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## Short communication

# The discovery of two spotted leopards (*Panthera pardus*) in Peninsular Malaysia

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### Abstract

We discovered the presence of two individual spotted leopards *Panthera pardus* in Ulu Muda Forest Reserve, a previously under-researched selectively logged rainforest of Peninsular Malaysia. These findings are unexpected, because only two other studies have detected the spotted morph amongst many other melanistic leopards caught on camera traps in Peninsular Malaysia. We discuss the implications of our findings with respect to the prevalence of melanism among leopards in the region.

**Keywords:** Melanism, habitat modifications, felid conservation

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## Introduction

Melanism, commonly known as the production of a group of pigments (collectively known as melanin) in the skin, leads to the condition of having dark-colored skin or fur coat. The wild felid family (Felidae) exhibits a wide variety of coat colors and patterns, and melanism is common in 11 of the 37 felid species [1]. One of the best known examples of melanistic polymorphism is the leopard, in which melanism is conferred by a recessive allele [2]. The black leopard is common in the equatorial rainforest of Malaya, in the forests and mountains of Java, and in the tropical rainforest on the slopes of some African mountains, such as Mount Kenya [3, 4]. They have also been reported to occur in China, Myanmar, Assam, Thailand, and Nepal [5]. Interestingly, a study in 2009 reported that leopards south of the Isthmus of Kra on mainland Southeast Asia (Peninsular Malaysia and Southern Thailand) are all melanistic. Another study commented that this “is also possibly the only place in the world where an entire population of animals is almost completely composed of the melanistic form of a species” [6].

Here, we report the discovery of two individuals of spotted leopard in Peninsular Malaysia in a study site south of the Isthmus of Kra. These two individuals were caught on our camera traps as a by-catch of our ongoing research work on clouded leopard. This unexpected discovery deepens the mystery into the spatial dynamics of melanism in the region.

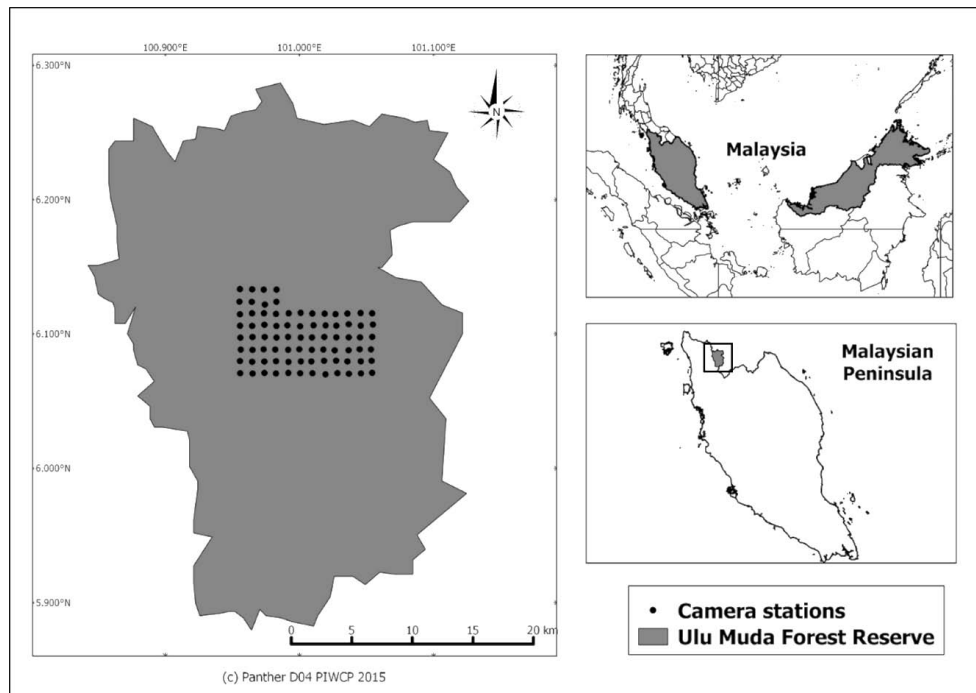
## Methods

Our on-going research into the ecology of clouded leopard *Neofelis nebulosa* and associated felid guild in Ulu Muda Forest Reserve began in November 2014. The study site of Ulu Muda Forest Reserve is located in the northern state of Kedah, Peninsula Malaysia (Fig. 1 & 2). The reserve covers an area of 1,051 km<sup>2</sup> and is comprised of lowland dipterocarp, hill dipterocarp and upper hill dipterocarp forest, with an elevation of 97 – 1,256 m. The position of this forest range gives it the potential to act as an important wildlife corridor connecting to the forests in Thailand and to the Pedu Forest Reserve. Ulu Muda Forest Reserve is also an important catchment area for two lakes: Ulu Muda and the larger Pedu Lake, supplying water to the paddy fields in the states of Perlis and Kedah. Selective logging by the forestry department of Kedah state is ongoing in the southwestern regions of Ulu Muda (personal observation during field work). Additionally, evidence of poaching activity (gun shells) was found during the deployment of camera traps.

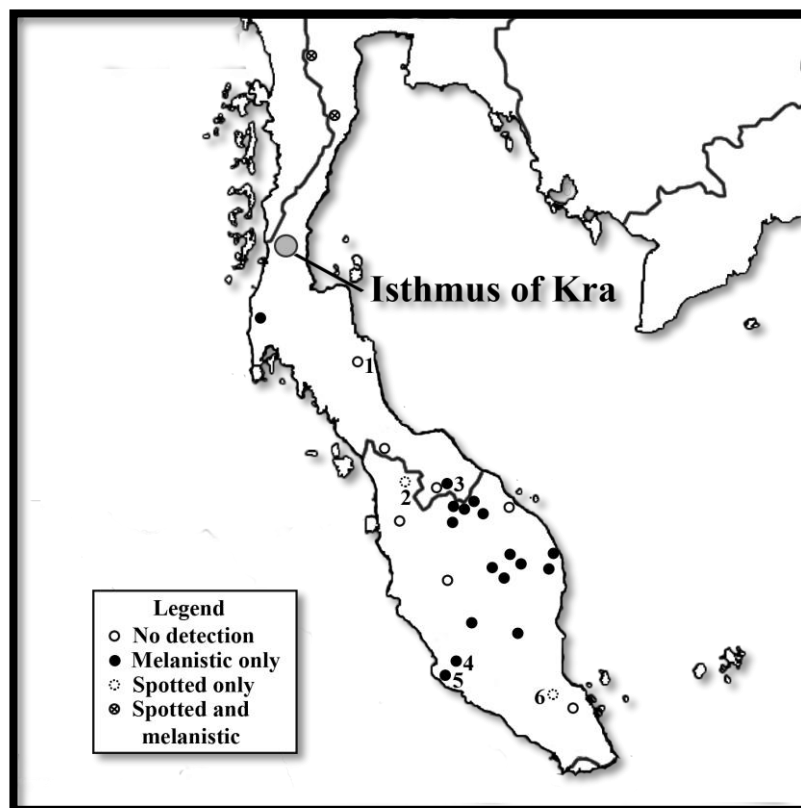
At present we have a total of 160 cameras deployed at a density of 1 km<sup>2</sup>, two per camera trap location, covering 80 km<sup>2</sup> of the Ulu Muda Forest Reserve. So far we have retrieved 57 days of data from each of the 160 camera traps, from which we obtained the equivalent of 9,120 camera trap nights producing 21,186 camera trap images.

## Results

From the above-mentioned camera trap effort we detected two non-melanistic leopards *Panthera pardus* at three of our camera trap locations. From three separate images of the right flank we identified one, probably female, individual (Fig. 3A) detected on the 22<sup>nd</sup> November 2014 at 6:51 p.m. and 25<sup>th</sup> November 2014 at 5:24 p.m., and one male (Fig. 3B) on the 4<sup>th</sup> January 2015 at 12:10 a.m. Coordinates of these discoveries have been intentionally omitted as this animal is a high-risk poaching target [7]. We had no camera captures of melanistic leopards.



**Fig. 1. Location of Ulu Muda Forest Reserve and the survey area. Coordinates are in WGS 84 UTM 47N**



**Fig. 2. Map of Peninsular Malaysia and Southern Thailand showing the detection of spotted and/or melanistic leopard. Points with numbers are ones recorded after 2009, and added to the map adapted from the Kawanishi et al. [11] study. Points without numbers are the ones recorded in the Kawanishi et al. [11] study. Site names: 1 – Thale Noi [15]; 2 – Ulu Muda (current study site); 3 – Hala-Bala [15]; 4 – Ayer Hitam Forest reserve [14]; 5 – Plantation estates in Selangor [11]; 6 – Endau Rompin National Park [8].**

## Discussion

The spotted leopard is rare in Peninsular Malaysia – so far it has been reported only in two other written works: one in Endau Rompin National Park, in the southern state of Johor [8]; and the other mentioned anecdotally (in an old identification book) as being outnumbered by 'conventionally colored leopards' in Malaya [9]. This is despite the extensive camera trapping efforts in Peninsular Malaysia, all of which (with the exception of the above two studies) have recorded the presence of only the melanistic form [6, 10-15]. A study in 2010 examined the frequency of leopard melanism in 22 locations in Peninsular Malaysia and southern Thailand [5] (Fig. 2). Out of 42,565 trap-nights, 445 photos of melanistic leopards and 29 photos of the spotted morph were collected; all photos of the spotted leopard were taken from study areas north of the Isthmus of Kra, which is the narrow neck of southern Myanmar and Thailand and a well-known zoogeographical boundary [16]. We also added data from five studies since 2010 on figure 1. All these suggest that spotted leopards are at the very least rare in Peninsular Malaysia.



**Fig. 3. Trap photos of one possible female (left) and one male (right) spotted leopard.**

Kawanishi (2010) suggested that the black morph has become genetically fixed south of the Isthmus of Kra due to an historical bottleneck event. Subsequently, genetic drift or natural selection or both could explain the fixation of melanism in leopards in Peninsular Malaysia. A low rate of gene flow across the narrow Isthmus of Kra was also proposed to cause the segregation of morphs between both sides of the Isthmus [5]. Our discovery of the spotted morph in Peninsular Malaysia, together with the discovery in Endau Rompin National Park, in areas where only the black morph has been reported, provide more insights on the spatial distribution of melanism in this region. It is possible that the spotted morph might have been migrants from recently disturbed areas in the north, or that the melanistic phenotype never become entirely fixed. It also suggests that the degree of melanism might be an evolutionary response to different environments: the pigment genes can help the melanistic form to adapt better to their evergreen dipterocarp forest with closed canopies and low light levels, whereas the spotted ones may do better in open grassland [17]. For example, the black morph may be

at a selective advantage in the forest through camouflage from tigers, which are larger in size and overlap with the leopards in their ecological niches [18]. Our discovery of two spotted individuals and none of the black morph might reflect a lack of competition from tigers in this forest. However, absence of evidence of tigers is not necessarily evidence of their absence, and although our camera traps detected no tigers, local people have reported the presence of tiger paw prints and claw markings on trees. Similarly, Weller [8] detected their spotted leopard in an area where tigers were known to be present. Our study area may also house melanistic leopards that have not been captured by our cameras. We therefore have no support for the hypothesis that leopard melanism is driven by tigers.

### Implications for conservation

The discovery of spotted leopards at Ulu Muda forest adds further intrigue to the selective pressure determining leopard coloration. Ulu Muda is one of the two known places in Peninsular Malaysia where the spotted leopard can be found. Its rarity in areas south of Isthmus of Kra accentuates the importance of the forests of Ulu Muda Forest Reserve as a valuable conservation area. Unfortunately, ongoing logging heading north from the southwestern regions of Ulu Muda, as well as poaching activities pose threats to this large carnivore. Therefore, there is a need for the loggers to better manage their logging regime spatially and sustainably, and for the curbing and monitoring of current poaching activities to minimize their impacts on the spotted leopard.

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