Short communication

Feasibility of using scent-baited hair traps to monitor carnivore populations in Peninsular Malaysia

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Abstract
Non-invasive genetic sampling is increasingly being used for monitoring mammalian carnivore populations. However, environmental conditions in the tropics challenge researchers' ability to collect samples. We present the results of a preliminary study on the feasibility of using scent-baited hair traps for population monitoring of mammalian carnivores in Peninsular Malaysia. Stations were baited using either fatty acid scent or male cologne applied to hair traps. Video camera traps were also used to monitor carnivore reactions to the scent stations. We recorded 19 visits by seven carnivore species over 764 camera trap nights. Cheek-rubbing and scent-marking behaviour was recorded only for single individuals of two species: the Malayan tiger (*Panthera tigris jacksoni*) and clouded leopard (*Neofelis nebulosa)*. This study suggests that scent-baited hair traps hold some promise for ecological issues requiring DNA analysis in Peninsular Malaysia. Additional research is needed to develop its full potential for conservation monitoring of large carnivores.

Keywords: conservation; wildlife corridor; camera-trapping; attractant; lure; hair trap

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Introduction

Non-invasive genetic sampling is fast gaining popularity [1,2] for wildlife population monitoring [*e.g.,* 3]. However, in tropical rainforests, the relatively low densities of carnivores and humid conditions prevent consistent genetic sampling, such as from scats, due to low detection rates and the rapid decay of usable DNA [4,5].

Scent-baited hair traps have been proposed as a possible non-invasive technique to obtain genetic samples [6,7]. Responses to olfactory stimuli are actively induced, making detection of cryptic species more efficient and less dependent on environmental conditions that could alter their detectability (*e.g.,* thick vegetation obscuring samples) [8]. Two studies have successfully obtained hair samples using this method in rainforest environments in the neo-tropics for Felidae, Canidae, Mustalidae, Procyonidae, Mephitidae and Didelphidae [9,10], and for dingoes, *Canis dingo*, in the Wet Tropics of Australia (D. Morrant, unpublished data).

Scent-baited hair-trapping can provide useful population data such as the genetic diversity of individuals within a carnivore population, without necessarily detecting every individual in the population [*e.g.,* 11]. These insights may be vital to the conservation of threatened carnivores. For example, in habitats fragmented by roads, hair traps have already been used to provide useful information on carnivore gene flow [*e.g.,* 12]. Despite the theoretical advantages, several studies using this method have been unsuccessful or ineffective in monitoring or even detecting the target species, even where they are known to be present in the landscape [*e.g.,* 13].

Peninsular Malaysia is home to 28 species of terrestrial mammalian carnivores [14], and habitat loss and illegal hunting threaten many of these species with extinction [15]. While population estimates, necessary to determine conservation status, have been obtained for some carnivore species using camera traps, (*e.g.,* tiger *Panthera tigris*; [5], and leopard *Panthera pardus*; [16]), many other species have not been similarly studied. This is perhaps due to a lack of natural markings allowing identification of individuals.

Here, we investigate the feasibility of using scent-baited hair traps to collect hair samples of carnivores in the tropical rainforests of Peninsular Malaysia.

Methods

Study area

We conducted our study in two wildlife corridors, also known as habitat linkages (Primary linkage 2 – N5° 35.198' E101° 29.115' [189 km^2] and primary linkage 7 – N5° 01.004' E102° 32.236' [150 km^2]), delimited (but not formally established) by the Federal government to ostensibly connect larger forest complexes to one another [17]. The former is located in the State of Perak and the latter is in the State of Terengganu (Fig. 1). Both linkages contain lowland-hill dipterocarp forests that have been selectively logged in the past, and both are fragmented by roads, logging, and infrastructure development. Sampling was conducted between October 2012 and October 2013, with a break during the wet season (approximately December to February in the western study site and December to March in the eastern study site).

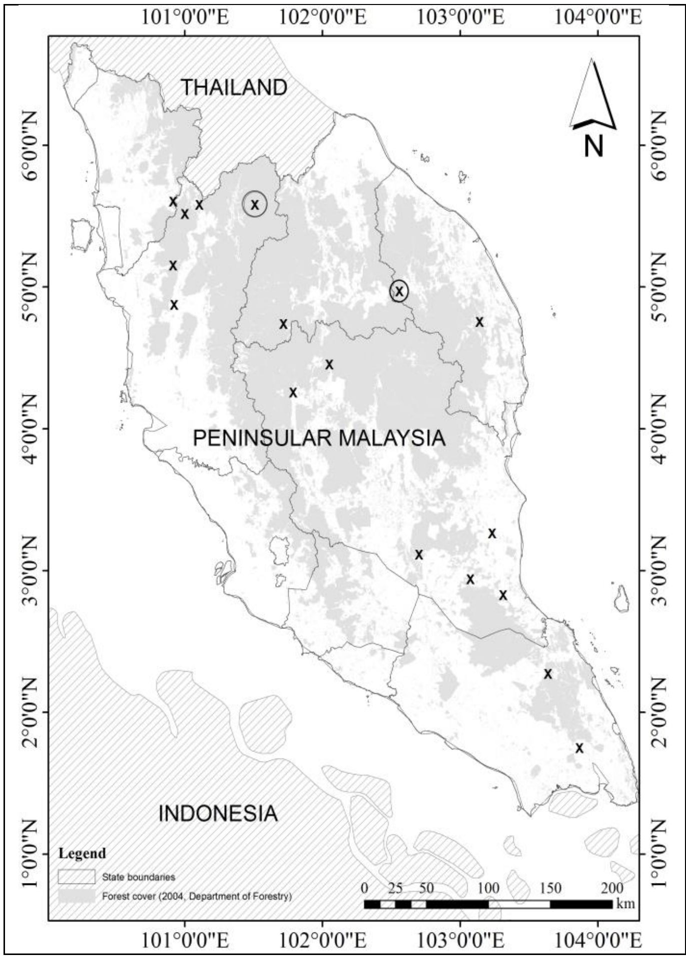

Fig. 1. Location of 'habitat linkages' (indicated by x's) within the Malaysian Central Forest Spine (CFS) Master Plan. The wildlife corridors where sampling occurred are circled.

Hair trap designs

We used two different hair trap designs. The first trap consisted of a plywood board with a plastic boot-scraper mat attached to the top of it. A hole in the bottom of the board, beneath the mat, contained a perforated plastic packet containing cotton wool balls, onto which either 5 ml of Fatty Acid Scent (recipe from United States Department of Agriculture; synthesised by D. Morrant) or 10 pump sprays of male cologne (Hypnôse ™; Lancome, Paris) were applied. The second trap differed only in that there was no plywood board beneath the mat.

For the first design we attached traps to the ground to target Dholes (*Cuon alpinus*), the only canid known to be present in the landscape-; studies conducted on other canids such as Dingoes (*Canis dingo*) in Australia successfully obtained hair samples using this design [18, D. Morrant, unpublished data]. For the second design, we attached traps to trees (Fig. 2), targeting six known felids in the landscape: the Malayan tiger (*Panthera tigris jacksoni*), leopard (*Panthera pardus*), clouded leopard (*Neofelis nebulosa*), golden cat (*Pardofelis temminckii*), leopard cat (*Prionailurus bengalensis*) and marbled cat (*Pardofelis marmorata*). The rationale for placing traps on trees was to prevent the traps from appearing as 'foreign ground objects' to felids, and to facilitate cheek, head, and neck rubbing, which are commonly observed scent-marking behaviours in felids [19,20]. A blank compact disc (CD) was added approximately 10-30 cm above the scent packet as a visual attractant [sensu 21].

Fig. 2. An example of one of the scent-baited hair traps used in the study, designed to target felids.

In order to document the rubbing behaviour of carnivores, video camera traps (Model Trophy Cam; Bushnell [R], Missouri) were attached to tree trunks ~50 cm above ground level and between 2-5 m from the center of the trail. The camera traps were set to record 60-second-long videos upon triggering, with an interval of 1 second between consecutive videos. Instead of adhering to a stringent inter-trap distance for camera trap placement, sites for camera traps were chosen based on large carnivores having been already detected by two previous camera trap studies [5, 22]. Within each site, hair traps were placed along trails where detection probabilities for large mammals are known to be high (*i.e.,* animal trail, ridge or old logging road [*e.g.,* 5]). A total of 35 hair traps were placed, 23 in Linkage 2 and 12 in Linkage 7, over a time period spanning 764 camera trap nights (Table 1). More traps were placed at the former linkage due to resource limitations in the latter linkage.

Table 1: Species captured on camera at the scent-baited hair traps, the degree of effort used for each trap type.

** These occasions featured rubs on the hair traps by the species.*

Trap type	No. of traps	Combined effort (days)	Carnivore detections	Occasions where carnivores visibly attracted to scent
Canid traps	6	72	common palm civet – 1 golden cat – 2 leopard – 2	leopard – 1
Felid traps	24	615	sun bear – 6 clouded leopard – 3 tiger – 2 banded linsang – 2	clouded leopard – 1* tiger – 1* sun bear – 1

Results

Rubbing behaviour

There were only two successful rubs from two carnivore species, one from a male Malayan tiger (*Panthera tigris jacksoni*; Fig. 3, in primary linkage 2 using the second trap design) and one from a male clouded leopard (*Neofelis nebulosa*; in primary linkage 7 using the second trap design). The clouded leopard individual rubbed the tree at the exact location where the scent packet had been placed (the packet and mat had been removed by elephants before this). Hair was retrieved from the station at which the tiger rubbed. On two occasions, male clouded leopards were detected at a station, but no rubbing behaviour was recorded. On one of these occasions, the individual appeared to display a negative reaction to the CD, which caused it to run in the opposite direction to which it had been traveling. A leopard was also detected on two occasions at the same station during the period when scent stations were placed on plywood boards on the ground. On the first occasion, the leopard sniffed the scent trap but moved on. On the second occasion the individual appeared to ignore the traps.

Fig. 3. An adult male tiger 'cheek rubbing' on one of the hair traps in the study.

Discussion

Our preliminary results indicate some potential for scent-baited hair traps to obtain hair samples of large carnivore species. However, it remains to be seen whether they can serve as effective monitoring tools for carnivores, especially in landscapes such as Peninsular Malaysia where elephants pose a serious obstacle to the function of these traps.

We recorded positive rubbing responses from two carnivores (*i.e.,* the Malayan tiger and clouded leopard). However, two (male) clouded leopard individuals did not display rubbing responses. It is possible that either they did not detect, or were not attracted to the Fatty Acid Scent. Alternatively, male tigers display territorial marking behaviour (which includes cheek rubbing) more frequently when females are in oestrus [19]. Such behaviour challenges the implementation of capture-recapture population monitoring due to the possibility of imperfect detections.

Surveys using scent-baited hair traps have achieved some success in obtaining samples from Canid species (*e.g.,* [8]. Our inability to detect dholes (and other animals) was likely due to their rarity in our landscape [5, 22, 23]). However, there is a possibility that dholes simply did not detect the odour. We applied only 5 mL of attractant to the ground lure because canids may be repelled by, or cautious of, strong olfactory stimuli [24]. Alternative lures or 'traditional', more pungent attractants such as rotten meat or fish oil, may more effectively attract dholes to the vicinity of the trap. Animals which travel to investigate the 'call lure' would move into the range of the 'trap lure' and hopefully interact with the hair trap [*e.g.,* 25]. As the attractiveness of lures can also vary with season and location [25, 26], further work is required to determine whether our lack of dhole detection was an artifact of our sampling regime.

Implications for conservation

More systematic survey designs are needed to assess the full potential of this technique for non-invasive monitoring of carnivores in Peninsular Malaysia. Currently, scent-baited hair traps may only be able to provide complementary information related to genetic diversity, such as whether populations are genetically isolated from one another. In turn, this could inform and assess conservation management interventions of threatened carnivore species in tropical rainforests.

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