Determining occupancy, abundance and population structure of an endangered apex predator, the Sri Lankan leopard (Panthera pardus kotiya)

Submitted By

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Part A – Wilpattu National Park

Executive Summary

This closed population leopard study was conducted in the later part of 2015 with remote camera trapping being carried out for a total of 836 trap days/nights. The study area was a 500 km^2 area in the central core of the park which was accessible. Due to flooded conditions and reduced accessibility this study area was chosen as the most feasible for conducting such a survey.

A total of 49 individual leopards were identified within this study as the sample population with a spatially explicit capture-recapture total density for the study area of 16.2 leopards per 100km^2 or an adult density of 8.2 leopards per 100km^2. This density falls between the recorded leopard densities for Yala National Park and Horton Plains National Park as established by our earlier studies in these NPs and is in keeping with density estimate trends. A sex ratio for this population of 1M: 1.75F was observed.

On-going prey analysis shows that barking deer, sambur, wild boar and axis deer are the primary available prey species but more in depth analysis is required to indicate prey preference. Axis deer and barking deer densities have been estimated using standard distance sampling methods.

The presence of Sri Lanka's smallest wildcat the Rusty spotted cat was also detected numerous times indicating a relatively healthy population within the study area. Bear (including mother and cubs) were detected throughout and at most camera trap stations indicating widespread presence within the study area.

Timelines & Study design

Exceptionally heavy rains were experienced in 2015 and continued through into 2016. Due to limited access of the park as a result of flood waters we designed a camera trapping grid based on accessibility. Camera trapping was conducted over a 13 week period in the latter half of 2015. This time period was adequate for a closed population survey as well as allowed for coverage of the chosen study area within the park.

A total of 36 remote camera stations were set up across the central portion of Wilpattu covering an area > 500 km². This design allowed the project to optimize the trade-off between photographic re-captures and area coverage. We also conducted 3 prey transects every month which ranged in length from 20 – 23 kms and traversed the heart of the study area.

Success was high with all camera stations recording repeated leopard presence as well as numerous prey species.

Leopard Population Estimates

Population numbers & Density: Over the course of the 836 trap days (each 24hr from midnight to midnight) there were a total of 49 individual leopards photo-captured (Fig. 1). Using spatially explicit capture-recapture analysis we estimated a population density within the study area of 16.2 leopards/100 km² or 8.2 adult leopards/100 km². This suggests a density slightly lower than in Yala National Park, Block I and slightly higher than in Horton Plains National Park.

Sex Ratio: From the sample leopard population a total sex ratio for the study area of 1M: 1.75 F was obtained.

Fig. 1: two of the resident male leopards repeatedly photo-captured within the study area in Wilpattu National Park, 2015. b. Cover picture is of a resident female within the study area.

Leopard Diet

A total of 24 scat samples have been collected so far. We hope to continue with once a month monitoring for scats to supplement this as the larger the sample size the more accurate the information gained. Due to the unusual heavy rains experienced during 2015 and 2016 scat samples were easily washed away and thus sample availability low. On-going microscopic identification will reveal if leopards in Wilpattu are showing particular prey preferences.

Prey abundance

Based on distance sampling methods from 62.7km of road transects that were repeated over 4 months in 2015 and 16.2km that was conducted only in October 2015, we were able to estimate the abundance of spotted deer (7.8/km²) and barking deer (9.5/km²). Other species were not detected in sufficient numbers to allow for accurate absolute density estimates.

Other species:

Apart from leopards our camera trap stations also recorded a total of 19 mammal species (Table 1) indicating mammal biodiversity within the park.

Class	Family	Common name	Scientific name
Mammalia	Boviidae	Water buffalo	*Bubalus arnee*
	Canidae	Jackal	*Canis aureus*
	Cercopithecidae	Toque macaque	*Macaca sinica*
	Cervidae	Axis (spotted) deer	*Axis axis*
		Sambar	*Rusa unicolor*
		Barking deer	*Muntiacus muntjak*
	Elephantidae	Asian elephant	*Elephas maximus*
	Felidae	Leopard	*Panthera pardus*
		Jungle cat	*Felis chaus*
		Rusty spotted cat	*Prionailurus rubiginosus*
	Herpestidae	Ruddy mongoose	*Herpestes smithii*
	Hyxtricidae	Porcupine	*Hystrix indica*
	Leporidae	Black naped Hare	*Lepus nigricollis*
	Manidae	Pangolin	*Manis crassicaudata*
	Mustelidae	Otter	*Lutra lutra*
	Suidae	Wild boar	*Sus scrofa*
	Tragulidae	Mouse deer	*Moschiola meminna*
	Ursidae	Sloth bear	*Melursus ursinus*
	Viverridae	Common palm civet	*Paradoxurus hermaphoditus*
		Indian civet	*Viverricula indica*

Table 1: Mammal species captured on remote cameras in the study site at Wilpattu National Park.

Wildboar were the species detected in greatest numbers by remote cameras, followed by spotted deer and then leopards (Fig. 2). This measure indicates the high success of the camera placements for recording leopard presence. It does not, however, mean that leopards were more abundant than many of the other species captured by remote camera less often, as the rate at which species were recorded on remote cameras is also determined by their use of roads and prominent jungle trails where cameras were set.

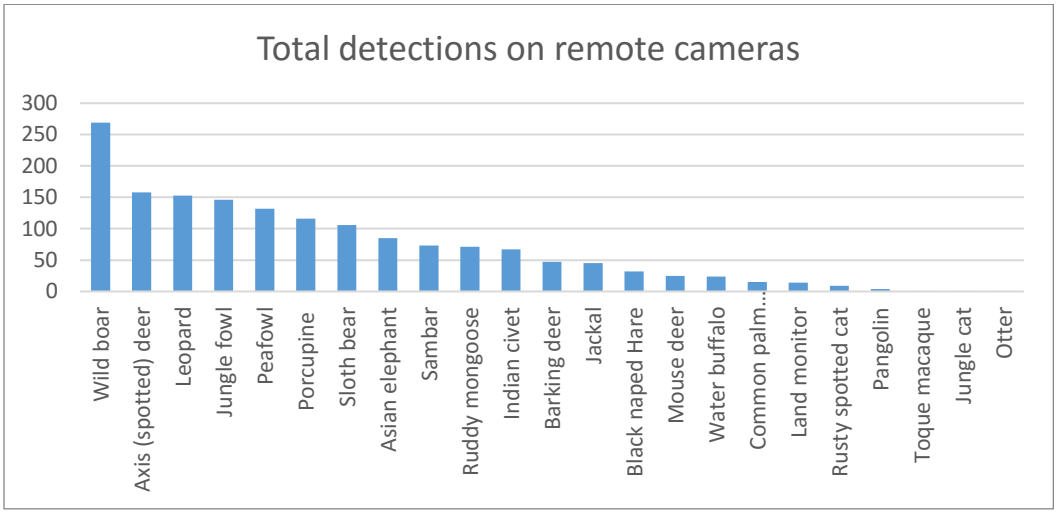

Fig. 2: Total number of animals of each species detected by remote cameras within Wilpattu National Park over 836 trapping days.

A high detection rate of bears was observed (N=106 photo captures); this is a positive sign for Wilpattu as having bear presence throughout the study indicates good quality undisturbed habitat is still available. Mother and cubs (N=15 cubs) were also detected spread out throughout the study site.

Photo-captures of other wild cats are also of substantial importance and although no fishing cat was detected, jungle cat (N=1) and numerous detections (N=9) of Sri Lanka's smallest and least understood felid, the rusty spotted cat were obtained (Fig. 3). The lack of detection of the fishing cat however does not indicate an absence of them in the study area as they have been recorded otherwise.

Fig. 3 Rusty spotted cat photo captured at Kokkari villu, Wilpattu 2015.

Limiting Factors

The primary limiting factor was the heavy rains and resultant flooding of the park. This made many jeep tracks inaccessible as the villus had overflown their banks. In general the road network within the park is limiting, with the southern and north eastern sections of the park in-accessible as there are no maintained jeep tracks traversing these parts. The fear of the presence of poachers is also a limiting factor and needs to be addressed.

Recommendations

Increasing the study size area is recommended if a follow on survey is to be conducted at a later date, which we would like to do, as this would allow for a more thorough leopard population estimate of the entire park. Opening up some jeep tracks for patrolling purposes especially in the southern and north eastern parts of the park may address the issue of inaccessibility. It will also help keep track of poaching presence and perhaps deter poachers from freely accessing the park. A more robust census of the prey throughout the park would also be a future recommendation.

Acknowledgements

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who accompanied us at the initial stages and especially to Bimal without whom this study would not have run as efficiently. His enthusiasm and knowledge of things, willingness to clear access points and help out with set up helped in the smooth running of the project. Thanks goes to Jagath, Hemantha and Rupasingha of Wimal Safaris for always being available to drive us around the park, getting us into difficult terrain and for putting up with long days. Thanks to Friends of Wilpattu who willingly contributed their knowledge of the road network of the park. Last but not least a big thank you to our WWCT team and volunteers for so willingly being a part of this study.

PART B – Peak Wilderness Sanctuary Area

Field Work

After extensive recce work conducted in the first half of the year to determine remote camera placement, estate interest and map routes, the closed population leopard survey was begun in early August 2016. For the first round of remote camera trapping 9 estates were selected and 12 total stations set up. The first week saw glorious weather and setting up was done in good conditions for the most part. However towards the latter stages unusual rains for the region set in once again and field work was hampered by wet vegetation and tea bushes with a multitude of leeches.

However the results have been well worth the effort as we have in this first round established the movement patterns of a resident male (Figure 2) and established five females (one with cub) in this area already.

Round two of camera trap locations commenced in the second week of September with 5 more estates being included and 13 camera station locations set up. Once again we have had success with establishing further movement pathways of the resident male Arnold, including time lines of his movement. Another 2 males and 2 additional females were photo captured during this round, giving a total of ten leopards identified in this area so far.

Round three, most likely the final round for this closed population survey will being on the 22nd of October and run for a further 4 weeks, covering a further 4 estates as well as within Sanctuary locations.

Working in this Central Hills region and in the Bogawanthalawa Valley area bordering Peak Wilderness Sanctuary, where no work has been done prior to this project, has been rewarding. Although field work very complicated and physically demanding, the result of establishing leopard movement patterns in this diverse landscape (Figure 2) is definitely worthwhile. We have accumulated a good sample size of leopard scat (n=38) so far with more collection ongoing of for diet and genetic analysis so as to better understand leopard prey preference (proportion of domestic prey for example) and population structure.

Figure 1. i) Resident Adult Male 'Arnold' photo captured on a misty evening.

Figure 1. ii) Resident female leopards repeatedly photo captured at site.

Figure 2. Views of the study site areas; Eucalyptus trees, tea bushes and forest make up this mixed diverse landscape, highlighting the need for mixed landscape conservation as the landowners are varied.

Other Wildcats/Mammals

Our other aim was to also establish and document Sri Lanka's other wildcats in this region together with general mammal biodiversity. Fishing cat and Rusty spotted cat are both being recorded and we hope that a better understanding of their movement patterns, diet and habitat use can be established (Figure 3).

Figure 3. A fishing cat, Sri Lanka's second largest cat photo captured at one of the Peak camera stations.

As an overall aim of this study is to establish movement corridors here, where this year alone 5 leopards were killed incidentally in snares in this specific area, the results obtained thus far are revealing. At the end of the study and post analysis a better understanding of leopard/wildcat use locations that can be targeted for conservation action will be obtained.

Snare removal and Habitat Restoration

Restoring habitat corridors and reducing snaring in areas are also key here and we hope, in conjunction with landowners and the DWC, to be able to reduce the snaring. Following on from the earlier map given to DWC for targeted snare removal, the WWCT team are also coming across areas that have snares and are able to actively contribute towards, at the very least, short term reduction of this. In the long term, together with education and awareness, continued targeted snare removal programmes will be required.

In keeping with the above WWCT is also assisting in a forest restoration project at one of the nearby estates and it is hoped that this will be replicated in other estates, informed by the leopard movement patterns this project will establish.

Education & Awareness

Continuing with our awareness work in this region, especially with a focus on educating and addressing the local tea estate workers and their concerns and the importance of wild habitat, 7 targeted programmes covering 4 estates were conducted in May and a further 3 in July/August together with Department of Wildlife Conservation (DWC) Nallathaniya field officers. A total of 275 tea workers were addressed in the former programme and had the participation of regional DWC staff and area police together with our team (Figure 4). The July/August programmes addressed 140 tea related workers. A programme in Strathspey estate, one of the estates covered in Round 2, was completed in end September at the request of the estate manager and addressed over 50 school children and estate workers. We have had requests for more programmes and we are happy to note that continuing these programmes together with the DWC office is planned.

A trilingual leaflet titled 'Living with Wildcats' was created and distributed widely (Figure 5); this has also been given to the DWC offices and the local police for their use in any community programmes. This pamphlet reminds people of the simple solutions that can be carried out as part of daily life in order to avoid incidents with leopards. We continue to carry out these programmes as we move through the estates and work closely with DWC field staff and estate

management to ensure co-existence between humans and wildlife is fostered. Targeted talks to the Tea estate management and naturalists are also being conducted with the aim of sharing the larger theme of how research for conservation works.

Figure 4. Awareness programmes conducted together with DWC field staff for i) local area police, estate management and field staff; 2) male field workers and 3) female tea pluckers in the field.

Figure 5. Trilingual pamphlet created specifically for addressing problems with human wildcat interactions.

Dunkeld Conservation Station

The Dunkeld Conservation Station, housed within the Dunkeld Estate in close proximity to the Dilmah Tea factory now houses a WWCT field team. This has been possible through partnership with Resplendent Ceylon, the luxury boutique villa experience leisure arm of Dilmah tea and Dilamah Conservation. It has allowed for efficient field work to be conducted from this site and will we hope become a Research and Conservation Station that will add to the value of the area and enable targeted conservation work in the region. As the DWC offices are at a distance from here (in Nallathaniya and Nuwara Eliya) this station has allowed for quick communication and action to be taken in the event of wildlife incidents occurring in these estate lands. Already the release of a captured fishing cat cub has been coordinated by WWCT as news came in from relevant estate management, due to the presence of this station.

Acknowledgments

Thanks to the DWC for continued issuance of permits to carry out this work. A special thank you to the Nallathaniya office for collaborating with us so as to carry out effective awareness and direct conservation work in this area. All Estate management companies as well as the superintendents and mangers

and their teams at each estate have been extremely accommodating and helpful and we thank them for their time and interest. This project would not run as smoothly without their assistance. A final thank you to the WWCT team who have braved bad weather, insane roads and multitudes of leeches to carry out this work.

PART C - Leopard population genetic structure via non-invasive scat analysis

This component of the project is ongoing. Due to delays in import of laboratory consumables the laboratory analysis was delayed. A new article (Maroju et al. BMC Genetics (2016) 17:37) revealed that additional caution needed to be adhered to during the amplification process and shed doubt on many of the Indian studies done to date which was our reference point for this study. However as the leopard is Sri Lanka's only big cat we feel that confusion and cross amplification with other big cat species such as tiger as in the Indian case should not result here. However in order to be more rigorous and ensure no doubt only scat samples with large enough bolus size are being selected for this DNA analysis.

So far a total of 108 samples from an earlier much older study are currently being optimized for usable DNA extraction. If this process proves successful once these samples are completed we will proceed with the Wilpattu (n=24) and Peak area samples (n=18) that have been collected and separated for DNA extraction. If the old samples are not viable for such an analysis we will only use fresh samples for this analysis. If this is the case then things could take longer as fresh samples need to be soured in the field. Currently we have a limited number of fresh samples (n=13 in total). However we are hopeful that current analysis will be successful and that our separated samples can be used. We will continue to source fresh scat for this important component of the project.

CONCLUSION

Overall I can report that this project has been a success. We were extremely pleased with the results of the Wilpattu component and thrilled at the results being obtained in the Peak area, which have far surpassed our expectations. The support that this project has received overall has been uplifting and we hope that this will translate into strong conservation measures for the leopard here in Sri Lanka. It has been a steep learning curve for the genetic component and although delays have ensued we are hopeful of results soon. This ambitious genetic component is the first attempt of its kind here in Sri Lanka and we feel will be a revolutionary step in research and conservation for us.

Anjali Watson, October 2016