Snow Leopard Identification Good Practices

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Reliable assessments of snow leopard populations are key for their conservation. A recent paper (Johansson et al. 2020) points to frequent errors in identifying individuals and highlights how even small errors can inflate population abundance estimates.

Snow leopards can be mis-identified as their spot patterns may not be easily recognized when their thick fur gets ruffled or when their body is photographed at different angles. Identification becomes even more difficult with blurry images associated with slow shutter speeds in low light or an animal's rapid movements. A large number of photographs of different individuals can also lead to observer fatigue and error. Johansson et al. (2020) reported that observers tended to identify more individuals than were actually captured leading to inflated estimates. Current Spatial Capture Recapture models do not make any allowances for errors in the identification of individuals. Mis-identifying individuals can either negatively or positively bias abundance estimates depending on the type of mis-identification error.

Improving the individual identification of snow leopards with artificial intelligence, and building uncertainties in the identification process into later statistical models, are both challenges that are at the cutting edge of research efforts. Until solutions are available to meet these challenges, it is necessary to minimize the misidentification of animals through careful scrutiny, transparent reporting, and skills development and assessment. To this end, we provide the following recommendations:

1. **Use the GSLEP training and evaluation app**
   - An online training tool (camtraining.globalsnowleopard.org) has been set up where observers can practice their skills in identifying snow leopards and evaluate their risk of making different types of error.
   - We recommend that observers practice individual identification with this training tool and report their errors after a set of at least n=20 identifications.
   - Report your values of accuracy, confidence and number of trials in reports or publications.

2. **Use at least three marking patterns to confirm matches or differences and exclude any suspect cases**
   - Sharma et al. (2014) recommends that studies should not consider any two snow leopard images as belonging to different individuals unless at least three marking

patterns were confirmed to be different. Images with three or more similarities should be considered to belong to the same individual.

- In case the observers are unable to locate three or more similarities or differences, the image should be considered suspect, ideally rejected from the analysis and reported as unidentified captures.

3. **Use 2-3 observers for the individual ID**
   - Misidentifying individuals from a large set of images is possible, irrespective of the experience of the observers (Johansson et al. 2020).
   - Theoretically, collaborative efforts where observers first review images independently, and then review them jointly tend to reduce the potential errors substantially.
   - Collaboration between three observers can potentially minimize individual errors by a factor of $(1-q_1)*(1-q_2)*(1-q_3)$, where q_i is the probability of an individual observer misidentifying snow leopards as new.

4. **Report number of unidentified captures**
   - As a rule of thumb, all snow leopards identified with a single encounter should be scrutinized several times before agreeing on their identification as individuals.
   - In cases where all observers fail to find at least three markings that could be distinctly identified as either similar or different, the images and the particular encounter should be discarded from the current analyses. We however recommend that these images are retained and compared with pictures the following years in order to verify individuals. Many images that remained unidentified in the initial years could be identified by the end of several years (Sharma et al. 2014).
   - Researchers should report the percentage of captures that are discarded.
   - If the survey has very few captures or many single captures we recommend that the survey design is adapted. By for example increasing the density of camera traps in the study site. Please see survey design recommendations under the Population Assessment of the Worlds snow leopards (Sharma et al. 2019)

5. **Check spatial clustering of each individual**
   - Resident snow leopard males and females are territorial (Johansson et al. 2016) and if the camera trap survey takes place over 2-3 months, snow leopard captures of the same individual are likely to occur in a given home range area. A few transient individuals or floaters however maybe observed to travel throughout the study area.
   - It is usually a good practice double-check the photos for any recaptures that look suspiciously far apart. While it can be difficult to assess if an animal is resident or a floater in a single-year study, as a rule of thumb any female with cubs should be considered as a resident.

6. **Present identification sheet as annexure to the results**
   - Given the possible effects of misidentification of individuals, we recommend that any study using camera trap based individual identification report at least one (two in case both sides have been used) reference picture of each identified

individual. The reference pictures can be tagged with the individual snow leopard's name so independent reviewers can scrutinize the individuals whose IDs have been used in the analysis to estimate snow leopard abundance.

Additional Resources
- PAWS: Misidentifying snow leopards in Spatial Capture Recapture video
- PAWS: Good practices for Individual ID video
- An online individual identification training tool: camtraining.globalsnowleopard.org
- PAWS Guidelines: https://globalsnowleopard.org/gslep-projects/paws/the-paws-process/

References

Johansson, Ö., G. Rune, G. Samelius, T. Mccarthy, H. Andrén, L. Tumursukh, and C. Mishra. 2016. Land sharing is essential for snow leopard conservation. BIOC **203**:1–7. Elsevier Ltd. Available from http://dx.doi.org/10.1016/j.biocon.2016.08.034.

Johansson, Ö., G. Samelius, E. Wikberg, G. Chapron, C. Mishra, and M. Low. 2020. Identification errors in camera-trap studies result in systematic population overestimation. Scientific reports **10**:6393.

Sharma, K. et al. 2019. PAWS GUIDELINES.

Sharma, K., R. Bayrakcismith, L. Tumursukh, O. Johansson, P. Sevger, T. McCarthy, and C. Mishra. 2014. Vigorous dynamics underlie a stable population of the endangered snow leopard Panthera uncia in Tost Mountains, South Gobi, Mongolia. PLoS ONE **9**.