
Great Sand Dunes National Park and Preserve lagomorph survey manual

P21AC11324-02 Survey Protocol



Image from an adult American pika perched on a boulder at Niwot Ridge, Colorado (photo by Sara McLaughlin).

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Equipment lists

Navigation, observation, and recording equipment

- GPS unit(s) for each crew, WAAS-enabled
- Plot locations
- Survey data sheets on waterproof paper (see pages A13-A14)
- Map of survey site/plot locations
- Plot photos
- Vegetation/lichen cover estimation sheets (see page A15)
- Rock shade estimation sheet (see page A16)
- Mechanical pencils and notebooks
- Binoculars
- Tablet/phone
- Thermometer
- Flashlight
- Compass
- Radio
- Spare batteries for the GPS unit

Genetic sampling materials

- Paper ‘coin’ envelopes
- Desiccant & re-sealable plastic bag
- Gloves

Personal equipment

- Daypack large enough to carry everything
- Sunscreen, hat, mosquito repellent
- Water, food
- First aid kits
- Gloves, long sleeves, long pants
- Good boots
- Watches/phones for each crew member (don’t rely on GPS units)

Table 1. Field definitions for monitoring pikas.

Term	Definition
C	Call; observer heard a pika call
S	Sighting; observer saw a pika
Scat	Animal excrement; lagomorph fecal pellets; fresh or old pika pellets (FS or OS); fresh, intermediate or old rabbit/hare pellets (FS, IS, OS)
R/H	Rabbit/Hare; observer saw a rabbit or hare
Haypile	Cuttings of forbs, shrubs, grass, or other vegetation cached (by a pika) among rocks or other debris to be used as a winter food source; fresh or old hay (FH or OH) is characteristic of pikas

How legacy plots were established

1. Crews used a GPS to navigate to points that had been selected using a spatially balanced random design (GRTS).
2. A numbered aluminum tag was wired to a rock at the plot center to facilitate repeatable establishment of the plot—an area of radius 12 m around the plot center (Figure 1).

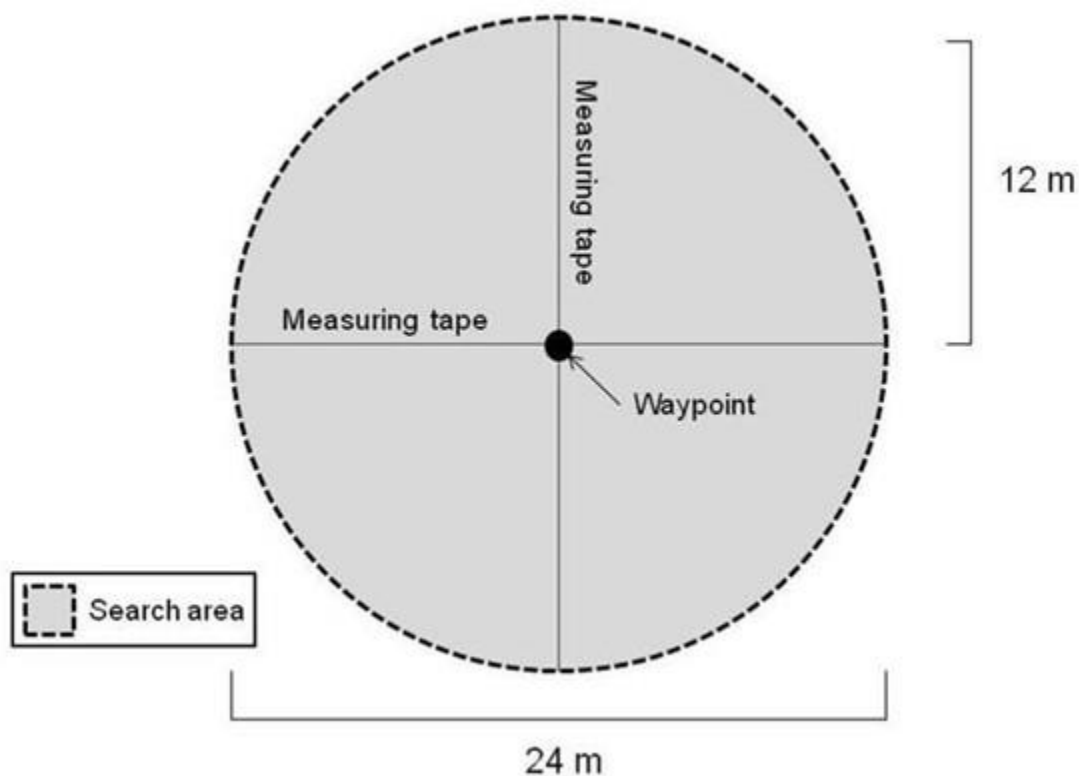


Figure 1. Diagram of a pika monitoring plot.

How sub-optimal plot locations were updated

Crews referred to the checklists below for determining whether a survey plot should be dropped or moved/offset.

Rejection criteria:

- Dangerous/prohibitively difficult to work on (e.g., slope $>35^\circ$, rockfall imminent, or other unsafe conditions).
- The plot contains $< 10\%$ target habitat. Target habitat includes any form of **creviced rock** that can provide shelter for pikas. Please note that scree or collections of small rocks (<6 inches across) do not provide sufficient shelter for pikas. If the proportion of target habitat within the plot can be increased to $\geq 10\%$ by moving the plot $<50\text{m}$, see ‘Moving a plot’ (below).
- The plot is never snow-free ($<10\%$ snow cover). If the site has not yet experienced snowmelt (e.g., if the site is being surveyed early July), the site should be surveyed at a later date and should not be dropped unless snow cover persists year-round.

In order to maintain desirable properties of a GRTS sample (e.g., spatial balance, valid inclusion probabilities), plots must be included in the sample in the proper sequence. Plots in a GRTS sample are given an ID number representing their priority for inclusion in the sample. For example, if plot #X were inaccessible, then it should be replaced by the next plot in the “oversample” (list of extra plots) that is of the same **category** (caty). Some plots were replaced during the first few years of this study, to resolve issues like dangerous slopes or lack of suitable habitat.

Moving a plot:

- If a plot containing $<10\%$ target habitat could be improved (to contain $>10\%$ target habitat) by being “offset” (moved), then it was simply offset as needed **up to 50 m** from the original coordinates.
- If insufficient pika habitat ($<10\%$ target habitat) was available within 50 m in every direction, the plot was dropped and replaced with another plot from the oversample.

Marking and documenting plots

- Each legacy plot was marked with a numbered aluminum tag and should have been photographed to assist in future relocation.
- At least 3 photos should be taken at every plot in our current survey.
 - **plot-center-with-context** = taken at a few meters from the plot center, aimed toward plot center to provide a good visual record of the plot center, its habitat features, and any conspicuous features on the horizon to help future crews find this location;
 - **downslope transect** = taken in the general direction of the downslope transect, and including all 50 m of that transect, if possible; and
 - **transverse transect** = taken in the general direction of the transverse transect, and including all 50 m of that transect, if possible.

Conducting surveys

The number of observers must be noted on the datasheet and the following describes how multiple-observer surveys should be conducted. The first step is choosing a safe, efficient route to each plot you plan to visit. Discuss plot access routes with your partner.

Surveys should begin with a 5-minute period of silent observation to allow for visual and aural detection. The two observers both participate in this 5 minutes of quiet time. After this first 5 minutes, one observer will search for sign while the other records data, takes pictures, does the vegetation survey, etc.

The search for sign should be conducted for a minimum of 20 minutes and a maximum of 30 minutes, depending on the topographic complexity of the site. Setting a minimum and maximum search time helps to standardize effort and reduce the possibility of search bias. It's important to avoid bias such as, "This site looks great. There must be some sign around here somewhere. I'll keep looking..." However, if a survey is still not finished after the 30 minutes (e.g., site is very complex), the survey should continue until the site has been thoroughly searched. Search effort will be adjusted by the record of start and end time for each search. It is imperative to maintain consistent effort. If a pika is detected after the search time (e.g., a pika calls while you are packing up), it can be recorded but the time must be noted as occurring outside the standard search period in the special space provided on the datasheet.

Data collection

1. Once the plot is located, the survey should **begin with a 5-minute period of silent observation** to allow for visual and aural detection. At the end of this 5 minutes, record your arrival time, plot coordinates, and environmental conditions on the datasheet (pages A13-A14). If you heard or saw a pika during those first 5 minutes, those data should be entered into the space for sign detected outside (before or after) the official plot search.
2. The survey should **continue with a timed search for pika sign** within the pika plot. One surveyor should thoroughly examine the entire plot and record all evidence of pika sign encountered, including time and types of sign. This search will involve kneeling down and looking underneath overhanging rocks and into crevices. If fresh pika fecal pellets are encountered, they should be collected at this time (unless this plot is selected for a "double survey," in which case you should not remove sign until the second survey). During the pika plot survey, the focus should be on pika scat, although rabbit/hare sign is also recorded; outside the pika plot, on the rabbit/hare transects, the focus should be on rabbit and hare scat, although pika calls and sightings are also recorded.
3. During the hay/scat search in a single-survey plot, the other crew member can conduct the **vegetation survey** and fill in other portions of the datasheet, as well as **recording data** or **fecal sample collection** called out by the searching crew member.
4. The vegetation survey is quite simple, involving a visual estimate of percent cover within the plot for each of six broad classes: **rock** (including only rocks bigger than a football), **bare ground** (including bedrock, dirt, gravel, scree, rocks smaller than a football, and the "litter" of dead vegetation on the ground), **grass** (graminoids like grasses, reeds and sedges), **forbs** (all non-graminoid flowering herbaceous plants), **shrubs** (woody plants and trees shorter than a human), and **trees**. Cover estimates *within* each class should not exceed 100% but cover

estimates summed across all classes may exceed 100% (e.g., where tree or shrub canopies spread over other cover classes).

Recommended steps for estimating percent cover visually are as follows:

- Select one cover class (rock, bare, forb, grass, shrub or tree). The first class selected should be one with fairly high cover. For pika surveys, this is most often rock.
 - Decide whether cover is > or <50%.
 - If cover is less than 50%, determine whether it is > or <25%, and so on.
 - Similarly, if cover is >50%, determine whether it is > or <75%; and so on.
 - Use the visual cover estimation guide (page A15) to help determine percents.
5. After the plot survey, if no fresh scat has been collected and there appears to be a possibility of pikas nearby, the crew should spend at least another 5-10 extra minutes **searching outside the plot for a fresh scat sample**.
 6. Before leaving the plot, the surveyor should double-check data entry to **make sure all fields have been filled** (or crossed out if not applicable) and all equipment (including any sensor that should be pulled) has been removed.

Data entry instructions

Each item refers to a field on the datasheet or in the Survey123 app:

1. **Date** – full date of survey (e.g., 8/8/22), including year
2. **Plot ID** – number of plot or siteID from the GRTS draw spreadsheet
3. **UTM Easting** and **Northing** – coordinates in UTM WGS 84 Zone 13 (e.g., 445026, 4434884), including both your target coordinates (the coordinates “on file” for the plot) and the coordinates of your actual survey (taken “on site” by you at the central cairn)
4. **Observers(s) – full names** (at the very least, your first initial and full last name)
5. **Environmental conditions during the survey** – includes plot-specific data regarding ambient temperature recorded by thermometer or by ‘feel’ (cold is usually <45°F, cool <60°, warm 60-75°, and hot for pikas >75°) along with units (circle °F or °C); qualitative information about the skies, recorded as sunny, partly cloudy, overcast (defined as >65% cloud cover) or drizzle (surveys should not be conducted in precipitation heavier than drizzle); and wind level recorded as low (grasses just bend), medium (branches just wave), or high (treetops bend).
6. **Times of day** – use military/24 hour time (00:00 – 23:59); record your **Arrival** time at the plot (the time just before your 5-minute silent observation); then record the actual **Begin** and **End** times for the hay/scat search (which should range 20-30 minutes total depending on habitat complexity); and finally, right before you leave the plot, record your **Departure** time; adjust the begin/end times for the hay/scat search if the search was interrupted; also note (in the “Notes” section) any time you spent away from the plot between arrival and departure time; we need to know how much time you were able to detect pikas and calls at the plot
7. **Time of sign detection** – to model detection rates, we will use the time of first scat/haypile detection relative to the start time of the hay/scat search

8. **Type of sign** -- use the categories given on the data sheet; note that “fresh” hay or scat would contain at least some visible chlorophyll—some green tint—and some flexibility/plasticity, while “old” hay or scat would contain little (hay) or no (scat) visible chlorophyll and would be brittle (see pages A10-A11); fresh scat is either on top of fresh hay or “perched” (stuck to a rock in a precarious position, glued there by urine); if it’s difficult to determine freshness, explain the problem in a note
9. **Fresh scat collected** – collect fresh scat when you can (there’s a prize!) and tell us here how many pellets you managed to collect
10. **Distance from plot center** -- if you see or hear a pika inside **or outside** of the plot, record your best estimate of the *distance between the plot center and the pika*; this field is not relevant for haypiles or scat, but for pika sightings or calls we use it to determine whether they were inside the plot or how close to the plot they were; **use the notes field if necessary**
11. **Largest rock/deepest crevice within 1 m of sign** -- for any sign encountered, record the size (largest dimension) of the longest axis of the largest rock nearby (within about one meter); for example, if you saw a moving pika, record the size of the largest rock that the pika passed within one meter of, and if you encountered a hay- or scat-pile, record the size of the largest rock within one meter of this sign; crevice depths can be estimated by half-meter classes (see below)
12. **Classes of land cover** – Visually estimate and record percent cover (within the 12-m radius of the plot) for each of six classes of land cover: **rocks** (defined here as talus or loose rocks and boulders bigger than a football), **bare** (including dirt, dead “leaf litter,” gravel, scree, loose rocks smaller than a football, and exposed bedrock), **grass** (graminoids like grasses, reeds and sedges), **forbs** (all non-graminoid flowering herbaceous plants), **shrubs** (woody plants and trees shorter than a human), and **trees**. Cover estimates *within* each class should not exceed 100% but cover estimates summed across all classes may exceed 100% (e.g., where tree canopies spread over other cover classes).
13. **Presence of other mammals and birds of prey** – do not attempt to exhaustively search for each type of mammal sign—focus on pikas, but take data on other species opportunistically; if you are unsure about the sign of any animal, record your questions and observations within the “Notes” section
 - **Marmot sign** – record whether or not a marmot(s) was seen or heard within ~50 m of the plot center (Yes/No), marmot scat piles or scat stations were detected (Yes/No), and/or dens were encountered; marmot dens are usually associated with a fresh mound of dirt amidst talus and covered with marmot scat; if you are unsure whether a den belongs to a marmot family, explain in your notes
 - **Woodrat sign** – record woodrat sign **within** the plot (because woodrat sign is not readily observed or obviously relevant outside the plot), and keep woodrats in mind when conducting the hay/scat search; woodrat nest(s) are usually associated with a collection of dried twigs and small branches, plus urine-soaked mats of feces, urine stations (usually a thick, very bright, white deposit on the rocks, surrounded closely by bright orange, nitrogen-loving lichen), and/or scat stations (like a bunch of brown vitamin or medicine capsules, each about 1 cm long).
 - **Weasels** – record any weasel sightings within ~50 m of the plot

- **Rabbit sign** – record whether any rabbit or hare pellets were observed within the plot; these pellets are shaped like a slightly squashed sphere, and they’re 5-10x larger than pika pellets; we have begun taking these data because rabbits and hares might transmit lagomorph diseases to pikas, such as Rabbit Hemorrhagic Disease V2; focus on this variable during the hay/scat search
- **Other species** – record any other species observed, using either the common or Latin name; focus on mammals, snakes and potential birds of prey, including ravens, hawks, owls, etc.; note any specifics about the observations in Notes

14. **Water features** – circle/select all features that occur nearby (within 100 m of the plot):

- Visible or audible runoff under the rocks in the plot
- Pools or saturated soils immediately downslope (<100 m)
- Riparian vegetation (e.g., willows) immediately downslope (<100 m)
- Snow upslope (<100 m)

15. **Deepest talus (m) in plot** – after the scat/hay search, estimate the minimum depth (e.g., <0.5 m, >0.5 m, >1.0 m, >1.5 m) of the very deepest cracks/crevices available within the plot, regardless of proximity to sign

16. **Size range of largest 10 boulders** – after searching the plot, estimate the size range of the largest 10 loose boulders/rocks in the plot; e.g., if the very largest rock is about 2 meters long (in its longest axis) and the 10th-largest rock is about 1 meter long, the size range is 1-2 m; include only loose boulders, and exclude rock outcrops and exposed bedrock that pikas can’t really make use of

17. **Temperature sensors** – a sensor might have been positioned within the plot about ¼ to ½ m below the surface of the talus; the sensor should have a tail or retrieval cord that is (only slightly) **visible only to someone standing directly over it**; record the name/ID of the sensor in a notes field in the datasheet/survey app before leaving the plot

18. **Distance to accessible forage** – *for plots that do not contain at least 2×2 m of accessible forage*, distance to accessible forage should be recorded to the nearest 5 m (from the plot center); for our purposes, accessible forage is defined as grass/forb/shrub cover that occurs in a patch of at least 2×2 m within an area of 4×4 m; for example, a ‘patch of grass’ covering approximately 1×2 m would not constitute a foraging area unless an additional 1×2 m of accessible forage occurred along with the ‘patch of grass’ within an area of 16 square meters

19. **Rock shade** – estimate the average shade of rocks in the plot (excluding lichen) as 1 of 3 shade categories (light, medium, or dark) using the shade color guide (page A16)

20. **Lichen cover on rocks** – estimate the average cover class of all combined lichen on rocks within the plot as less than 33% cover, 33-67% cover, or greater than 67% cover

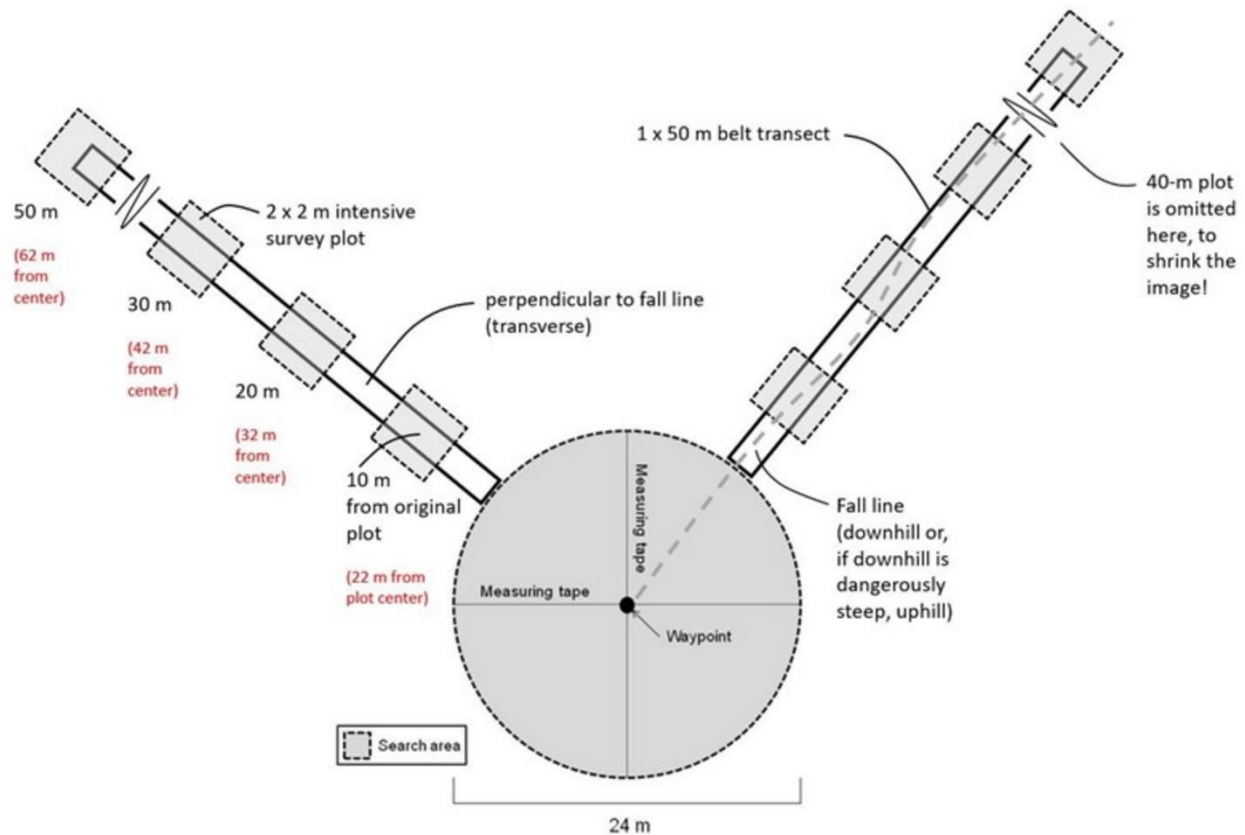


Figure 2. Diagram of the full 2022 lagomorph monitoring plot.

21. **Rabbit/hare transects** – after surveying the circular sub-plot, conduct two belt-transect surveys for lagomorph sign (Fig. 2). A “downhill” belt transect will extend 50 m from the plot edge (62 m from the plot center) along the down-slope fall line (or, if that is too dangerous, try the opposite, up-slope direction; the goal is to intersect different types of vegetation, which often occur along an elevational gradient). A “transverse” belt transect will extend 50 m from the plot edge perpendicular to the fall-line transect in the direction of highest apparent abundance of shrubs or similar vegetation offering potential cover for lagomorphs. First, walk outbound along a transect, focusing within ½-meter of the transect centerline to survey a 1x50-m belt, recording the distance from the plot center to each (non-pika) lagomorph sign observed, sign age (OS = old scat, IS = intermediate and FS = fresh). Record also other sign types, such as carcasses, tracks and the amount of sign (e.g., number of pellets observed) separated by 1 m from previously recorded sign. ***If neither the circular sub-plot survey nor the outbound belt transect resulted in sign of non-pika lagomorphs***, then a more thorough survey will begin, to bolster evidence of presence/absence. One crew member will conduct a 3-minute survey of a 2x2-m sub-plot centered at the end of the 50-m transect (Fig. 2; 62 m from the plot center), followed by similar 3-minute surveys of sub-plots centered at meters 40, 30, 20 and 10 from the plot edge (62, 52, 42, 32 and 22 m from the plot center) along the belt transect. These in-bound surveys will continue until evidence of (non-pika) lagomorph sign is detected or until all 5 sub-plots are surveyed, whichever comes first.

22. **Vegetation transects** – Regardless of lagomorph survey results, the dominant land cover within each of the 5 subplots along each belt transect will be recorded as rock, bare, gram, forb, shrub or tree (as defined above) during inbound transit along the transect.
23. **Double surveys** – If the plot is designated for double survey, the crew members reverse roles and repeat the pika-plot survey and the belt-transect portion of the lagomorph and land cover surveys (outbound and inbound). At double-survey plots, any fresh pellets encountered will not be collected until the second survey, so that all sign is available during both surveys.
24. **Take digital pictures** of the plot, recording separate camera and photo IDs for each of the four photos required: 1) plot center with context, 2) downhill transect and 3) transverse transect; re-name files descriptively upon download, and download them every day to avoid confusion (associating photos with the wrong plots is a common occurrence when photos are not stored on the day they were taken)
25. **Opportunistic sampling** – fresh scat samples collected or other sign encountered in transit between plots can be recorded here; please win the prize for most scat collected!

Scat sampling protocol

We can obtain genotypes and stress-hormone data from scat samples, as well as determining diet and certain gut parasite levels. Most of these analyses require that the samples be fresh when collected, and remain dry and cool during storage.

At or near each occupied plot, attempt to collect two samples of fresh (see below) fecal pellets. Avoid collecting multiple samples from a single territory (e.g., collect samples only if they are more than 50 m apart). Record the date and UTM coordinates on the collection envelope. If time permits, collect up to 5 samples within 300 m of the plot center. Fresh pellets can also be collected opportunistically during transit between plots.

What are fresh pellets? Rabbits, hares and pikas produce both fecal pellets (round and brownish) and cecal feces (long, skinny and blackish), but cecal feces are rarely found because they are usually re-ingested immediately. Pika pellets are the size and shape of a peppercorn (rabbit and hare pellets are 5-10x larger and a bit squashed like a Milk Dud).



Pellets aged from fresh (left) to old (right). Note both the color and size. Only collect from the left two categories! Note also the pellets in cracks: we do not want to collect pellets that have been in contact with older pellets of questionable origin.



Example of fresh pellets stuck to a rock with urine.

The only way to be sure that pika pellets are fresh is if they are resting on fresh hay or "perched" in a precarious position on a rock. Fresh pellets are deposited with urine that helps them stick onto the rock surface. Passing animals, rain and wind will knock perched pellets into the duff or dirt, where they are difficult to distinguish from older pellets. For pika sampling, we collect only pellets perched on rocks (ready to fall) or resting on fresh hay. For rabbit/hare sampling, fresh pellets are reddish-brown to golden on the outside and greenish on the inside.

Each sample should consist of pellets from a single defecation. We need a minimum of 3 pellets for genetic studies and 9 for stress hormone estimates. Don't mix pellets from different rocks or haypiles. Push the pellets into the envelope using a twig or a flower stem. In pencil, record the date, coordinates and a rough estimate of the number of pellets on the outside of the envelope (e.g., 08/13/2019, 0452146, 4194256, N > 9). Avoid crushing the pellets when writing on the envelope and during storage in our day-pack. Offload samples every evening to avoid crushing them the next day.

Store envelopes in a cool room, fridge or freezer, preferably grouped together in a plastic zip-loc containing desiccant. Label the bag "GRSA pika pellets."

Daily data submission

If using paper datasheets, enter your own data into the on-line app for the lead technician to review. Also, submit all plot photos and an image of each datasheet through the shared Google Drive folders used for this project. All of your submitted photos must be geo-tagged. To allow the geo-tagging feature on your phone, follow these steps:

iOS (Apple Operative System):

1. Navigate to 'Settings' > 'Privacy' > 'Location Services,' then swipe right to turn on.
2. In the same path/menu, scroll down to 'Photos,' and select the option 'While using the app'.
3. Submit a test photo to the Google Drive folder for the lead technician to review by following the next path: 'NWT-PikaOccupancy-PlotPictures' > 'Testing'.

Android Operative System:

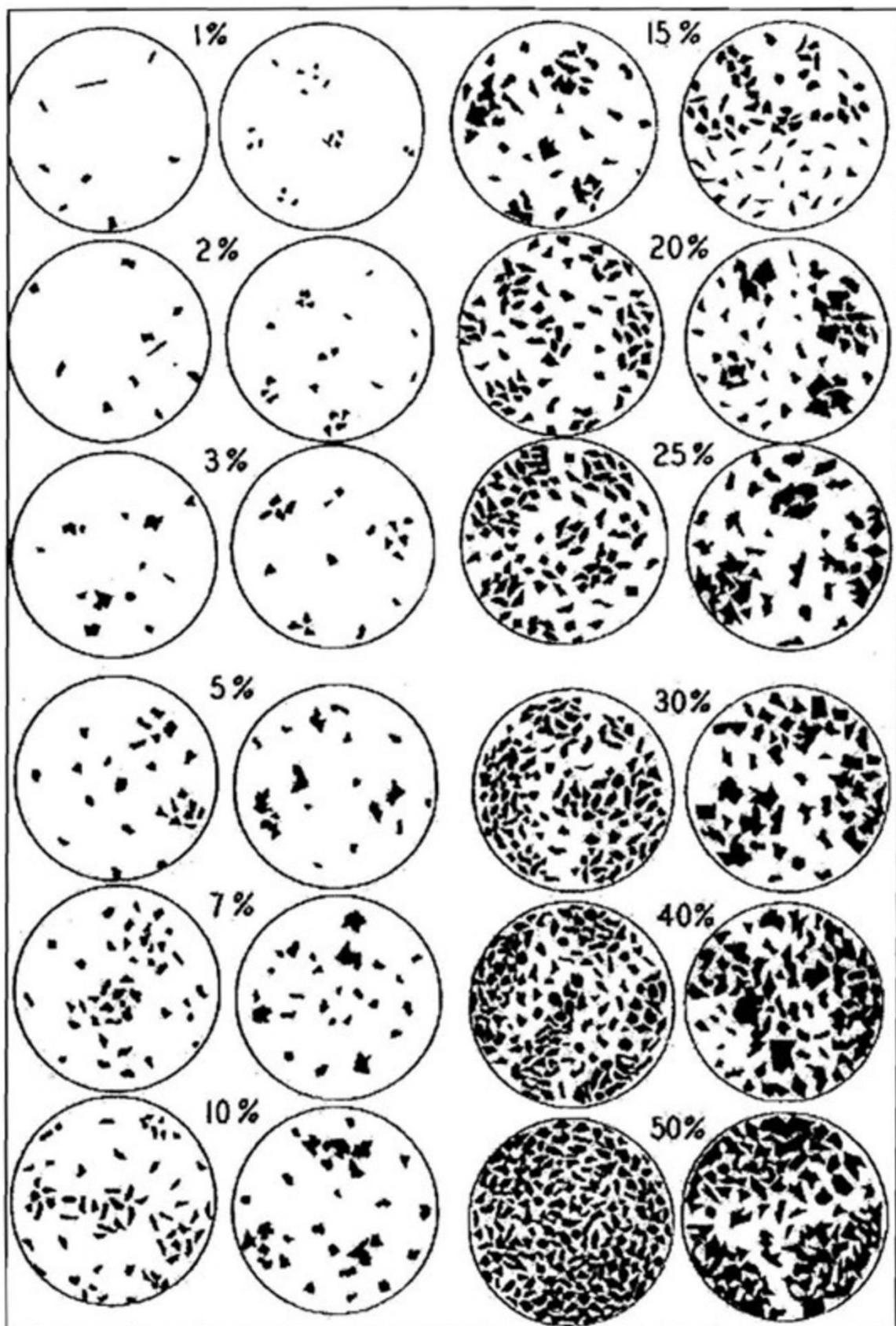
1. Navigate to the 'Menu' > 'Settings' > 'Location' > 'Location and Security,' then turn on the option 'Use GPS Satellites'.
2. Press the home button > tap the camera icon > tap the camera App menu > tap the 'settings'.
3. Depending on your Operating System, turn on either 'Store Location in Pictures' or 'Geo-tag Photos'.

To facilitate data sharing, install the Google Drive App on your phone. To access on-line material while in the field with limited connectivity, enable off-line use of the folders used for this project by navigating to each folder, clicking on the ellipsis button, and then selecting the option 'Make Available Offline'. We recommend that you make sure you have off-line access to: pictures from previous years that show plot locations, the Survey Manual, the "sensor-locations-info" document, etc.

Transect 1: downhill			Transect 2: transverse			Depth of deepest crevice in plot (circle one)						
Meter (1-50)	Sign type (R, H, FS, IS, OS...)	Amt (#)	Meter (1-50)	Sign type (R, H, FS, IS, OS...)	Amt (#)	< 0.5 m	> 0.5 m	> 1.0 m	> 1.5 m			
						Size range of largest 10 rocks in plot: _____ to _____ (m)						
						Mean rock shade: <i>light</i> <i>medium</i> <i>dark</i>			Mean lichen cover: <33% 33-67% >67%			
						Marmot sign		Woodrat sign		Weasel sign	Other species	
						Marmot	Y N	Woodrat	Y N	Weasel	Y N	1.
						Scat	Y N	Scat	Y N	Scat	Y N	2.
						Den	Y N	Midden	Y N	Den	Y N	3.
						Opportunistic sampling between plots (any lagomorph):						
						Time:_____ Sign type:_____ UTM E:_____ UTM N:_____						
						Time:_____ Sign type:_____ UTM E:_____ UTM N:_____						
						Time:_____ Sign type:_____ UTM E:_____ UTM N:_____						
Intensive search of 2x2 m plots			Intensive search of 2x2 m plots			Photos						
Meter	R/H sign?	Cover type	Meter	R/H sign?	Cover type	Photo 1: center with context (include landmarks)						
50	Y N		50	Y N		Camera ID:_____ Photo ID(s):_____						
40	Y N		40	Y N		Photo 2: transect 1 from plot center (downhill)						
30	Y N		30	Y N		Camera ID:_____ Photo ID(s):_____						
20	Y N		20	Y N		Photo 3: transect 2 from plot center (transverse)						
10	Y N		10	Y N		Camera ID:_____ Photo ID(s):_____						

Notes:

Daubenmire cover estimation guide for circular plots



Rock shade chart

