



Molecular prevalence and phylogenetic relationship of *Haemoproteus* and *Plasmodium* parasites of owls in Thailand: Data from a rehabilitation centre

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ABSTRACT

Owls are nocturnal raptors that are prevalently infected with haemosporidian parasites worldwide. These birds were commonly submitted to the Kasetsart University Raptor Rehabilitation Unit, Kasetsart University, Thailand and were examined using PCR-based methods for the presence of haemosporidian infections of by the genera *Plasmodium* and *Haemoproteus*. Blood samples from 167 individual owls belonging to 12 species common in Thailand were collected between September 2012 and February 2018. The overall prevalence of haemosporidians was 34.1%, with *Haemoproteus* infections (25.1%) being more prevalent than *Plasmodium* infections (9.0%). The prevalence of both *Haemoproteus* and *Plasmodium* parasites was similar in all seasons of the year. Molecular characterization revealed 17 new haemosporidian parasite lineages (11 *Haemoproteus* and six *Plasmodium*), with genetic variation among partial cytochrome *b* sequences ranging from 0.0% to 3.6% in *Haemoproteus* lineages and 0.2%–8.8% in *Plasmodium* lineages. Phylogenetic analysis showed that all *Haemoproteus* lineages detected in owls appeared in one well-supported clade together with other parasites belonging to the *Parahaemoproteus* subgenus, indicating their close evolutionary relationship and common transmission modality by *Culicoides* biting midges. This study shows the existence of prominent non-described haemosporidian parasite diversity in Thai owls and provides baseline molecular information for further research on the genetic diversity of owl haemosporidian parasites. New DNA sequence information can be used for the diagnosis of owl infections, which have been often reported during rehabilitation planning.

1. Introduction

Kasetsart University Raptor Rehabilitation Unit (KURRU) was established in 2007 for the rehabilitation of both migratory and resident raptors (Accipitriformes, Falconiformes and Strigiformes) in Thailand (Salakij et al., 2015b). KURRU admits birds brought by local authorities and citizens throughout Thailand. The rehabilitation procedures include a health assessment and subsequent treatment, behaviour monitoring, and then release back into the wild. Furthermore, KURRU has made efforts to raise public awareness of raptor conservation through the mainstream media (Kidsin et al., 2012).

Owls (Strigiformes) are nocturnal or crepuscular predators that hunt small vertebrates, especially small rodents (Kunsorn et al., 2015). There are 19 species of resident owls and two species of non-breeding migratory owls in Thailand (BCST, 2018), including the near threatened

reddish scops-owl, *Otus rufescens*, and the vulnerable white-fronted scops-owl, *Otus sagittatus*, (IUCN, 2019). Most of the owls are legally protected by the Wild Animal Reservation and Protection Act, B.E. 2535 (1992) of Thailand, which prohibits trading, hunting and keeping these birds as pets. The owls are considered 'umbrella' species due to their role as top predators in the food chain which contributes to ecological balance in their environments (Krone et al., 2008). In agricultural areas, owls are used as an alternative biological control agent of pests (Puan et al., 2011). In southern Thailand, artificial nests have been used to increase the number of owls in an attempt to eliminate small rodents in oil palm plantations (Tavitchasri et al., 2016).

Between 2008 and 2011, owls were the most frequently admitted birds at KURRU (Kidsin et al., 2012). The most common reasons for admission were trauma in adults and malnutrition and parental death or abandonment in chicks. Blood parasite infections (Salakij et al.,

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