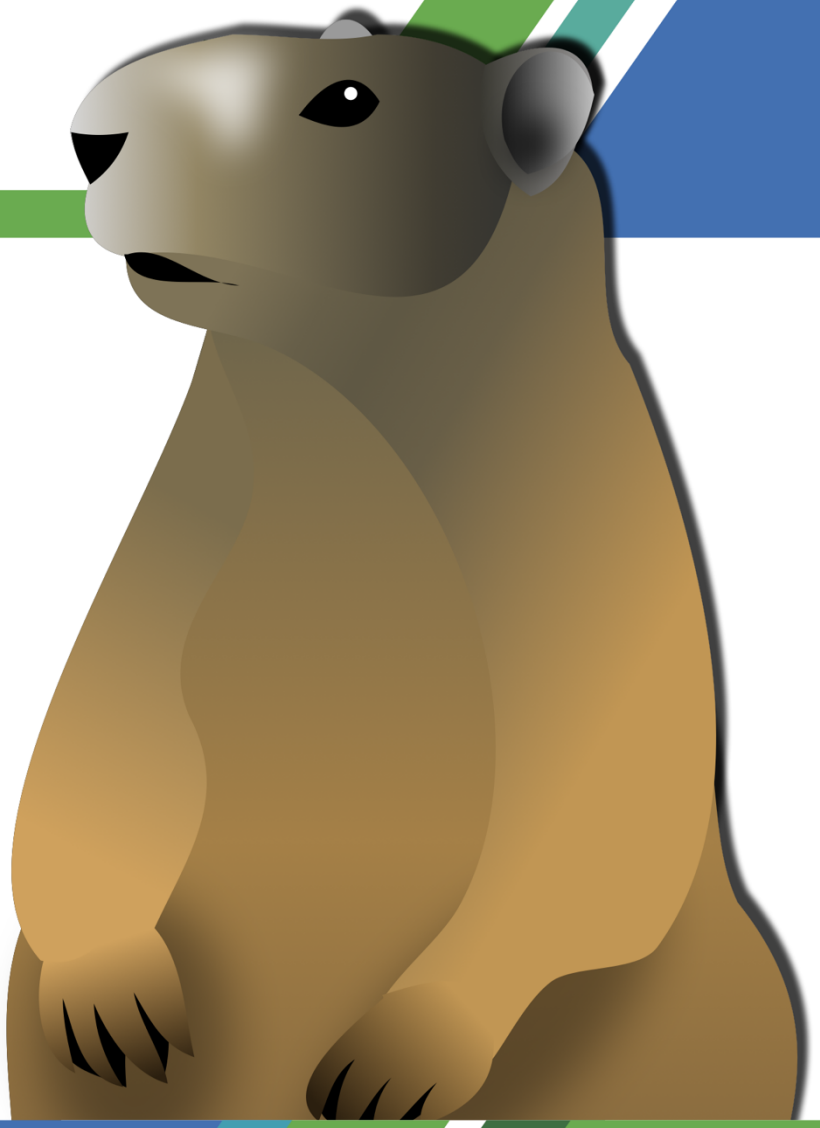
Training Manual for Long-term Monitoring of

# MARMOTS



Wildlife Conservation Society

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# Training Manual for Long-term Monitoring of Marmots

*Contributors*

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*With reference to methodologies described by*

Elsen, P. R., Poya Faryabi, S., Surya, G., Grantham, H. S. (2023). *Climate change vulnerability assessment for the Panj-Amu River Basin, Afghanistan*. Wildlife Conservation Society, Bronx, NY. doi:10.19121/2023.Report.45305.

Elsen, P. R., Poya Faryabi, S., Surya, G., Grantham, H. S. (2021). *Indicators assessment protocol vulnerability assessment for the Panj-Amu River Basin*. Unpublished report. Wildlife Conservation Society, Bronx, NY.

Moheb, Z. (2019). *Pika and marmot long-term monitoring protocol for Wakhan and Bamyan National Parks*. Wildlife Conservation Society. Unpublished document.

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# CONTENTS

# 1 INTRODUCTION

Climate change threatens biodiversity by altering the climate conditions under which species have evolved, forcing species to adapt, shift their ranges, or face local extinction[1]. Over the last few decades, climate change has already led to widespread range shifts[2], declines in species abundances[3], and full species-level extinctions[4]. These biodiversity losses have profound impacts on ecosystem structure, processes, and services, as well as multiple aspects of human well-being[5]. Wildlife species with ranges tightly linked to climate variables will be most impacted by climate change, and these species can serve as important indicators of changing climate conditions on the ground. Monitoring these species in the wild, and the habitats on which they depend, is thus essential for optimizing conservation planning to mitigate environmental, economic, and social vulnerabilities to climate change.

Marmots (*Marmota* spp.) are an herbivorous semi-fossorial species inhabiting high altitudes in Afghanistan[6]. They are considered a keystone species, playing an important role in providing ecosystem services to other species across their habitat[7]; they are an important prey for predators like snow leopards (*Panthera uncia*), and their burrows provide shelter to other species[8]. Combined with their high selectivity with regard to habitat temperatures, marmots have been considered a climate change indicator species worldwide.

## Survey objectives

The marmot long-term monitoring protocol in this manual has been developed to track marmot population abundance and distribution changes in response to climate change. The methodology consists of standardized practices for recording direct and indirect observations of marmots in the wild and has been designed to ensure reproducibility across survey teams and geographic areas.

## Important considerations

When conducting long-term monitoring of marmots, some foundational expertise is required. This training manual is not a replacement for a field guide. It is expected that at least one person conducting the surveys is skilled at identifying marmots by sight and sound, classifying observed marmots by sex and age group, and distinguishing different types of marmot behaviors (e.g., resting, foraging). Additionally, the methodology requires some basic knowledge of different types

[1] Araujo, M. B., Science, C. R. (2006). How does climate change affect biodiversity? Science 313: 1396-1397.
[2] Chen, I., Hill, J., Ohlemüller, R., Roy, D., Thomas, C. (2011). Rapid range shifts of species associated with high levels of climate warming. Science 333: 1024-1026.
[3] Root, T., Price, J., Hall, K., Schneider, S., Rosenzweig, C., Pounds, J. (2003). Fingerprints of global warming on wild animals and plants. Nature 421: 57-60.
[4] Pounds, J., Fogden, M., Campbell, J. (1999). Biological response to climate change on a tropical mountain. Nature 398: 611-615.
[5] Díaz, S., Fargione, J., Chapin, F. S., III, Tilman, D. (2006). Biodiversity loss threatens human well-being. PLoS Biology 4: 1300-1305.
[6] Habibi, K. (2003). Mammals of Afghanistan. Zoo Outreach Organization, US Fish and Wildlife Service.
[7] Townsend, S. E. (2006). Burrow cluster as a sampling unit: an approach to estimate marmot activity in the eastern steppe of Mongolia. Mongolian Journal of Biological Sciences 4: 29-34.
[8] Ahmed, T., Shoeb, M., Chandan, P., Khan, A. (2016). On the status of the Long-tailed Marmot Marmota caudata (Mammalia: Rodentia: Sciuridae) in Kargil, Ladakh (Indian Trans-Himalaya). Journal of Threatened Taxa 8: 9171-9176.

of vegetation (e.g., grasses, forbs, shrubs) and the ability to identify evidence of ungulate grazing.

## How to use this manual

This manual provides step-by-step instructions for conducting marmot surveys in the field.

Chapter 2, "Selecting a Site," outlines important considerations for choosing where to conduct the survey and how to create appropriate transects.

Chapter 3, "Preparations," discusses what surveyors should know before going into the field, such as the time and frequency of surveying, the number of surveyors required, and necessary equipment.

Chapter 4, "Field Setup," instructs surveyors on what to do once they arrive to the survey site and prepare to start the survey.

Chapter 5, "Field Methodology," provides step-by-step instructions for conducting the survey.

Chapter 6, "Reporting," gives additional detail on how to properly record the necessary data, such as how to classify marmots, burrows, ground cover, and topography.

Chapter 7, "Resources," lists some useful data, tools, and other resources available to surveyors for conducting the survey.

Finally, the Appendix contains copies of marmot datasheets that surveyors can print and use in the field to record the necessary data in their study area.

# 2 SELECTING A SITE

The survey sites should be selected based on the species basic habitat needs. Marmots prefer gentle slopes and flat areas with big rocks to dig their burrows under and patches of grassland where they can forage.

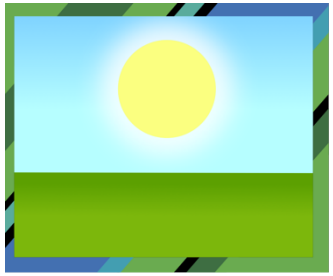
*NOTE: Maps of marmot occurrences or species distribution models are necessary for determining where to establish survey sites. If these resources are unavailable or unknown to the team, it may be useful to refer to data layers included in the Adapt Afghanistan web platform (https://adaptafghanistan.com) and in the Global Biodiversity Information Facility (https://gbif.org; see Chapter 7).*

Randomly select 25-30 transect starting points for each survey site. Exclude any points that fall outside of marmot habitat and any points within 500 m of another point.

The preferred approach would be to create random points using GIS (e.g., using the "Create Random Points" tool in ArcGIS Pro or an equivalent tool in QGIS, R, etc.; see Chapter 7).

Once you arrive at the starting point in the field, you will determine the direction and length of the transect at that time (see Chapter 4).

# 3 PREPARATIONS



## Time

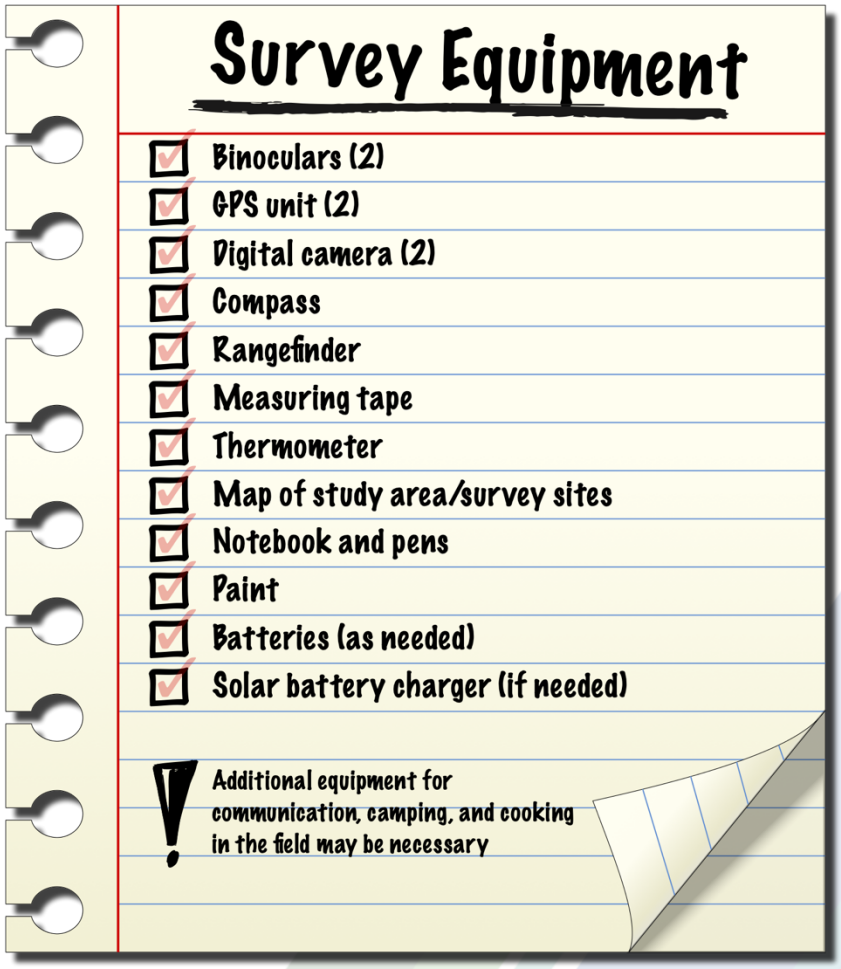
The survey should be conducted during the day when marmots are active above ground (7am-5pm).

## Frequency

If resources permit, surveys should be conducted twice per year. First, in July when newborn pups first appear. Second, in late September when the pups are grown and fully active.

## Team

Two people should conduct the survey at the same time. Observer 1 will record direct observations of marmots and their distances to the transect line. Observer 2 will count the burrows within 10 m of the transect line.



# 4 FIELD SETUP

1. Navigate your GPS to the selected start point of the transect.

2. Randomly toss a pen in the air and let it fall onto the ground. The direction of the tip of the pen is the direction of the transect line. *If the transect is facing towards inaccessible terrain, toss the pen again.*


3. Establish a straight transect line. You may find it helpful to use the GPS to estimate the survey end point and guide you in a straight line. Keep the following in mind when establishing the transect:

*Transect lines should be along valley bottoms and other gentle slopes (< 35 degrees).*

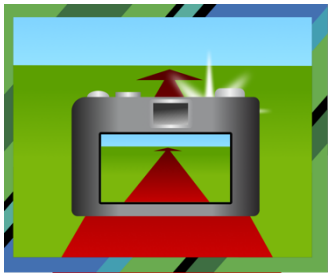
*In a valley bottom, transect lines should go up or down the valley.*

*On gentle slopes, transect lines should be located at different elevations, slopes, aspects, and vegetation communities in comparable numbers.*

*An individual transect line should remain on the same aspect and elevation.*

*Transect lines should be 200-500 m long, depending upon the topography (e.g., shorter transects in rugged terrain, longer transects in gentler terrain).*

*Transect lines should be at least 500 m apart from each other.*



4. Take a photo in the direction of the transect and record the photo number on your datasheet.

5. Mark the start of the transect for future relocation purposes (e.g., by painting on a prominent stone).

6. Before you begin, record the basic information about the survey location:

- Date
- Site ID
- Number of surveyors
- Name of surveyors
- Start time of the survey
- GPS location and elevation of the transect start and end point
- Direction of the transect
- Estimated distance from the transect to a prominent feature in the area
- Weather conditions
    - Percent cloud cover
    - Temperature
    - Wind
      (*high*, *low*, or *no wind*)


7. When you are ready to begin, both observers should start the GPS tracking.

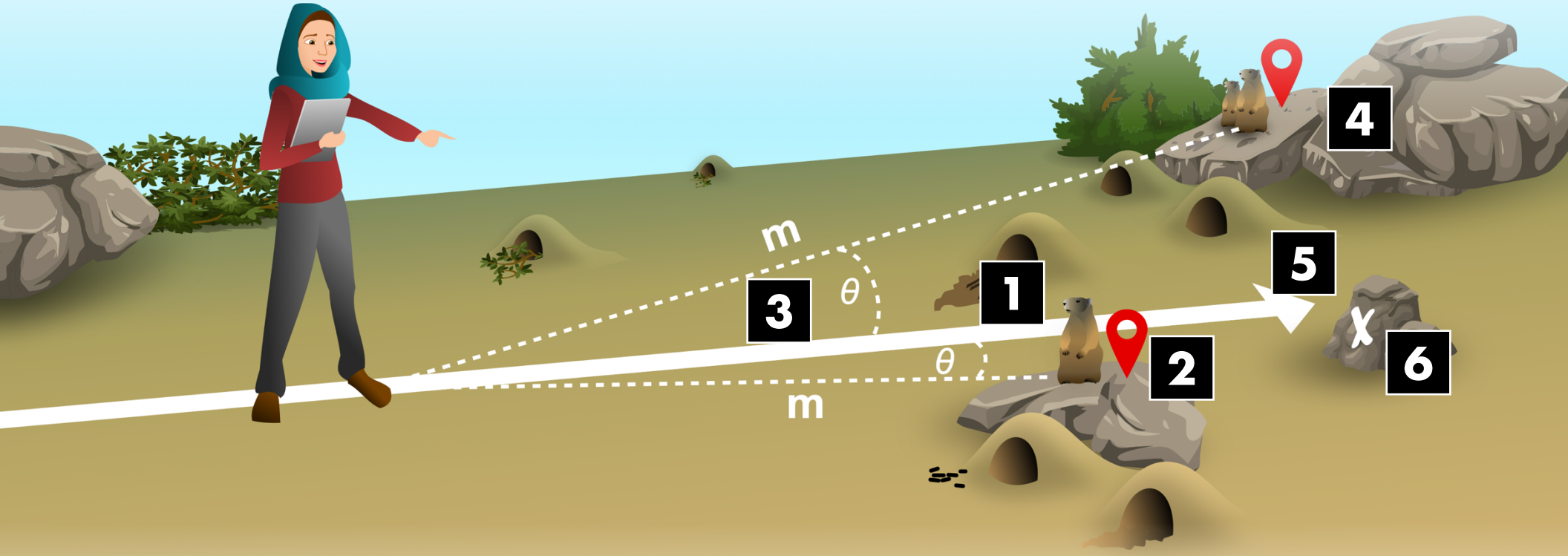
# 5 FIELD METHODOLOGY

## Observer 1

**1** Record the number of marmots seen on the transect line and on either side of the transect according to age and sex.

**2** Record the GPS point of each observation on paper and on the GPS.

**3** Record the distance and angle of the observed marmots from the transect line.




**4** Record the topography and ground cover where the marmots are observed.

**5** When the transect is finished, record the end time of the survey.

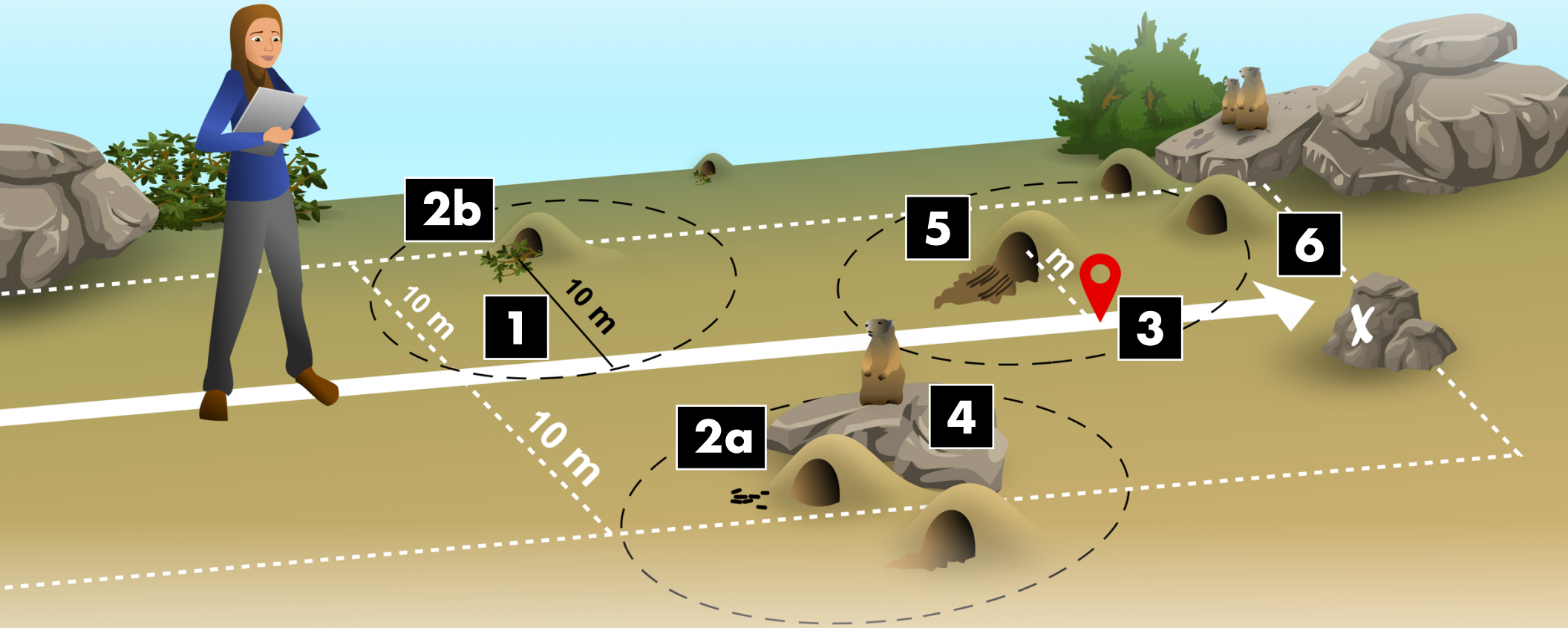
**6** Mark the end of the transect for future relocation purposes (e.g., by painting on a prominent stone).

# Observer 2

**1** Record the number of active and abandoned burrow clusters within 10 m of the transect and whether it is located on the transect line or to the right or left side of the transect.

**2a** **For active burrows**
Record the number of marmots seen, number of fresh pellet groups, and number of fresh excavations.

**2b** **For abandoned burrows**
Describe any debris detected at the burrow's entrance.




**3** Record the GPS location of the point on the transect perpendicular to each cluster and the distance to the cluster center from the transect.

**4** Estimate the percent ground cover around each cluster at a radius of 5 m from the edge of the colony.

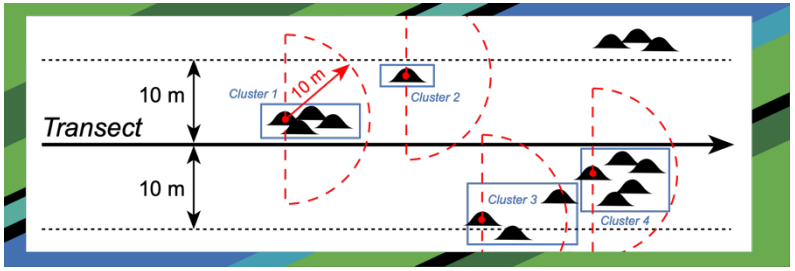
**5** Record any signs of predatory excavation of the burrows in the cluster.

**6** When the transect is finished, record the end time of the survey.

# 6 REPORTING

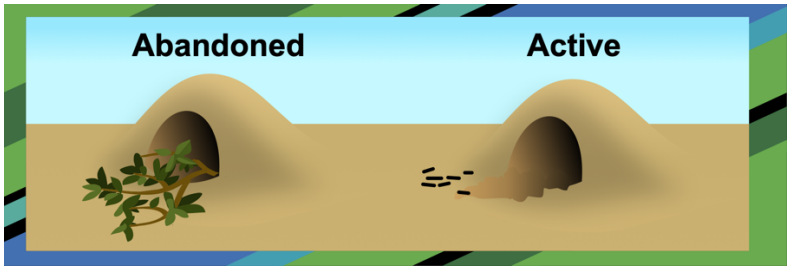
## Identifying a cluster

Burrows within 10 m of each other are considered one burrow cluster. Clusters cannot overlap. Once the 10 m range has been reached from the first burrow, any subsequent burrow will signal the start of a new cluster.




## Classifying burrows

Abandoned burrows can be determined by the presence of debris at the entrance of the burrows. Active burrows have a clear entrance with no debris and may have fresh fecal pellets or freshly excavated soil near the entrance.




## Classifying marmots

Record observed marmots according to 3 sex and age categories: (1) adult males and unproductive females, (2) productive females seen with young, (3) juveniles.

## Location topography

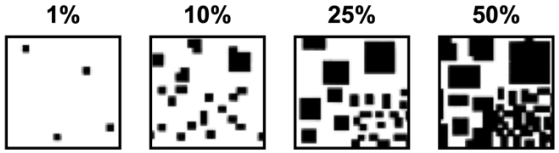
When describing the topography of the area where marmots are observed, use the following categories: (1) flat, (2) steep, (3) very steep. Use your best judgement when choosing a category.

## Ground cover

When describing the ground cover, choose one of the following vegetation categories that best describe the area:

- Graminoids (grass and sedges)
- Forbs (all flowering herbaceous plants)
- Shrubs (woody plants)
- Trees (woody plants taller than 5 m)
- Rocks (scree and talus)
- Barren land (dead vegetation, litter, dirt)
- Other (write in ground cover if none of the above)

When describing the ground cover around a burrow cluster, indicate the percent of the area around the burrow composed of the vegetation categories above, using your best judgement. Below are some examples of different percent vegetation cover estimates when looking down from above:




*Adapted from Kansas Geological Survey (1976). Criteria for Making and Interpreting a Soil Profile Description. University of Kansas.*

## Data management

When you return from the field, transfer all data from the paper datasheets into a digital spreadsheet (e.g., Microsoft Excel) and save the file.

# 7 RESOURCES

**Adapt Afghanistan**: An online repository of over 1,000 spatial data layers related to climate change vulnerability and resilience covering climate, natural hazards, ecosystems, biodiversity, hydrology, and local community sectors. https://adaptafghanistan.com

**Global Biodiversity Information Facility (GBIF)**: An online repository of species occurrence locations. https://gbif.org

**Create Random Points**: A tool for creating random points in ArcGIS Pro. https://pro.arcgis.com/en/pro-app/latest/tool-reference/data-management/create-random-points.htm

# 8 APPENDIX: SAMPLE DATASHEETS

The following page are sample datasheets surveyors can use to record the necessary data in the field. We recommend surveyors review the structure and content of the datasheets before going into the field. Surveyors should print as many copies of the datasheets as they might need to use based on the number of survey sites selected.

**DIRECT OBSERVATION**

**Date**: _____ **Site ID**: _____ **Start time**: _____ **End time**: _____

**Number of surveyors**: _____ **Names of surveyors**: _____

**Transect direction**: _____ **Cloud cover**: _____ % **Temperature**: _____ °C **Wind** (circle one): High Low No wind

**Transect Start Point**

**GPS coordinates**: Lat: _____ , Long: _____

**Elevation**: _____ m **Photo number**: _____

**Transect End Point**

**GPS coordinates**: Lat: _____ , Long: _____

**Elevation**: _____ m

| **No. of individuals** | **Age and sex categories** | | | | **Distance from transect line** (in meters) | **Angle from transect line** (in degrees) | **Topography** (flat, steep, or very steep) | **Ground cover** |
|---|---|---|---|---|---|---|---|---|
| | Adult males & unproductive females | Productive females | Juveniles | Unknown | | | | |
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**Other remarks**: _____

**INDIRECT OBSERVATION**

**Date**: _____ **Site ID**: _____ **Start time**: _____ **End time**: _____

| Cluster number | Center of cluster | | Active burrows | | | | Abandoned burrows | | Percent ground cover around cluster | | | | | | | Signs of predation |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Latitude | Longitude | No. burrows | No. marmots seen | No. fresh pellets | No. fresh excavations | No. burrows | Describe debris at entrance, if present | Graminoid | Forb | Shrub | Tree | Rock | Barren land | Other (describe) | Describe, if present |
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**Other remarks**: _____