D'ABOVILLE Foundation

Preliminary analysis, results and recommendations on the use of the Distance Sampling method with dungs' transects as an alternative method to monitor the tamaraw population at Mts Iglit-Baco Natural Park

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1. Background and context

Since the year 2000, the Department of Environment and Natural Resources (DENR) has been conducting a tamaraw population census annually using the simultaneous multi vantage point count method. The operation uses 18 vantages points, covering an area of around 2200ha within the core zone of the monitoring (CZM) inside Mts Iglit-Baco Natural Park (MIBNP), where most of the tamaraws in Mindoro are found today. The method requires burning the grasslands prior to the count in order to increase visual detection and artificially retain animals on new grass shoots.

One of the orientations of the Protected Area Management Plan for Mts Iglit-Baco Natural Park (PAMP MIBNP) is to phase-out the recurrent grassland burning in order to promote restoration of the natural vegetation. Subsequently, the Tamaraw Conservation and Management Action Plan (TCMAP 2021-2030) recommends developing alternative methods to monitor the tamaraw population of the CZM that does not require intrusive intervention but will compensate for the loss of pertinence of the current method after cease of the fire regime.

The D'ABOVILLE Foundation and Demo Farm Inc and its partners are assisting the DENR in that purpose by experimenting different techniques and methods. One of them is the **Distance Sampling method** for dungs using walking transects that is combined with the **Double Observer method** to evaluate the detection rate.

This report, which is a summary of a more complete technical report to come, presents the main preliminary results after conducting three iterations of the transect operation in 2020 and 2021 and the associated initial data analysis. It aims to evaluate the capacity of the method to render an estimate of the abundance of tamaraw based on the density of dungs recorded and to provide recommendations on the validity and limits of the methods as well as the next steps to follow.

2. Testing and developing the distance sampling technique combined with the double observer method in MIBNP

a. Rational and objectives of the operation

Measuring the exact population size of a species in a certain location is seen as the main indicator for management decisions and to define protection measures. However, it is barely reachable in the field for wildlife. This is the case with the annual tamaraw population count that only renders an estimate of the abundance of tamaraw in the area at the time of the annual count.

The implementation of the distance sampling of dungs method aims at creating an alternative to the annual count that will enable the local authorities to continue estimating the abundance of tamaraw inside the CZM after the fire regime will be successfully stopped. It is based on the assumption that

we can extract a conversion factor between the number of animals present in the area and the number of dungs they produce. This calculation is made feasible by assuming that the annual point count provides a quite accurate estimation of the number of tamaraws present in the count zone and therefore can be directly related to the density of dungs recorded on the same surface, thus reducing the need to count for the defecation rate and decay rate into the process (as shown in the diagrams in appendix). The closer the transect operation from the point count, the better so as to avoid seasonal influence. After a phase of tests and calibration, the aim of the operation is to develop a single operational method that can be implemented by the local stakeholders in the field and render an estimate of the population size from the density of dungs recorded in the field and a conversion factor that we assume constant in time.

b. Brief explanation on the methods and their implementation in the field

The combination of the distance sampling of dungs and the double observer methods allows recording the density of faeces over the study area and estimating the detection rate for these signs of presence by the field teams. The selected protocol involves walking transects of 500m that are semi-randomly plotted (avoiding rough terrain, cliffs and areas used by local communities) over 2200ha corresponding to the area covered by the annual count. Two independent teams are conducting the dependant double observer's protocol. Each team is composed of trail openers, front team spotting dungs, data recorders measuring the perpendicular distance of the dung to the transect line, taking GPS coordinates and encoding the data, then back team spotting only dungs missed by front team.

Both techniques and the rationale behind their use was more thoroughly described in the previous report "Distance Sampling of Dungs as an Alternative Complementary Method To Monitor Tamaraw Abundance in Mts. Iglit-Baco Natural Park - Technical report on the pilot test conducted in February 2020" and published in the IUCN AWCSG BULLetin Issue 4 of July 2020.

The following analysis encompasses the data collected during the three operations conducted so far:

- Operation 1 and pilot test was carried out in February 2020 during the dry season, with 29 transects completed.
- Operation 2 in December 2020 at the end of rainy season, with 27 transects completed but with a design of transect different than the previous operation.
- Operation 3 in June 2021 at the beginning of the rainy season and two months after the grassland burning operation for the annual population count of April. 27 transects were completed using the same design as operation 2 with slight adjustments.

In all cases, faeces of tamaraw, Philippine brown deer and Mindoro warty pig were recorded.

Operation/species	**Total number of faeces recorded (front team/back team)**		
	Tamaraw	**Brown deer**	**Warty pig**
1 - February 2020	850	122	55
2 – December 2020	413	69	20
3 – June 2020	518	112	60

We only focus on the tamaraw data in this report.

c. Parameters and data analysis

The analysis uses a statistical model that returns four parameter estimates of interest to us:

Parameter 1: dung density (*D*) = it is the calculation of the total number of dungs collected for the overall operation (all the transects) and the corresponding sampling surface it represents (on what surface were found all these dungs counting for the distance of each dung to the transect line), then extrapolated to the entire count zone (2200ha) to know the average density of dung of tamaraw in the area covered by the tamaraw count.

Parameter 2: average detection probability of dungs (*p*) = it is the calculation of the overall probability to detect a dung when walking on the transect line, according to its perpendicular distance to the transect line predicting that the further a dung is from the transect line, the lower the probability to detect it because of terrain and vegetation.

Parameter 3: detection rate (π) = it is calculated by comparing the number of dungs spotted by the front team and the back team. It is based on the assumption that the probability to detect a dung directly located on the transect line is equal to 1 (people don't miss a dung located where they have to walk). π is a reflexion of the detection rate estimated by the double observer method. If < 1, then it means that the double observer design is meaningful in correcting the value obtained by the front team (back team collects dungs missed by the front team) and estimating an unbiased density of dungs.

These three parameters are actually functions of environmental covariates (vegetation openness, terrain, climate….).

Parameter 4: conversion factor (C_t) = this is the calculation of the correlation between the dung density (*D*) estimated for the entire count zone and the number of tamaraws (*N*) resulting from the closest tamaraw point count operation. The conversion factor shall allow to estimate, in the future, the number of tamaraws present in the core zone of monitoring from the result of a transect operation in absence of point count.

d. Results

The model calculates all the parameters from the raw data of the three operations. Main results can be seen in table 1.

The primary detection rate (π) is always below 1, showing that there is an imperfect detection rate by the team, even on the transect line itself, with an underestimation of about 15% on average. This can be corrected thanks to the use of the double observer method.

The detection probability is always below 10%, showing a massive effect of the distance to the transect to detect a dung. Dungs are more likely to be spotted by rangers when located within 1m wide strip around the transect line (50cm on each side, with more than 90% of all dungs collected within this range) but drop dramatically beyond. Few dungs were collected beyond 5m due to favourable visibility conditions (lower vegetation at that location).

Over the three distance sampling operations, the mean density of dungs is D = 0,069 dung/m², and the equation linking the number of tamaraws to dung density is: **N = 344 + 1453 x D**, with an R^2 = 0.89, on three observations only.

Table.1: main results and parameter estimated by the model for the three operations:

Operation	**1**	**2**	**3**
Date /	February 2020	December 2020	June 2021
Total number of transect	29	27	27
Total tamaraw dung	850	413	518
Seen by front team	681	357	408
Seen by back team	169	56	110
Primary detection rate (π)	88%	91%	76%
Max perpendicular distance of dung to the transect	20m	10m	8,4m
Average detection (*p*)	0,09 (9%)	0,05 (5%)	0,06 (6%)
Proportion of dungs detected within the first 50cm of the transect	>90%	>90%	>90%
Total surface sampled	290.000m²	216.000m²	189.000m²
Overall dung density (*D*)	0.091 dung/m²	0.051 dung/m²	0.065 dung/m²
Count result *N* (year)*	487 (2019)	427 (2021)	427 (2021)
Conversion index (*Ct = N/D*)	5100,75	8338,53	6501,09

**There was no tamaraw population count in MIBNP conducted in 2020 due to the covid19 pandemic; therefore the gap between 2019 and 2021.*

3) Discussion and recommendations

Visual counting of tamaraw will be no longer a viable option for population monitoring in a context of habitat management with no fire. Therefore, shifting to a method that accounts for indirect signs of presence of animals becomes most relevant.

The three consecutive distance sampling operations combined with double observer method were successfully implemented at MIBNP. Several trainings and calibration were needed, but all rangers who participated demonstrated the ability to conduct the methods, even so foreign coordinators from DAF were not always present. Around eight (8) days are needed to carry out all the transects (27 to 29 transects in our case), which is longer than the traditional point count (6 days) but requires less people (12 to 16, plus helpers at base camps) compared to more than 40 people during an annual population count. The cost of the operation is consequently much lower as well.

Only little basic equipment is required: 2 measuring tapes, 2 GPS devices, data sheets, rangers gears and temporary camps' gears.

Results of the experiment show that we could measure a density of dungs corresponding to the same sampling surface as the area covered by the annual point count, enabling us to extract a conversion factor between dungs and tamaraws. In addition, the double observer technique was able to address the problem of imperfect detection of signs by the field teams and to improve the accuracy of the measure.

The use of distance sampling for dungs highlights that it could become a relevant alternative method to the traditional point count by providing a proxy for population abundance in the form of an indicator. It also allows us to introduce the concept of **indicator of ecological changes** that appear to us as the most promising tools for the management of the tamaraw and its habitat at MIBNP, considering that measuring an exact population size is a wishful thinking. This concept will be further explained in the final technical report.

An important end product of this experiment will be to provide a "ready to use" method to the DENR with the associated protocol, transect design and parameters estimates. Prior to that, it is important that we complete the cycle of experiments in order to ensure the most accurate values before delivering final documents to DENR. This includes conducting a **double observer point count** in April 2022 just after the annual count in order to estimate a more precise tamaraw population size for the last time. This operation will be then followed by a fourth distance sampling transect operation, so as to measure a robust conversion index. If this is respected, the cycle of experiments shall be completed by May 2022, and DAF will release final technical reports and a ready to use method document by September 2022.

More generally, several recommendations can already be formulated and must be taken into consideration by the decision makers if they decide to use this method in the future years:

- The detection rate has been measured to be around 85%, meaning that if only one team is used (no back team), results could be corrected accordingly using that parameter estimate. Nevertheless, we cannot assume the detection rate to be constant in time between operations, thus we recommend including the double observer method in the future protocol at all time.
- We can neither ensure that the conversion index will remain constant over time, as the stop of burning will result in changes in the habitat profile and in the behaviour of animals. Therefore, the conversion index that will be provided at the end of the experiment shall be considered only as indicative, as it might lose its accuracy with time.
- Thereby, the main output that must be considered as important is the capacity of the method to render an "**indicator of population abundance**" that could be combined with other environmental measurements (proportion of calf detected using another method, rate of consumption measured on vegetation, ranger's patrol reports….), so as to monitor trends in the population dynamic of the core zone and guide local authorities in their management.

These points of concerns and recommendations will be further developed in the final technical report and deliverable.

Diagram 1: Theoretical application of distance sampling combined with empirical estimation of biological parameters to estimate abundance

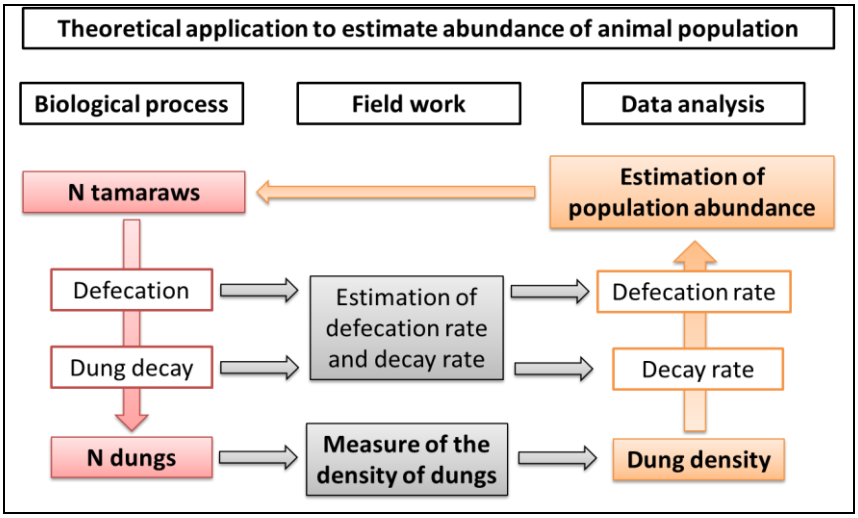
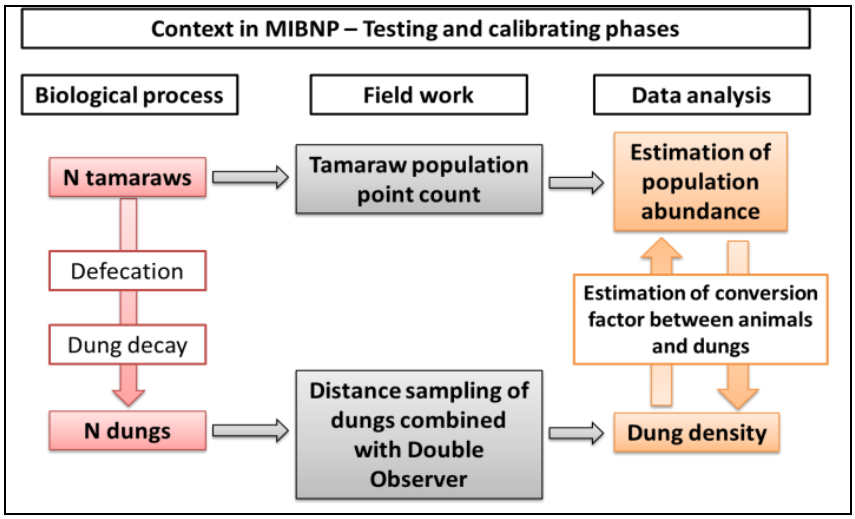
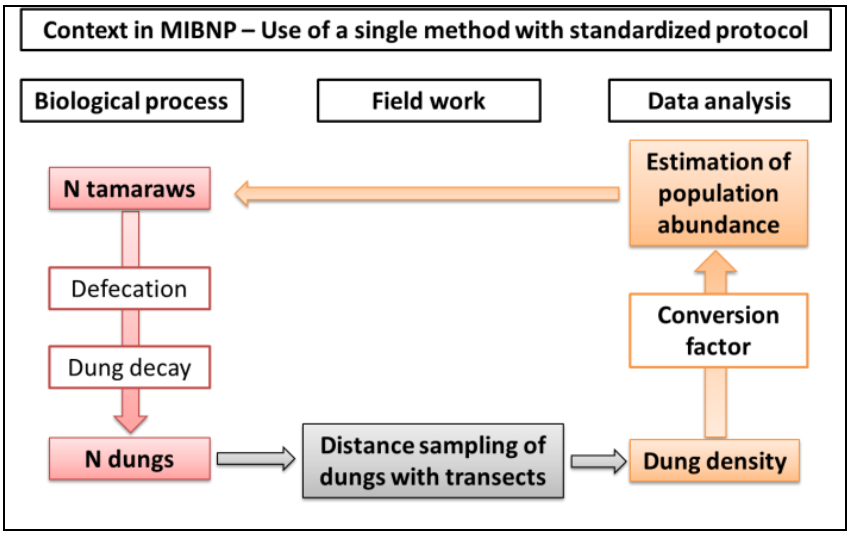
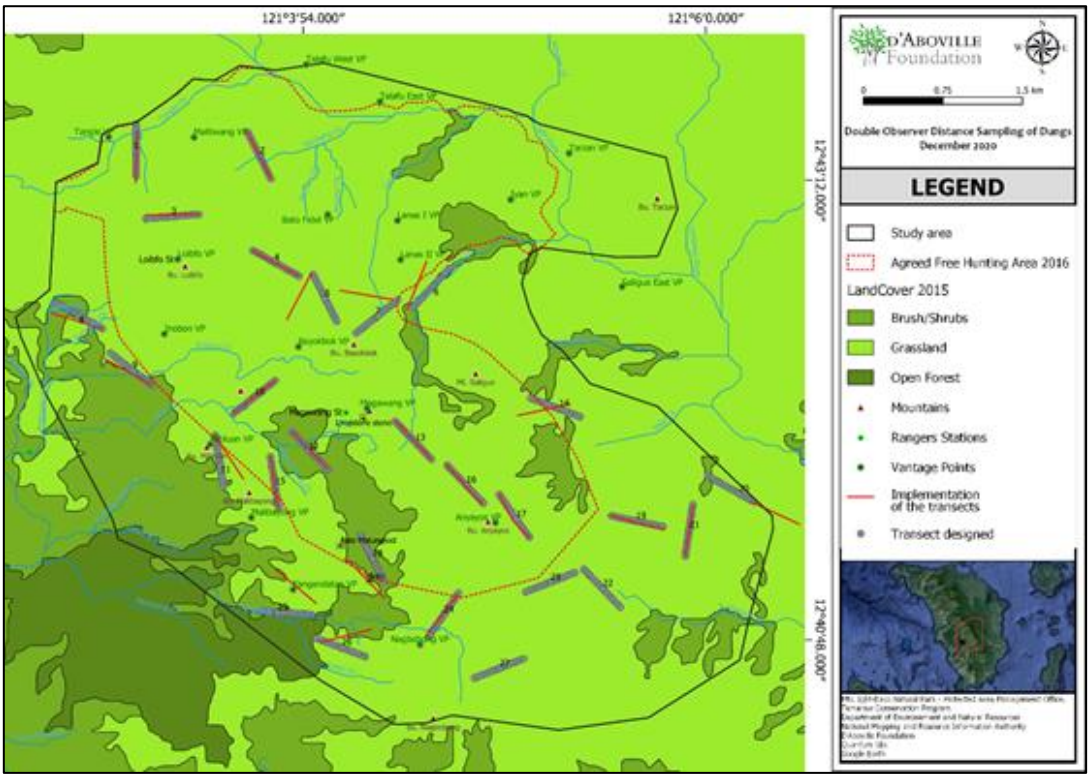


Diagram 2 and 3: Testing phase using both the point count method and the combination of the distance sampling with double observer method, enabling to extract a strong conversion factor prior to the establishment of a single method using only distance sampling.





Example of transect design used during the second distance sampling operation within the core zone of the monitoring in MIBNP



Transect team with back team and front team conducting distance sampling method combijed with dependant double observer method at MIBNP