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# *Plasmodium knowlesi* and other malaria parasites in long-tailed macaques from the Philippines

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## Abstract

**Background:** *Macaca fascicularis* (long-tailed macaque) is the most widespread species of macaque in Southeast Asia and the only species of monkey found naturally in the Philippines. The species is the natural host for the zoonotic malaria species, *Plasmodium knowlesi* and *Plasmodium cynomolgi* and for the potentially zoonotic species, *Plasmodium inui*. Moreover, other *Plasmodium* species such as *Plasmodium coatneyi* and *Plasmodium fieldi* are also natural parasites of *M. fascicularis*. The aims of this study were to identify and determine the prevalence of *Plasmodium* species infecting wild and captive long-tailed macaques from the Philippines.

**Methods:** A total of 95 blood samples from long-tailed macaques in the Philippines were collected from three locations; 30 were from captive macaques at the National Wildlife Rescue and Rehabilitation Center (NWRRC) in Luzon, 25 were from captive macaques at the Palawan Wildlife Rescue and Conservation Center (PWRCC) in Palawan and 40 were from wild macaques from Puerto Princesa Subterranean River National Park (PPSRNP) in Palawan. The *Plasmodium* spp. infecting the macaques were identified using nested PCR assays on DNA extracted from these blood samples.

**Results:** All 40 of the wild macaques from PPSRNP in Palawan and 5 of 25 captive macaques from PWRCC in Palawan were *Plasmodium*-positive; while none of the 30 captive macaques from the NWRRC in Luzon had any malaria parasites. Overall, *P. inui* was the most prevalent malaria parasite (44.2%), followed by *P. fieldi* (41.1%), *P. cynomolgi* (23.2%), *P. coatneyi* (21.1%), and *P. knowlesi* (19%). Mixed species infections were also observed in 39 of the 45 *Plasmodium*-positive macaques. There was a significant difference in the prevalence of *P. knowlesi* among the troops of wild macaques from PPSRNP.

**Conclusion:** Wild long-tailed macaques from the island of Palawan, the Philippines are infected with *P. knowlesi*, *P. inui*, *P. coatneyi*, *P. fieldi* and *P. cynomolgi*. The prevalence of these *Plasmodium* spp. varied among the sites of collection and among troops of wild macaques at one site. The presence of these simian *Plasmodium* parasites, especially *P. knowlesi* and *P. cynomolgi* in the long-tailed macaques in Palawan presents risks for zoonotic transmission in the area.

**Keywords:** Simian *Plasmodium*, *Macaca fascicularis*, Palawan, *Plasmodium knowlesi*

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