All cameras were set to "high" sensitivity and video mode with 10 seconds shooting interval and 60 seconds recording duration. Video mode was selected to allow for both species identification and behavioral observation. The cameras were checked once per month, and videos were downloaded and analyzed.

Result and Discussion

We recorded two incidents of symbiotic interaction between Pied fantail and Bornean red muntjac on the 14th and 18th of May, respectively. The first interaction lasted for 50 seconds. A male and female muntjac were seen feeding on the "Asam-asam" fruit (*Tetramerista glabra*) that had dropped to the ground. During the feeding session a Pied fantail moved between the ground and a small 75cm tree seedling in what appeared to kindle the muntjacs into accepting it landing on them. Eventually, the fantail landed on the rump of the male muntjac after which it stopped feeding for 50 seconds and took a position that allowed the fantail to move freely between its hind legs as well as its back to feed. This interaction is similar to the one observed between Black-tailed deer and Scrub-jays (Isenhart and DeSante, 1985; Olubayo et al., 1993).

Although bird-mammal symbiotic interactions are rarely observed in tropical forests, it is likely a common event that is difficult to observe in a dense rainforest habitat. How common such interactions are and to what extent the bird-mammal relationship is mutually beneficial remains a question, however, in most cases the relationships are obligate for the birds. Studies have shown that "cleaner" birds do not necessarily reduce ectoparasite loading on the mammals on which they feed, and sometimes have outright negative impact on the host's wound-healing abilities (Weeks, 2000).

The symbiotic relationship between birds and mammals is likely more complex than previously anticipated. However, the Pied fantail and the muntjac recorded on our video exhibited familiarity with each other, which suggests that such events have developed from past experiences, either between the respective bird-mammal individuals, or in general.

The Pied fantail-muntjac observation demonstrated the advantage of selecting "video-mode" setting for camera-trapping surveys. It provided behavioural insights into the interaction between bird and mammal that would not have been possible in "still picture" mode. We hope that this observation will promote more studies on this topic, to improve our understanding of bird-mammal symbiosis in tropical rainforest habitats.

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