

🐾 The Leopard Project 🐾



Adult female leopard photo-captured in Horton Plains National Park on Feb 22, 2012 at 22:00

Annual Report 2012

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Executive Summary:

In 2012 the Wilderness & Wildlife Conservation Trust's (WWCT) Leopard Project continued with a research focus in the Central Hills. This highly fragmented area, which encompasses few sizeable protected areas is little understood with regards to wildlife population parameters. This is the part of the country where human-leopard conflict is the most widespread due to a high population density combined with the aforementioned scarcity of well defined, protected wilderness habitat. The Leopard Project has been working hard to increase our ecological understanding of this fairly restricted, unique region, particularly with regards to the distribution, abundance and feeding ecology of the island's top predator.

Furthering this aim, the Leopard Project conducted a 2 month closed population mark-recapture study in the Central Hill country's main protected area, Horton Plains National Park (HPNP). Effective reconnaissance early on, combined with hard work and dedication by team members made this study successful. The results of the study indicate an estimated density of 13 leopards/100km², a relatively high density which is nevertheless in congruence with prey availability and long term anecdotal evidence.

Continuing with our determination to understand and quantify the importance of the numerous small forest patches that characterize the region, we conducted comparative studies on the relative use by leopards and fishing cats of HPNP and Duckwari Estate near Knuckles. Duckwari is an active tea estate which also incorporates some cardamom under-planting of its small forest patches within the plantation. We were interested to see if, like the Dunumadallawa forest reserve and the Agrapatana research station, this relatively small forest was being actively used by leopards. While we found no evidence of leopard presence during our study, we were able to estimate prey availability in the two sites which provides a potentially compelling reason for this observation. Fishing cat were using both sites.

Not restricting our work to felids, we also conducted a comparative biodiversity study between Duckwari Estate and the Dunumadallawa Forest Reserve near Kandy. Some very interesting results have arisen from this work, not least the fact that these two fairly close highland forest patches are comprised of a quite different suite of floral and faunal species.

The Yala "Spotting the spots" initiative is ongoing and continues to generate positive interest from park visitors. We are starting to accumulate a fairly sizeable database which we hope will prove a useful tool for long term monitoring of this important, and visible, National Park.

We are proud to work closely with Sri Lankan Universities and this association continued in 2012. Both Sabaragamuwa students successfully completing their final year theses and another student, from Sri Jayawardenepura, embarked on a very interesting and worthwhile project attempting to assign economic value to the leopard and its conservation. We expect to report on this work in 2013.

From a public awareness perspective the Leopard Project designed and printed two informative posters which were gifted to the Department of Wildlife Conservation and put out one publication internationally, with another accepted and awaiting publication locally.

Update of Leopard Project activities - January to December 2012

I. Research

A. Central Hills

- i. Horton Plains National Park mark-recapture camera trap survey*
- ii. Felid presence-absence surveys and prey transects (Horton Plains National Park and Duckwari Estate, Knuckles)*
- iii. Biodiversity surveys (Duckwari Estate, Knuckles and Dunumadallawa Estate, Kandy)*

B. Yala Block I

II. Education and Awareness

- A. Undergraduate student supervision
- B. Leopard distribution poster
- C. Horton Plains camera trapping poster
- D. Leopard Survey Questionnaire
- E. School/public awareness material
- F. Publications
 - a. CatNews
 - b. Loris
 - c. DWC special report

III. Acknowledgements

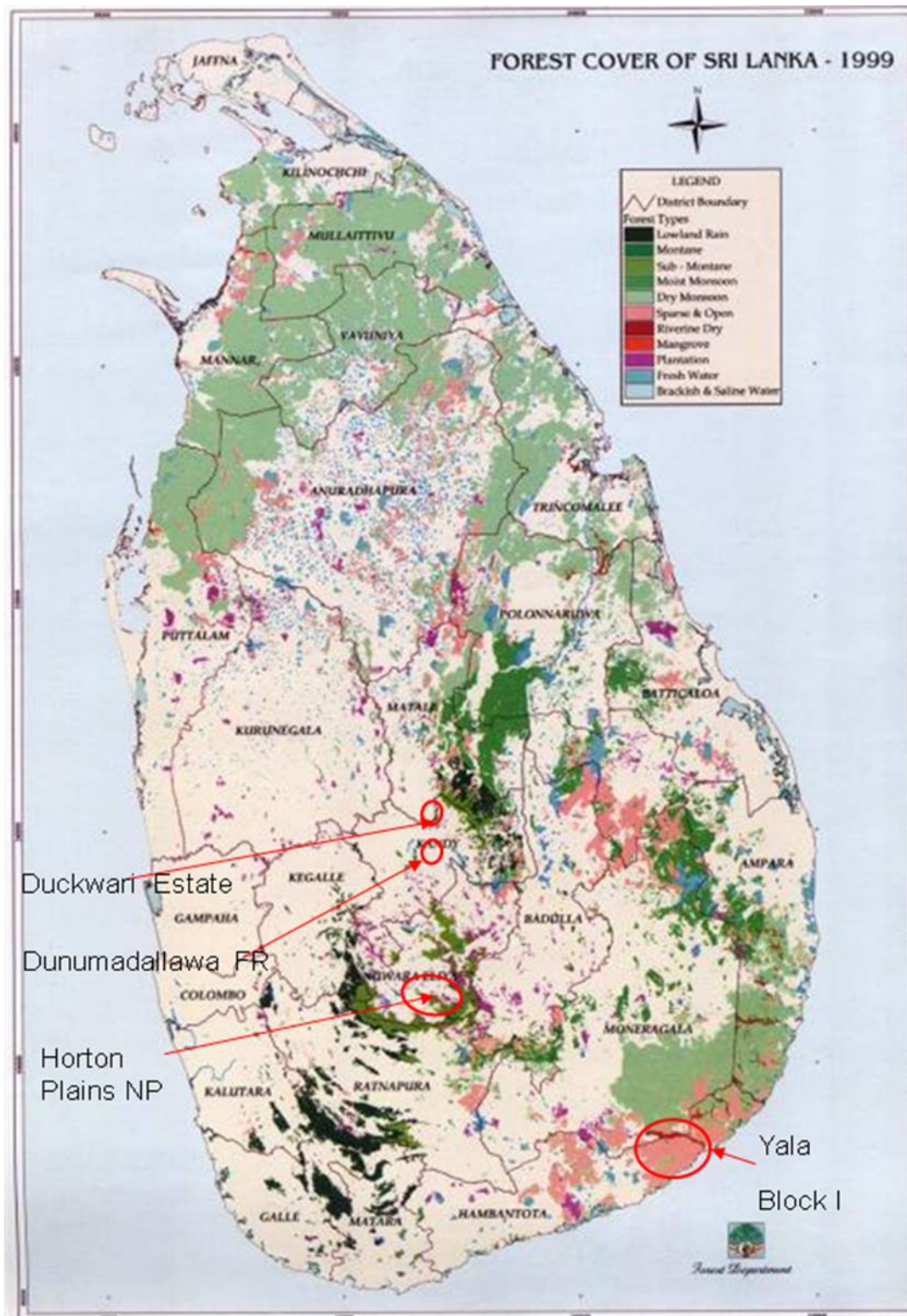


Fig. 1: Forest cover map of Sri Lanka showing areas where the Leopard Project was actively conducting research in 2012.

I. Research

A. Central Hills

i. Horton Plains National Park mark-recapture camera trap survey

We conducted a closed population mark-recapture camera trapping survey of Horton Plains National Park (HPNP) between February 11th and April 14th. This work was conducted at the behest of the Department of Wildlife Conservation (DWC) with the permit approved in January.

We had conducted extensive pre-approval observations in order to determine suitable camera trap locations and study area extent as well as to liaise with Department staff so that we could initiate the project quickly upon approval.

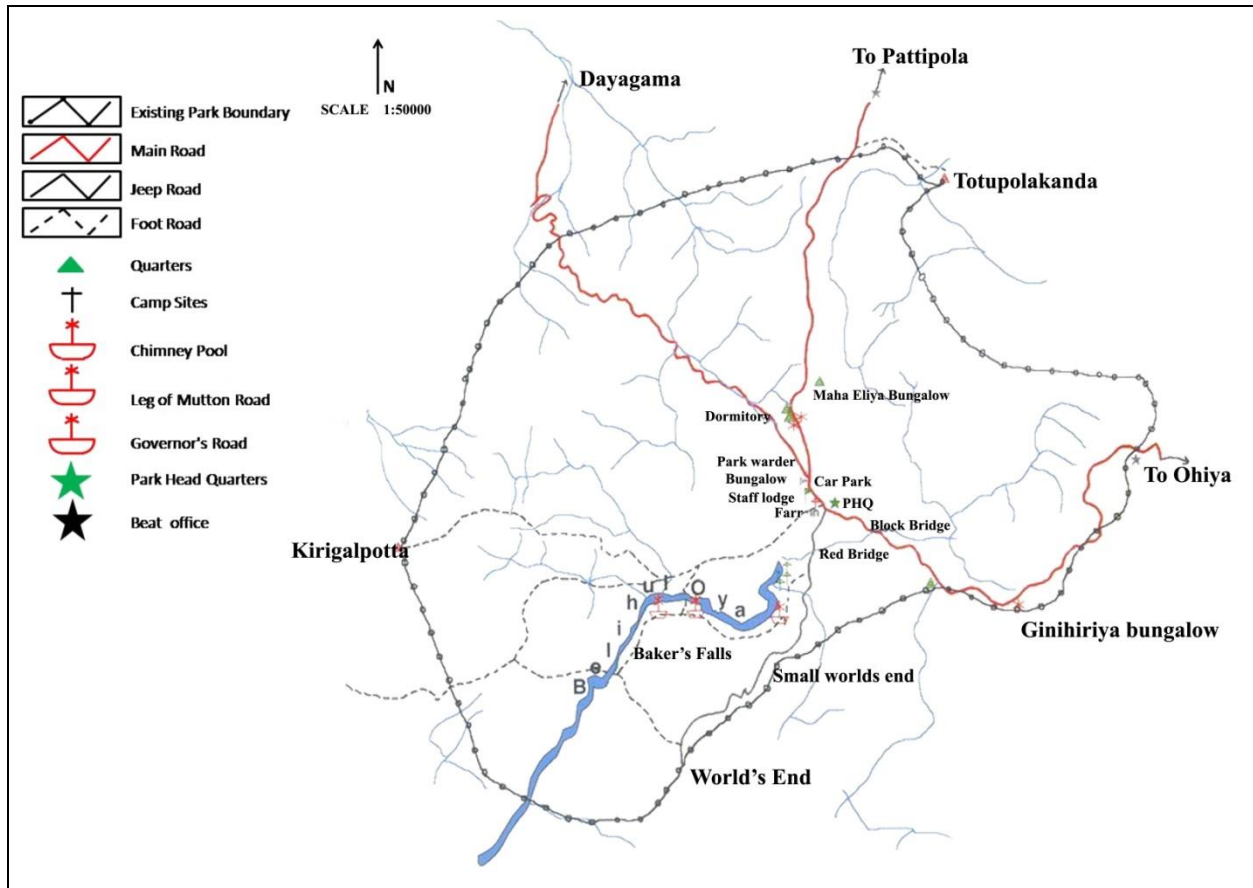


Fig. 2: Horton Plains National Park (HPNP) in the Central Hills of Sri Lanka (Map courtesy Department of Wildlife Conservation)

Due to the relatively intense visitor use of HPNP roads and walking trails we had to design the study in order to balance effective study area coverage and practical aspects such as ensuring we didn't lose camera traps to theft. In pursuit of this goal we divided the study area into 3 zones, with a total of 21 study area camera trap locations. The total trapping effort was 478 trap nights. The camera trap locations that made up each

zone's coverage were divided into high use and low use areas with the high use area cameras being removed every morning and re-set every evening and the low use area cameras left for the nights, but regularly checked to ensure there had been no disturbance. As such we needed to maintain a constant presence within HPNP during the course of the survey.

In total we photo-captured leopards 25 times (at a rate of 1 leopard/10.8 trap nights). Twenty-one of these photos were identifiable (84%). One adult male, 6 adult females and 1 sub-adult were identified for a total of 8 individual leopards. The density was estimated to be 13.3 leopards/100km² (95% CI ranging from 5.5 to 31.9) using the Spatially explicit capture-recapture (secr) package in R. This is the first empirical estimate of the HPNP leopard population density and is very useful for National Park managers, especially in light of the common assumption by staff that there are considerably more leopards than this in the park. The density estimate can be compared to the density estimated in an earlier WWCT project in Yala National Park (YNP) of 17.9/100km². Given the higher prey abundance available to leopards in YNP compared to HPNP, these numbers appear to provide a reasonable assessment of the ground reality.

Further analysis investigating resource attributes of capture vs non capture locations as well as scat analysis of the over 100 samples collected during the study are ongoing. The latter has been considerably complicated by a protracted strike across Sri Lankan universities in the 2nd half of 2012 as we utilize the lab and facilities at the University of Colombo for our microscopic analysis. As this strike is ongoing we have decided to invest in the development of a small lab of our own. Presently most scat samples have been washed and tried and are nearly ready for analysis. We plan to compare the results of this feeding ecology analysis with the available prey from earlier prey surveys to determine diet and selection of leopards in HPNP.

ii. Felid presence-absence surveys and prey transects (Horton Plains National Park and Duckwari Estate, Knuckles)

From November 2011 to February 2012 we conducted presence-absence surveys of the leopard and Indian fishing cat (*Prionailurus viverrinus*), as well as prey transect surveys in HPNP, in the Nuwara Eliya District of the central hills and Duckwari Estate in the Matale District bordering the Knuckles range. Where HPNP is a relatively well-protected National Park bordered by buffer areas of forest reserves, Duckwari Estate is an active tea plantation which itself occupies an effective buffer zone between the 17 500 hectare Knuckles Conservation Area and more heavily settled portions of the Matale district.

The objectives were to first determine whether either cat was present in these differing hill country locations, then to estimate their relative abundance and finally examine the prey available at each site as a possible explanation for felid presence and/or absence.

In HPNP and Duckwari estate, three trails (total length = 11km in HPNP and 10km in Duckwari) were walked with all sign/scat/tracks measured and recorded to determine an index of use. Each trail was traversed on three separate occasions, once in November, December and January. All signs were removed after recording to ensure that data was not collected on multiple occasions. Due to different substrates along trails making the interpretation of tracks and scrapes inconsistent, only scat was ultimately used to determine the use index.

Both leopards and fishing cat utilized HPNP whereas only fishing cat sign was detected at Duckwari (Fig. 3). The relative abundance of leopard as measured by the signs/km index varied between trails at HPNP (Fig. 4) with 1.3/km on the Ohiya trail, 2.3/km on the Pattipola trail and 5/km on the Kirigalpotha trail. Both the Ohiya and Pattipola trails are main arteries through HPNP. These trails pass through the larger open plains where large herds of sambhar (*Rusa unicolor*) congregate in the night however, they also see a much higher volume of traffic (both walking and driving) relative to Kirigalpotha, which is a more forested, walking trail leading to Sri Lanka's 2nd highest peak. Fishing cat signs were also considerably more common along the Kirigalpotha trail (Fig. 4) (6/km compared to 1/km on the Ohiya trail and 0 on Pattipola). This trail has many small waterways and at least two conspicuous low-lying marshy areas, providing ideal habitat for the fishing cat.

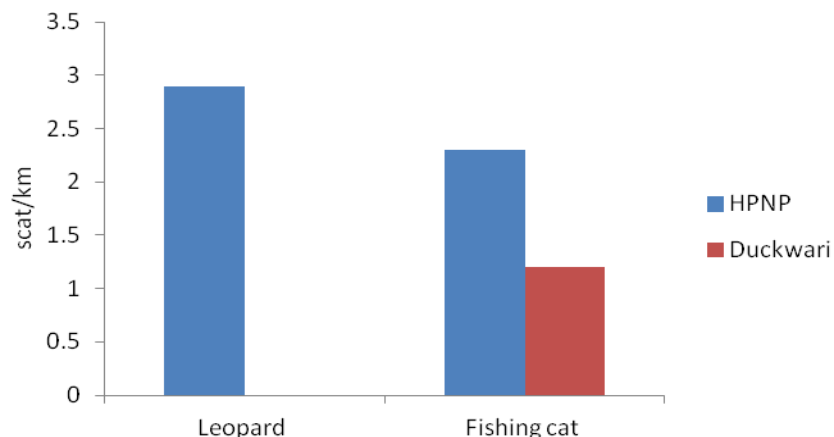


Fig. 3: Comparison of use index by leopard and fishing cat at Horton Plains National Park and Duckwari Estate.

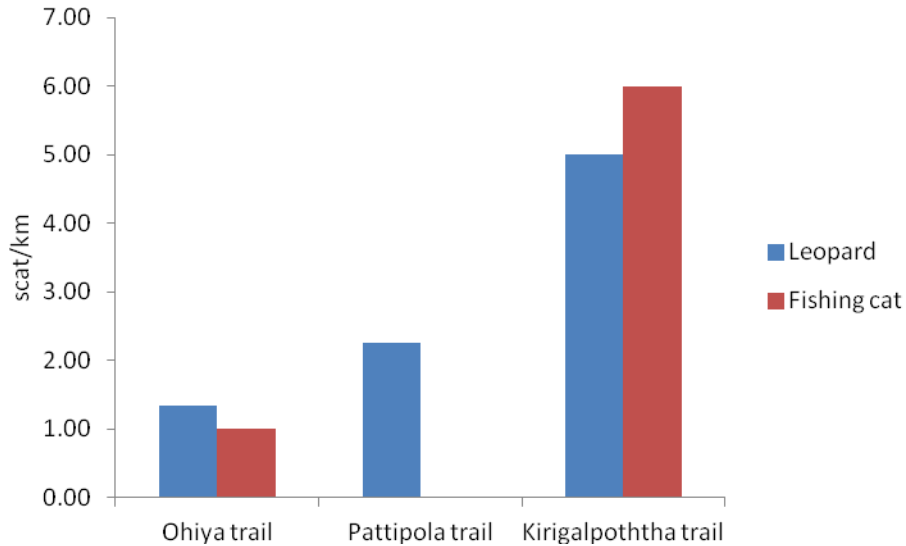


Fig. 4: Comparison of sign index between trails of leopard and fishing cat at Horton Plains National Park.

Fishing cat sign was ~2x more common in HPNP than Duckwari estate (2.3/km vs 1.2/km; Fig. 3). The diminutive rusty-spotted cat (*Prionailurus rubiginosus*) might also be expected to occur in these upland forests, and while indication of their presence was not detected, the methods used in this survey were not sufficient to rule out their presence.

Throughout each study area 7 x 1km transects were conducted, once a month in November, December and January using standard distance sampling methods (Buckland 1993). Results indicate a marked difference between available prey across the two sites (Figs.5,6,7). HPNP has a high density – and associated biomass - of sambhar, a large cervid (~200 kg), which congregate in the open patna grasslands that characterize the Plains, to feed (Fig. 5,6). This abundance of large prey is expected to be the main reason for the sizeable leopard population detected first during the sign surveys and confirmed during the above-mentioned mark-recapture survey. On-going scat analysis is expected to confirm this as the most common leopard prey in HPNP.

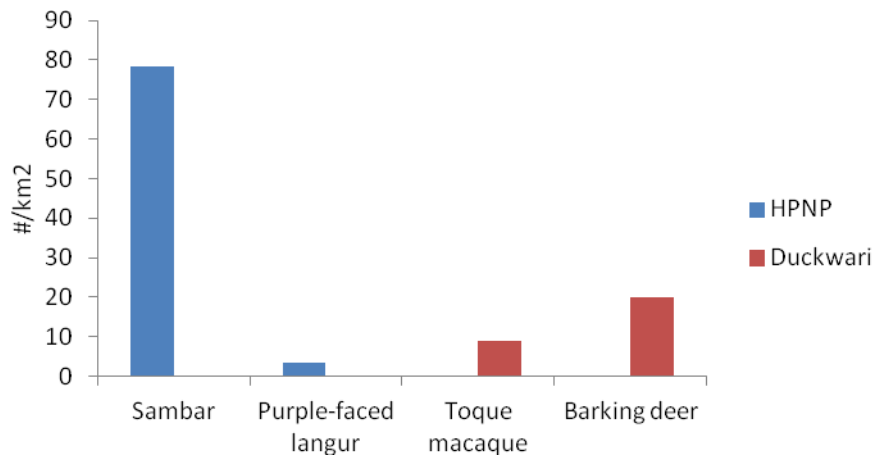


Fig. 5: Density of large mammals in HPNP and Duckwari estate.

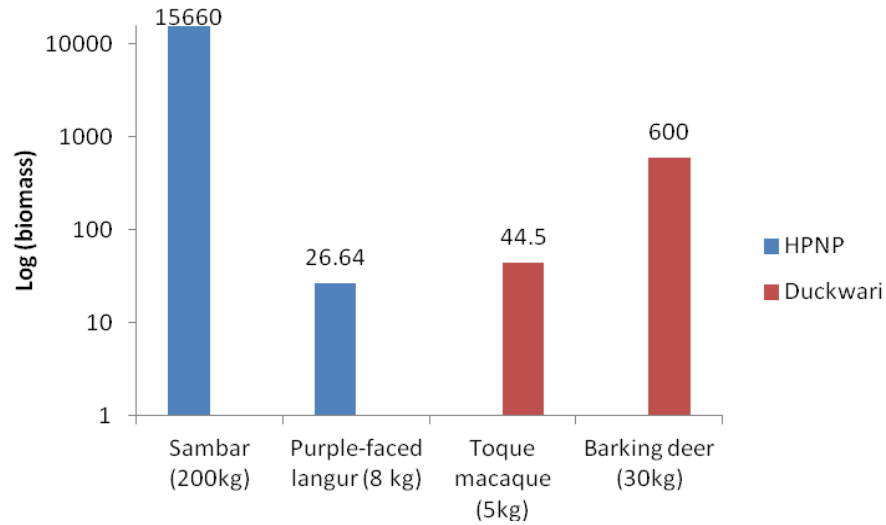


Fig. 6: Biomass of large mammal prey available at HPNP and Duckwari estate. Note log scale. Actual biomass/km2 values are indicated above columns.

By contrast, Duckwari is characterized by a much lower density – and associated biomass - with the largest potential prey item the barking deer (*Muntiacus muntjak*). This disparity in available prey explains the observed difference in leopard use between sites as leopards densities are well explained by available prey biomass (Markar and Dickman 2005). Leopards have been seen in and around Duckwari estate, however this study supports the hypothesis that they are not resident here but either use the area occasionally as part of a larger range, or the animals that have been seen in the vicinity are transients. As this estate is situated adjoining the large Knuckles Protected Area, where leopards are known to reside, this is not surprising.

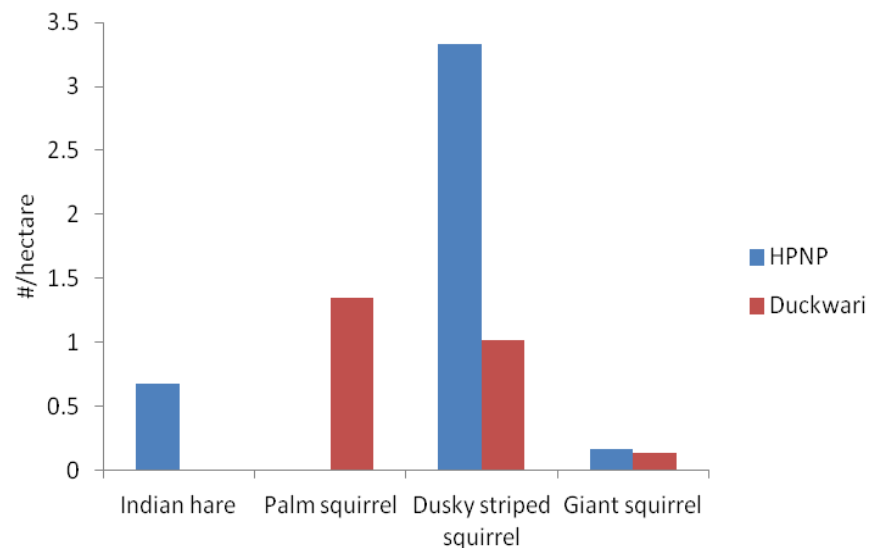


Fig. 7: Small mammal prey density comparison between HPNP and Duckwari Estate

Given the similar overall density of small prey at the two sites, it might be unexpected that fishing cat use is half at Duckwari what it is at HPNP, however this data does not account for aquatic prey which is a potentially important component of fishing cat diet. HPNP has an abundance of watercourses which might well provide ideal fishing cat habitat.

iii. Biodiversity surveys (Duckwari Estate, Knuckles and Dunumadallawa Estate, Kandy)

Biodiversity surveys were conducted in Duckwari Estate and the Dunumadallawa forest reserve near Kandy in order to compare the relative role that these small, disturbed sites play in the harbouring of biodiversity as well as the conservation of endemic species. Duckwari is a working tea estate which includes small patches of natural forest, some of which is under planted with cardamom. It is in close proximity to a larger protected area, the Thangapuwa forest reserve and the Knuckles Conservation Area. In contrast, Dunumadallawa itself is a small forest reserve comprising the watershed of the Roseneath reservoir in Kandy. It is an isolated forest, surrounded by mixed landuse including villages, urban areas, home gardens, tea plantations and grasslands.

Quadrat plots of 20x20m and 2x2m were used to determine plant and understory diversity and standard sized belt transects were used to determine bird, butterfly and amphibian diversity. One km line transects were used to determine mammal diversity and opportunistic observations were used to determine reptile diversity and supplement the more structured methods.

The Shannon-weiner index (H) was used to estimate biodiversity in each study area. This index takes both species richness and the relative species abundance in a community into account to determine the uncertainty that an individual picked at random will be of a given species. Typically, more disturbed, less stable areas are expected to have a lower value of H (<1) whereas more diverse locations will realistically have H values ranging from 1.5-4.5.

The Shannon-weiner index can be difficult to compare between sites given it is dependent, and thus influenced by, both changes in the relative abundance of species but also by changes in species richness. To ensure that we can compare between study areas using this diversity index, we calculated Evenness (E), an index that makes H comparable between sites by controlling for the number of species found within each community. E can range from near 0 in areas where only a few species are abundant, with most others rare, to near 1, where all species are essentially represented equally.

Evenness (E) was low in both sites (<.4), but very similar across sites, meaning the Shannon-weiner comparisons are a useful measure of biodiversity for comparison (Fig. 8). The lowest E value (.25) was seen in Dunumadallawa forest reserve with reference to floral diversity. This is probably explained by the fact that this forest reserve was once a tea plantation (as opposed to the Duckwari forests which are within a larger tea plantation) and most of its present composition is the result of a reforestation program.

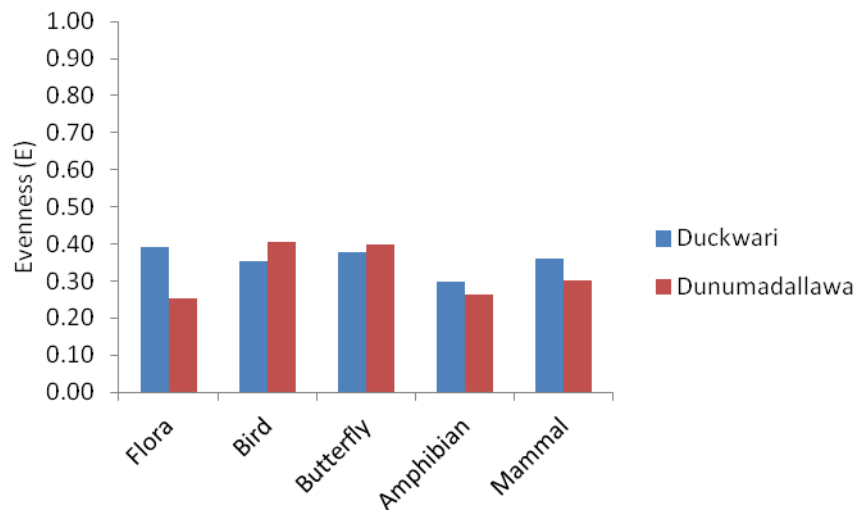


Fig. 8: Comparison of Evenness (E) for flora and four animal Classes between Duckwari Estate and Dunumadallawa forest reserve.

Diversity indices indicate that Duckwari is considerably more florally diverse than Dunumadallawa forest reserve (Fig. 9). However Dunumadallawa showed a higher diversity of birds and butterflies compared to Duckwari. The reverse was true for amphibians and mammals, although low numbers ($n = 5 - 7$) of these Classes was observed. All indices were on the lower end of the spectrum, which is consistent with the disturbed nature of both study areas. Given the isolation of the Dunumadallawa forest reserve and the rather extreme habitat fragmentation outside its borders, the observed bird and butterfly diversity here was impressive. This acts to underline the important role that this small forest patch plays in biodiversity preservation within the region.

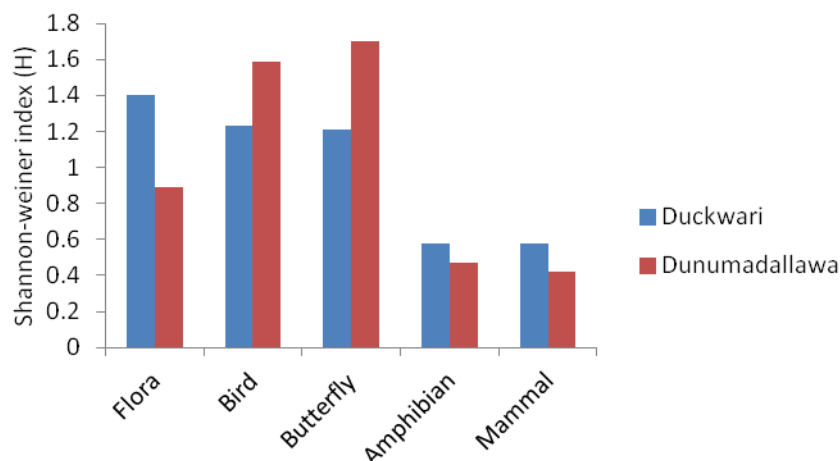


Fig. 9: Comparison of Shannon-weiner biodiversity indexes for flora, bird, butterfly, amphibian and mammal Classes between Duckwari Estate and Dunumadallawa forest reserve.

Another useful indication of the importance of a forest in terms of biodiversity conservation can be seen in the number of endemic species that it harbours. Both study areas showed relatively high species endemism (Fig. 10). Duckwari had a higher proportion of endemics in all Classes (except birds which were equal) than Dunumadallawa. This is probably due to its situation on the edge of the Knuckles Conservation Area as this hill country zone is separated from the central hills of the country by the wide valley of the Mahaweli Ganga, this island's largest and longest river. The separation of the Knuckles range from the rest of the central hills has resulted in a high concentration of endemic species here.

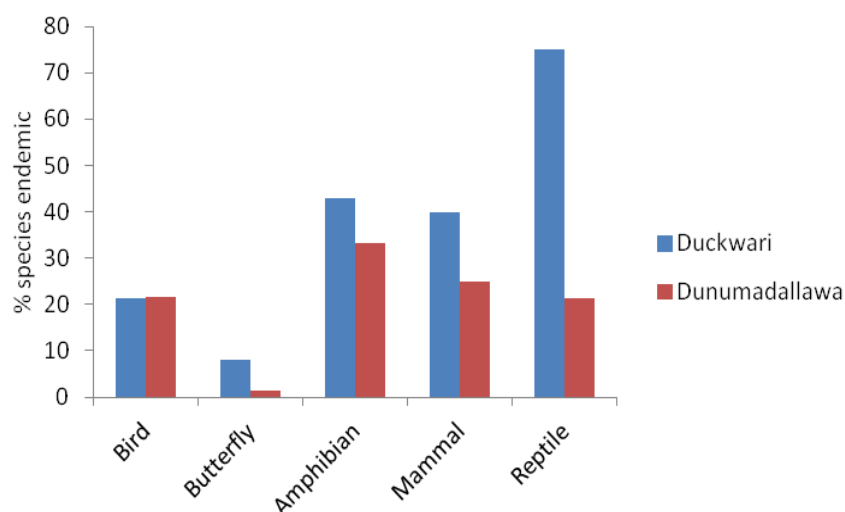


Fig. 10: Comparison of endemism for 5 animal Classes between Duckwari Estate and Dunumadallawa forest reserve. Reptile data based on opportunistic observations, other data on transect data.

A final comparison between the two highland study areas is in the form of the Jaccard's Index. This index measures the degree of overlap between species in two communities. If the Jaccard's Index = 1, there is perfect overlap meaning all species are shared between the two communities. If the Jaccard's Index is close to 0, it is an indication that few species are common between the study areas.

From the low Jaccard's Index values observed it is apparent that these two study areas, although both small highland forest patches, are quite dissimilar (although only one Class – floral diversity – is significantly dissimilar)(Fig. 11). Despite the relative proximity of the two sites, this is not completely unexpected given the lack of present connectivity between sites as well as their different land use histories. The unique attributes of the Knuckles range, and the importance of the river valley that separates it from the Central Massif, is again highlighted by this result.

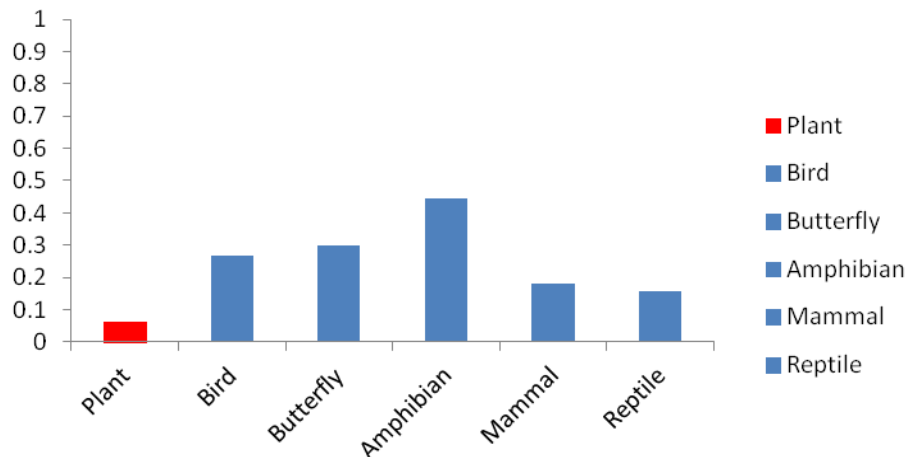


Fig. 11: Jaccard's Index measuring degree species composition similarity between Duckwari Estate and Dunumadallawa forest reserve. Red indicates a significant difference ($p \leq 0.05$) between community compositions.

B. Yala Block I

The “Spotting the spots” initiative is ongoing in the country’s most popular leopard-viewing location, Block I of Yala National Park. We have several hundred photographs from a dedicated core of six contributors from which we have created a population database. The photographs have been analyzed and catalogued, with records including individual identification (if known), GPS location, time, date, behavior and additional comments, so that we will be able to continuously monitor this population. Photo identifications have been conducted by WWCT staff as well as interested local volunteers, with all final categorizations subject to verification by WWCT PI. So far 8 adult males and 7 adult females have been identified.

This effort to incorporate “citizen science” into WWCT activities has been a positive process overall. The interest and support that it has received from regular Park visitors has been very good and we are contemplating opening it out to a wider set of contributors and utilizing a specialized computer identification software package for the continued management of the database. One thing that has been underlined is the fact that the general public is very interested in contributing to monitoring and management applications such as this. As long as we remain aware of the limitations of such a method (i.e. No measurement of effort; limited ability to interpret observed behaviour) we feel confident that this can continue to provide a dual role of engaging the public in the scientific/conservation process and allow a meaningful relative measure of the Block I leopard population over time.

II. Education and Awareness

A. Undergraduate student supervision

WWCT Principal Investigator Andrew Kittle has been external supervisor for three students in 2012. Dharshika Pathirathna and Thushani Senevirathna from Sabaragamuwa University of Sri Lanka completed their undergraduate theses in the beginning of 2012 (see details above). At the same time Ama Wickramarachchi began her final year thesis project at the University of Sri Jayawardenepura. Ama has now almost completed an ambitious project aimed at quantifying the value of the leopard in Sri Lanka. She has focused at two scales, regionally by using the zonal travel-cost method (ZTCM) to estimate the local recreational value of leopards in YNP, and nationally by using the dichotomous choice contingent valuation method (DC-CVM) to determine a willingness-to-pay (WTP) value which is then used to estimate the non-use value of the Sri Lankan leopard. This is a very useful piece of work which will provide quantitative measures of the economic worth of the Sri Lankan leopard, a potentially useful tool in the effort to ensure the long-term conservation of this species in Sri Lanka.

A. Leopard distribution poster

We designed and printed a large (2 x 5 foot) canvas poster depicting our current knowledge of leopard distribution in Sri Lanka (Fig. 12). This is the result of years of our own presence/absence surveys and the compilation and verification of data from a wide variety of external sources. We gifted this poster to the DWC and it is now prominently displayed at their central headquarters. These types of awareness projects are extremely important as they provide a visible means to transmit the information gleaned in the field, display results from our projects for which we needed DWC permits and highlight the follow through from these projects, an important aspect of our work.



Fig. 12: WWCT leopard distribution poster as displayed at the head office of the Department of Wildlife Conservation, Sri Lanka.

B. Horton Plains camera trapping poster

A second poster has recently been completed which provides some general results from the HPNP camera trapping survey (Fig. 13). As above, this attractive display which includes camera trap photographs from the survey and an overview of the project design and results has been presented to the DWC for their head office. Copies will also go to HPNP so that visitors and staff can benefit from the information.

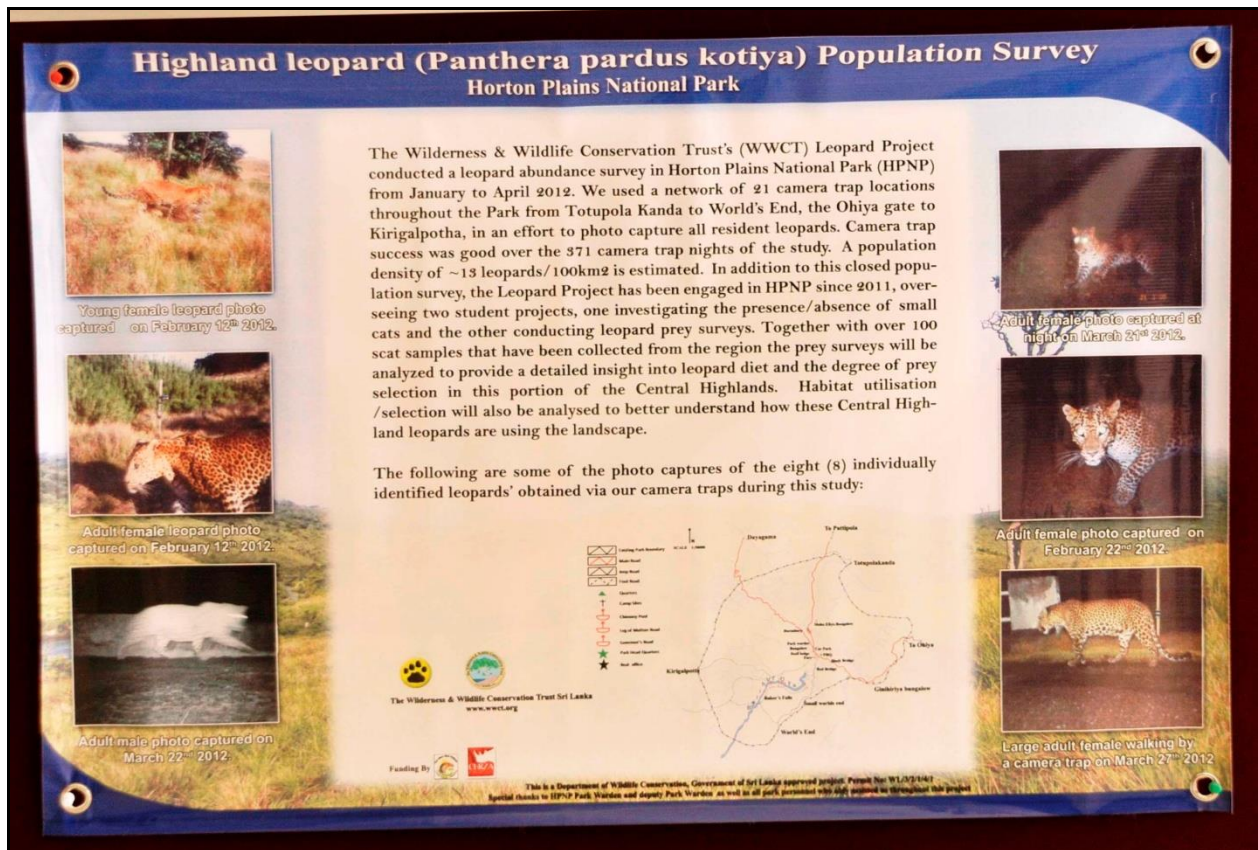


Fig. 13: Horton Plains National Park camera trap survey poster as displayed at the head office of the Department of Wildlife Conservation, Sri Lanka. Additional copies are being presented to the HPNP head office and visitor centre.

C. Leopard Survey Questionnaire

As a first step in establishing leopard use locations within Wilpattu National Park, a questionnaire targeting the wildlife department staff and some dedicated local park visitors was formulated. With DWC permit we hope to conduct a closed population leopard camera trap survey similar to the one conducted at HPNP in 2014; information gleaned from this survey will be useful when considering trap locations. As well we plan to use the same questionnaire at other more remote protected areas with an idea of establishing specific leopard locations so as to fill in the gaps of our leopard distribution database. We also hope to better understand how wildlife department field personal view the leopard as they are the first tier of protection for the leopard and wilderness areas. Through our work over the years we feel that this form of direct involvement of wildlife department field staff is a positive step in merging scientific research with the protection and conservation of the leopard across the country.

D. School/public awareness material

Following our forest border schools programme in 2011 in the Nuwera Eliya district, we realized that there was a need for awareness on the other cat species that resided within the island; many misconceptions and misidentification of cats was occurring. As such a simple yet informative poster depicting the Cats of Sri Lanka was designed, focus being on the actual differences between these four species. This poster, once printed will be utilized in our public awareness seminars as well donated as part of the awareness package given to the forest border schools within which we hold/have held awareness campaigns. We would like to encourage them to record what cat species they come across in their vicinity, getting them actively involved in such baseline data collection and giving them a more direct link to these cats; with the hope that such interest would also foster the conservation of them.

E. Publications

Kittle, A.M., Watson, A.C. and Kumara, P.H.C. 2012. Baseline wildlife surveys of Northern Sri Lanka. Loris, Spring 2013 (accepted, awaiting publication)

Kittle, A.M., Watson, A.C., Kumara, P.H.C. and Sanjeewani, H.K.N. 2012. Notes on the status, distribution and abundance of the Sri Lankan leopard in the central hills of Sri Lanka. CatNews 56, Spring 2012

Kittle, A.M. and Watson, A.C. 2012. The Sri Lankan leopard (*Panthera pardus kotiya*) in Yala National Park: A research summary. Report for Department of Wildlife Conservation.

III: Acknowledgements:

All WWCT work within Sri Lanka has been following the guidelines and with the permission of the Department of Wildlife Conservation (DWC) and the Forest Department (FD). We would like to thank the DWC for their continued support and permissions to conduct our ongoing work.