

## **Rocky Mountain Biological Laboratory (RMBL) Marmot Trapping Guide, Protocols, and Data Management Plan**

This guide describes the data collection protocols used by personnel to study yellow-bellied marmots at the Rocky Mountain Biological Laboratory (RMBL) and outlines how we archive these data. The goal of this document is provide a comprehensive overview of our long-term data management. Here we define the core types of data collected, the structure of those data, and the administration of data collection and archiving procedures. Inventories of metadata are regularly updated at the RMBL website, archived at the University of California-Los Angeles on an annual basis, and made available. For continuing observations, data inventories are regularly updated both in this document and on the web to reflect any significant changes in the location, type or frequency of data collection.

This project is one of the world's longest studies of free-living animals. Ken Armitage ([marmots@ku.edu](mailto:marmots@ku.edu)) started the study in 1962 and Dan Blumstein ([marmots@ucla.edu](mailto:marmots@ucla.edu)) is now responsible for its daily management and oversight. General data collection methods include regularly trapping, handling and observing these animals. We also collect blood, fecal and hair samples from these animals for genetic and hormone analyzes in the lab. In addition, we collect data from detailed experiments depending on our current research goals, each of which has its own set of specific protocols.

### **DATA MANAGEMENT AND DISSEMINATION**

**Overview:** All data are freely available to the public.

**Educational users:** We are very keen to work with people developing educational modules and other uses of these data.

**Academic users:** Data have been collected through the collaborative efforts of many and while we widely advertise our meta-data, we request that potential academic users of the data contact us to talk about collaborative projects.

These meta-data are available both at The Marmots of RMBL website ([www.eeb.ucla.edu/Faculty/Blumstein/MarmotsOfRMBL/](http://www.eeb.ucla.edu/Faculty/Blumstein/MarmotsOfRMBL/)) and at the RMBL Database Catalog ([www.rmbl.org/home/index.php?module=htmlpages&func=display&pid=13](http://www.rmbl.org/home/index.php?module=htmlpages&func=display&pid=13)). We maintain a policy of freely sharing data with potential collaborators. Metadata are publicly available within a year of collection. Please note that because we are actively engaged in many collaborative and concurrent projects, data are shared on case by case basis so as not to conflict with planned or current projects. For inquiries and additional details, please contact Dan Blumstein (email: [marmots@ucla.edu](mailto:marmots@ucla.edu)).

Data are archived as Excel files and in Base database (Base is the OpenOffice database which is compatible with Microsoft Access) that is stored on a Macintosh computer in Blumstein's UCLA lab (and backed up on drives stored in different locations); copies are periodically sent to the RMBL for archival storage. The RMBL has developed, over the past decade, a data repository. The core data set consists of demographic, behavioral, and genetic data collected on individuals. Demographic and behavioral data are proofed and entered into our database the fall after collection. Genetic samples are extracted annually, which allows us to update measures of reproductive success. Plasma and red blood cells are stored in a -80°C freezer with an alarm and daily monitoring. Blood smears are scored for parasites and neutrophil:lymphocyte ratios calculated upon return from the field. Steroid hormones are extracted from frozen fecal samples upon return from the field.

**CORE DATA TABLES include the following:**

- I. Emergence Logs** (Pages 2-4)
  - 1) Emergence Log (Pages 2-3)
  - 2) Pup Emergence Log (Page 4)
- II. Hibernacula Log** (Page 4)
- III. Snow Melt Log** (Page 5)
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- VI. Genetic and Physiological Data Logs** (Pages 14-20)
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- VII. Observation Logs** (Pages 25-31)
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**1A) Emergence Protocols**

*Quantifying Marmot Emergence*

One of the main goals is to determine where and when marmot groups emerge from hibernation. To do this, you must regularly check areas where marmots were seen in the fall of the previous year by either skiing or snowshoeing up to known burrow areas (e.g., River, Bench, Town, Marmot Meadow) or by looking with binoculars and/or spotting scopes from afar (e.g., Avery, Cliff, Picnic, Boulder, North Picnic, Stonefield). Avoid skiing or snowshoeing on or near steep slopes! Each day you investigate a site, you should try to identify each animal and get a maximum count for each demographic category (AM, AF, YM, YF). If you can't ID an animal, draw it and try to update your notes when you eventually trap subjects. Each day, add a list of all the individuals identified and the total number in each category to the emergence log. This will ultimately be turned into a cumulative emergence plot.

**1B) Emergence Log**

**Data variables arrangement:** Columns, **Data variables description:** Each row is an individual marmot, with its unique identifiers (e.g., ID number, ear tag numbers, mark) as well as pertinent information about when and where it was last trapped and observed. There are a total of 15 columns, with the following headers:

<b>Column</b>	<b>Variable</b>	<b>Description</b>
<b>A</b>	Unique ID (UID)	Combined numbers separated by "-" of the original L and R ear tags (see below)
<b>B</b>	Current L	Current tag number on left (L) ear (may be 3 or 4 digits)
<b>C</b>	Current R	Current tag number on right (R) ear (may be 3 or 4 digits)
<b>D</b>	Date Last Trapped	Date when marmot last capture during previous season (format: Day-Month-Year, e.g., 13-Jun-01)
<b>E</b>	Date Last Observed	Date when marmot last seen during previous season (format: Day-Month-Year, e.g., 13-Jun-01)
<b>F</b>	Previous Year Age (e.g., 2009 Age)	J (juvenile), Y (yearling), or A (adult)
<b>G</b>	Current Year Age (e.g., 2010 Age)	J (juvenile), Y (yearling), or A (adult)
<b>H</b>	Sex	M (male), F (female), or U (unknown)
<b>I</b>	Colony	Distinct matriline or social groups (e.g., River, Marmot Meadow, Picnic, Town)
<b>J</b>	Location/Area	Distinct locations of burrows or areas within colony sites
<b>K</b>	Fur Mark	Name (in words) of mark (drawing) used to recognized marmot as an unique individual
<b>L</b>	Mark Pict	Drawing (from previous season) of picture used to recognize marmot as an unique individual, draw the mark on the trap sheet assuming the head is up. Abbreviations for body locations include: H = head, N = neck, S = shoulder, M = middle, R = rump.
<b>M</b>	Current Year (e.g., 2010) Mark Drawn	Drawing (from current season) of picture used to recognize marmot as an unique individual, draw the mark on the trap sheet assuming the head is up. Abbreviations for body locations include: H = head, N = neck, S = shoulder, M = middle, R = rump.
<b>N</b>	Emergence Date	Date in the format of Day-Month-Year when marmot was first observed above ground in current year

Current colonies include: Bench, Boulder, Horse Mound, L Picnic, Lower Picnic, Marmot Meadow, Middle Picnic, North Picnic, Picnic, River, River Mound, South Gothic, Stonefield, Town, or Upper Picnic)

Current locations include: 45 log, Aspen, Aspen Burrow, Back, Bellview, Bench Ridge, Bench Wall, Big Flat Rock, Big Split Rock, Biorde Cliff, Border cliff, Border Mound, Bridge, Bridge/Road, Bridger, Canterlope, Cliff, Cliff lower, Cliff upper, Dining Hall, Doctor's, East Talus, East Talus Slope, Ender's, Escarpment, Fat Rock, Fortress, Front, Galena, Gates, Grey, Greys, Hull, Johnson's Dorm, Johnson's Lab, Johnson's Meadow, Lead King, Levi, Library, Little Flat Rock, Little Pinnacle, Lone Spruce, Lower, Lower Aspen, Lower Slope, Lower Slope Burrow, Main, Main Lower, Main Parking Lot, Main Talus, Maroon, McLeod, Mid/South Gully, Mid/Spruce Gully, Middle/South Gully, Middle, Middle Cliff, Middle Mound, Middle/Spruce Gully, Middle/South Gully, Mound, Mound Back, Mound Front, Near Big Split Rock, North Pole, Oh Be Joyful, Old Fox Den, Old Savoy, Paradise, Peebles, Phone Shed, Pinnacle, Pyramid, Red Rock, Richard's, Ridge, Right of Lone Spruce, River Mound, River Mound Cliff, Road/Bridge, Road/Dining Hall, Rock Talus, Rubble Field, Sage, Sage Cliff, Sage Cliff/Post, Sage Mound, Sage Post, Sage/Middle Gully, Sage/Spruce Gully, Slope Burrow, Snowmass, South, South Mound, South Pyramid, South/ Middle Gully, Spruce, Spruce Gully, Spruce Mound, Spruce/ Middle gully, Spruce/sage, Spruce/sage gully, Spruce/Middle Gully, Steep Slope, Stump, Sylvanite, Tin cup, Tower, Tower Mound, Trapezoid, Treasury, Tree Burrow, Triple spruce, Upper fortress, Visitor's Parking Lot, Wall, Wall/Grey, Wall/Tower, West Talus, White Rock).

### 1C) Pup Emergence Log

**Data variables arrangement:** Columns, **Data variables description:** Each row is for an individual pup, with its unique identifier, litter size, and mom. This table includes pertinent information about when and where each pup was first observed. Whereas the main emergence log refers to the end of hibernation in the spring, the pup emergence log refers to the first time newly recruited pups emerge from burrows in the summer. There are a total of 6 columns, with the following headers:

Column	Variable	Description
A	Colony	Distinct matriline or social groups (e.g., River, Marmot Meadow, Picnic, Town)
B	Location/Area	Distinct locations of burrows or areas within colony sites
C	Mother	Combined numbers of pup's mother separated by "-" of the Current L and Current R ear tags
D	ID (perm)	Combined numbers separated by "-" of the original L and R ear tags (see below)
E	Date first seen	Date when pup first seen above ground (format: Day-Month-Year, e.g., 13-Jun-01)
F	Litter size	Number of pups estimated in litter in the field

### 2A) Hibernation Protocols

#### *Identifying hibernacula*

Hibernacula are burrows where marmots hibernate. These are the burrows from which they first emerge in the spring. It's really obvious when a marmot is actively using a burrow (there are footprints on the snow and the area around the burrow is often muddy). It also can be obvious when a marmot emerged, and then went back into torpor—what you see then is a hole that has snow piled in the opening...no sign of active footprints, etc. And, if you know where a burrow should be, it's obvious when nobody HAS emerged (no holes!). Tricky sites are under cabins and on the cliff burrows of River. At River, the marmots may emerge but it may take them a while to climb up the cliff and get to the top. It's essential to look for sign of activity from the hillside North of the burrows. When marmots first emerge, they lounge around a lot. When you see a marmot first emerge, sometimes it will have snow on its nose because it tunneled out! *Keep a list of all known hibernacula and all known animals to use each hibernacula for the groups you're watching.*

### 2B) Hibernacula Log

**Data variables arrangement:** Columns, **Data variables description:** Each row is refers to a specific hibernaculum used by marmots for hibernation. There are a total of 4 columns, with the following headers:

Column	Variable	Description
A	Date of use	Date when hibernacula first used in current year (format: Day-Month-Year, e.g., 13-Jun-01)
B	Colony	Distinct matriline or social groups (e.g., River, Marmot Meadow, Picnic, Town)
C	Location/Area	Distinct locations of burrows or areas within colony sites
D	Details	Details about hibernacula use in that season

### 3A) Snow Melt Protocols

**Quantifying Snowmelt:** Each day, at each area you will estimate the percent snow cover for each area that marmots use. If there is no bare ground, there is 100% snow-cover. If there is 95% bare ground, there is 5% snow cover. It's best if the same people do this each day for an area. Be sure to calibrate yourself with someone who knows what the areas that marmots' use is. This will ultimately result in a date of 50% snow melt. Be sure to have an emergence log, a snowmelt log and a hibernation log in the lab on clipboards.

### 3B) Snow Melt Log

**Data variables arrangement:** Columns, **Data variables description:** Each row is refers to a data and location/area monitored for coverage by snow. There are a total of 17 columns, with the following headers:

Column	Variable	Description
A	Date	Date of snow cover measurement (format: Day-Month-Year, e.g., 13-Jun-01)
B	River-South	% of snow cover on ground at location/area
C	River Spruce	% of snow cover on ground at location/area
D	River Mound	% of snow cover on ground at location/area
E	Bench	% of snow cover on ground at location/area
F	Horse Mound	% of snow cover on ground at location/area
G	East Gothic	% of snow cover on ground at location/area
H	West Gothic	% of snow cover on ground at location/area
I	Avery	% of snow cover on ground at location/area
J	Cliff	% of snow cover on ground at location/area
K	MM-aspen/spruce	% of snow cover on ground at location/area
L	MM-MT	% of snow cover on ground at location/area
M	Lower Picnic	% of snow cover on ground at location/area
N	Middle Picnic	% of snow cover on ground at location/area
O	Upper Picnic	% of snow cover on ground at location/area
P	Boulder	% of snow cover on ground at location/area
Q	North Picnic	% of snow cover on ground at location/area
R	Stonefield	% of snow cover on ground at location/area

### 4a) Trapping data

#### Trapping marmots

Trapping is essential to: 1) monitor marmot population dynamics, 2) to mark animals to facilitate behavioral study, 3) to bring marmots in to the lab for study, and 4) to collect samples that range from alarm calls to blood or fecal material for later analysis. *Trapping is one of the single most important on-going activities for the long-term study of the RMBL marmots.* Improper trapping can kill marmots and **there is zero tolerance for trap-induced mortality.** Trap mortality is almost always avoidable if animals are not left to overheat in the sun or left out overnight in an un-checked trap. Sometimes things are stressful (e.g., when you're closing traps during a rainstorm). Marmot safety and well-being are of the utmost importance. If there is *any* doubt in your mind, triple-check to ensure that you've closed all traps. These procedures are designed to allow the safe and effective trapping of RMBL marmots. **Note: each and every time a marmot is trapped,**

**it must be logged on the trap sheet.** This includes multiple captures in a given trapping session (when you may collect no additional data) and multiple captures in a given day (when you may only weigh it).

### Trapping

Place traps as close to burrow entrances as possible or along trails frequented by the marmots.

Ensure that the trap can be set to close with a limited amount of pressure, and that traps are in good repair (i.e., check the back to ensure that a marmot won't escape).

Bait traps with Omalene 100 (horse food)—a bait that is preferred to the traditional salted oats. Use dandelions and/or cow parsnip to increase chance of trapping success.

"Judy's special" includes: oats, salt, Omalene, peanut butter, and VANILLA.

Place the majority of the bait behind the treadle (place a little in the entrance to entice the marmot in), and ensure that the door can close freely.

Make sure the traps are placed in locations where they are secure (i.e., marmots cannot easily roll the trap down a hill or into a river). It is also better if the traps are stable, that is, they don't move when the marmot enters.

Trapping in the morning: Either open traps within 1 hour of darkness (around 8PM), OR open them first thing in the morning (typically between 6 and 7 AM). Leave traps open until checking. Marmots easily overheat. Traps should typically be checked by 9:30 or 10 AM. The one exception is Marmot Meadow, which is in a shadow for much of the early morning. **CLOSE ALL TRAPS AFTER THE MORNING TRAP CHECK.** Feel free to provide shade for marmots in traps with rocks, sticks, leaves, branches, or even cow pies.

Trapping in the afternoon: Open traps around 3 or 4 PM and leave them open until checking time...7-9 PM.

If it is particularly hot (July/August), check traps **NO LATER** than 9 AM and open traps no earlier than 4 PM. **If it's an 80° day, be very careful.** Consider not trapping or setting fewer traps and checking them more frequently. Setting traps in the shade, when possible, is a good idea. Pups are particularly unable to thermoregulate. Trap them carefully and check traps frequently.

When any marmot is heat-stressed, you are checking too late. A heat-stressed marmot lies flat on the trap floor and has sweaty feet. Babies become heat-stressed one hour earlier than adults and can die quickly. Beware of heat-stress...it can kill.

**Be absolutely certain that you have checked/closed all set traps. Mistakes may be fatal.** Make a list of how many traps you set and at what locations. Count all your traps and cross them off the list as you close them to guarantee all are closed. When you are done, count them again. And again! A marmot's life depends on it.

### Fixing Broken Traps

The Tomahawk single door live traps used are relatively straight-forward in their operation. The treadle is attached to a lever arm, which is attached to a hook that hooks the front door open. Sometimes the treadle, the lever arm, or the hook may need to be bent with a pliers to adjust trap sensitivity. More serious repairs include broken steel reinforcement bars on the front door and along the bottom of the trap. If the trap door moves about when closed, a marmot could escape by bashing against the door. Wire or welding may be required to fix the trap. Some traps are collapsible—ensure that the back door is wired shut.

### Trap locations

*These are suggestions; when pups come out it's often a good idea to saturate an area with traps and trap anything that moves.*

- River: There are 3 main River locations—River Mound (2 traps); River Spruce Mound (5 traps); River South Mound (6 traps).
- Bench: Set 2 traps at Bridger house (closest to the river), 2 traps at the water tower, and 2 traps at tiny cabin/storage shed.
- Gothic townsite: Set traps where marmots are observed (15 traps).
- Beaver Talus: set traps where marmots are observed (5-6 traps).
- Marmot Meadow: There are 3 main Marmot Meadow locations—Main Talus (at the up-valley end of the meadow—6 traps); Aspen Burrow (6 traps); Middle Burrow (near Aspen Burrow—2 traps).
- Picnic: There are 4 main Picnic trapping areas--Upper (4 traps), Split Rock (3 traps), Aspen Burrow (immediately below Split Rock—2 traps), and Lower Picnic (around Big Pinnacle/Little Pinnacle area—5 traps).
- Boulder: Set 4 or 5 traps around the Boulder.
- North Picnic: see map for locations. Main talus is traditionally a good place. Only trap when animals have been first seen there.
- Stone Field: Set 5-7 traps around frequented areas in the Main Mound area and 5 more traps around South Mound. The big stone mound is the main burrow for one group, South Mound is the main burrow area for the other matriline. Other areas include Diamond Rock.
- River Corral/River Annex/River Bend/West River Bend/River Falls: set traps where sign of marmot
- Bellview Parking lot area: set traps where you see marmots.

### **Mixing Nyanzol Fur Dye**

Nyanzol dye is a 'binary' hair dye. It's mixed by dissolving several tablespoons of dye into 60 ml of rubbing alcohol and 40 ml of hot water into a dark, sealed jar. A good dark mix should be a super-saturated solution (i.e., there should be un-dissolved crystals in it). Shake and set the jar into a bath of hot water for an hour or so. The dye is activated just before use by mixing 1 capful of hydrogen peroxide per half 'vial' of dye mix. Don't mix more than you need and only use the dye during the trapping session (i.e., morning or evening) that you mixed it.

NOTE: The dye will temporarily stain fingers and permanently stain clothes. Keep the dye off the trap sheets.

### **The Trap Bag**

The trap bag should contain:

- A list of all previously trapped marmots with their last known fur mark*
- 2 marmot bags (more if marmots are going to be transferred to the lab)
- 1 5 kg scale
- 1 10 kg scale
- 1 pair of dial calipers
- 1 log book with several blank data sheets for each of the data sheets being used and at least 2 pens and a sharpie
- 1 container of mixed Nyanzol dye.
- 1 container of hydrogen peroxide
- 1 container to mix the dye and the peroxide
- 1 toothbrush for applying the dye
- eartags and tag pliers
- alcohol pads for cleaning skin before bleeding and ears and eartags before tagging
- forceps and envelopes for collecting hair samples for DNA analysis
- small zip lock bags for collecting fecal samples

Additional equipment may include:

Sprint speed equipment: tape measure, inclinometer

Alarm call recording setup: DAT, microphone, spare batteries, notebook, pen

Blood kit: alcohol swabs, rubber band tourniquets, styptic stick or corn starch as well as cotton balls to stop bleeding marking pen for taking blood sample from femoral vein, and most importantly, an ICE BOX with ice in the bottom. Don't forget to check that you have needles/syringes as well as vacutainers, (needles and holder if using vacutainers to collect blood) and micro-capillary tubes (along with putty).

Flea collection kit: square white cloth, red comb

Ectoparasite treatment kit: water spray, pyrethrum spray

### **Additional Notes about Completing the Trap Data Sheet**

Comments: additional information that may help with identification (e.g., missing ear, new ear tags added, short tail, etc.), number of fleas, whether it rolled the trap, and whether it is a NEW ANIMAL.

NOTE: Do not keep completed data sheets in the trap bag, and avoid spilling dye on the trap sheets. Ensure that the data are entered into the computer when a trap sheet becomes full.

### **Handling a trapped marmot**

- 1) Try to read the ear tags before doing anything else while the marmot is in the trap in case it escapes while you are getting it into the bag. Record these immediately.
- 2) Check the blood log to see if you need to draw blood from the marmot. If you find you need blood, this will be collected first. (see section on blood collection procedures)
- 3) Ensure the handling bag is Velcroed shut and does not have any large holes in it. Put the handling bag over the front of the trap, stretched out ahead with the Velcro side up. Do not leave any openings when you open the door. The easiest way to do this is to straddle the trap, facing the door, hold the trap bag tight against the bottom corners of the trap with the balls of your feet, and open the door. Much of the time, the marmot will immediately walk into the bag, but it may have to be encouraged. Several methods of encouragement include: banging on the cage, blowing at the marmot, The Marmot Two-step (duck walk from the back of the trap), and The Stick (gently prod a marmot into the bag).
- 4) Once in the bag, tie a knot in the back of the bag. Ensure the marmot's head is at the front of the bag and that its ears (not teeth) face the Velcro (maybe the easiest way is to make sure where the hind legs are). If the marmot is not head first, or the head is not on the Velcro side of the bag, give the marmot a bit of room to move around inside the bag by untying the knot and allowing the marmot to reposition itself (keep a twist or two in the wide end of the bag to prevent the marmot from bolting). Retie the knot when the marmot is properly oriented.
- 5) Weigh the marmot and the bag. Weigh the empty bag later and subtract the total weight to obtain marmot mass.
- 6) Check the ear tags by carefully opening up the marmot bag near the head; restrain the head if required by pushing down to meet the marmot's resistance.
- 7) If required, ear tag the marmot and record the numbers on the trap sheet. ENSURE THAT THE NUMBERS ARE ON THE OUTSIDE OF THE EAR so that the ear tags can be read in the trap and to reduce the likelihood of tissue growing around the numbered part of the ear tag.
- 8) Re-seal the Velcro fasteners and ensure the marmot will not break out of the front of the bag.

- 9) Untie the back of the bag and grasp the marmot by the BASE of its tail and hind legs. Unwrap the bag so that it turns inside out and you can see the marmot's back/belly.
- 10) Check its sex and measure the distance between the anterior end of the anus and the posterior end of the 'ball' that either is the penis or the vagina. This is the A-G distance. Males have a large A-G distance (>20 mm), females have a relatively short A-G distance (< 10 mm). Young are sometimes difficult to accurately sex by eye. When trapping a pup for the very first time, measure the A-G distance three times to ensure that this measurement is accurate. For each of these three measurements, release pup and reposition the pup in your hand before taking each measurement. A mean will later be estimated from these data for the pups. If wet, the digital calipers may not work: dry them and/or use the dial calipers in the bag.
- 11) Measure the length of the left hind foot (in mm, using calipers as explained for A-G distance measures). The appropriate way to measure this is to hold the foot and measure the distance (with the dial calipers) between the heel and the center front of the foot pad. Don't measure the toes. Ensure you're measuring the maximum length.
- 12) Check its reproductive status. For males, descended testes are marble to almond sized while non-descended testes might be pea sized. For females, nipples are either barely present/visible (in young animals), prominent, swollen, or lactating where the nipples are both swollen and there is hair missing around the base.
- 13) Comb the marmot for fleas. Grab the marmot's feet from the bag and scoot the bag to the top of its bag. Place the marmot on the white flea cloth. Comb the marmot with the wide tooth side of the red comb. Comb each side and the back five times, each time wiping the comb on the cloth to count fleas. Then, remove the marmot from the cloth and count any fleas under the marmot. Record the flea count in the comments. If you collect the fleas, list under samples collected and note the number of the vial. If not, make sure to shake the cloth and get all the fleas off of it.
- 14) Mark the marmot. The dye is activated just before use by mixing 1 capful of hydrogen peroxide per half 'vial' of dye mix. If working alone, use one hand to grasp the marmot through the bag around its shoulders or neck while peeling back the bag to expose back. If two people are working together, one person can hold the feet/base of tail and the shoulders/neck while the other marks the marmot. Do your best to get the mark as high up as possible on the marmot. Sometimes this can be done by keeping the marmot in the bag and opening a few Velcro fasteners.  
**Remember, you're the boss. You can always put the marmot back into the bag and/or the trap if it's getting away from you.**

Marks may include: numbers, letters, blots, stripes, posts, or a mix of the previous. A stripe refers to a horizontal line (across marmot, from left to right side), and a post refers to a vertical line (along length of marmot, head to foot). When marking a marmot with a stripe, try to extend the stripe as far to the right and left sides of the marmot's body as possible. Ensure that you record the location of the blots and stripes. For instance, a marmot can be a blot head, a blot shoulder, a blot middle, a blot rump. A marmot could also be a stripe shoulder, stripe middle, stripe rump, or two stripes middle, two stripes rump, etc. DRAW THE MARK on the trap sheet assuming the head is up.

Abbreviations for body locations include: H = head, N = neck, S = shoulder, M = middle, R = rump. **Anterior marks should be used first** as they are easier to see in the field when marmots are in tall vegetation. Here marks may be applied by opening the Velcro (anterior) end of the bag. One hand can hold the marmot by the neck or top of the head and the other can apply the mark. Marmots tend to pull

back when the anterior end of the bag is opened and you may use your knees as a barrier to backward movement. You can also push down on the head to keep it in the bag. Pushing down on the back of the skull is a particularly effective way to immobilize an 'active' marmot.

In general, when choosing a new mark, simple marks are always better than more elaborate ones (less is more). Numbers and letters are often harder to tell apart than simple blots, stripes and posts, particularly if the number and letters involve curved lines. Symmetrical marks are generally easier to identify than asymmetrical ones because you don't necessarily need to see both sides of the animal to identify the mark. When choosing a new mark, it is particularly important that you consider the other pre-existing marks within the colony. Choose marks that are as different as possible from one another, while keeping in mind constraints imposed by the particular terrain of a colony. For example, in an area with tall vegetation, it would be best to avoid using a mark low on the rump as the distinguishing feature between two marmots (e.g., H• and H•R- would be poor choices). Some marks are particularly difficult to distinguish and should not be used in the same colony. For example, an "X" and a "+" can often end up slightly off-center, and therefore indistinguishable. An '8' and a '3' will look exactly the same from the right side. An "O" and a "Q" will look identical from the left. An "A" and a "delta" may look very similar depending upon how they are applied. Initials are generally not good marks. Please don't have too many marks in an area that rely on circles, or identical lines.

- 15) Release the marmot where you caught it by gently removing it from the posterior end of the bag and letting it run away into its burrow.

#### **Tape recording a marmot's alarm calls**

We study the alarm calls of marmots. You will be using a \$900 digital audio tape recorder or a solid state direct to disk recorder. Please treat it with extreme care. Avoid dropping it, putting it in the dirt, leaving it in direct sun, or under the rain, bouncing it around (e.g., while cycling back to Gothic). If you're using the DAT, be very careful if you have to change a tape: ensure that the area is dust-free before opening it up in the field.

- 1) To record a marmot, ensure that the microphone is properly plugged in, there is tape in the machine and that the various switches are in the correct location (see check sheet below—a copy of which is found in each fanny pack with the DAT).
- 2) Turn the machine on (it takes a few minutes before recording begins) and place the microphone 20-30 cm from the marmot's mouth.
- 3) Adjust the recording levels so that the meter is peaking around '0'. Typically, '4' on the recording level is a good place to start.
- 4) Try to be quiet while recording and try to record 10 different alarm calls. If you are at the River area, try to put your back to the river and block out the water noise. Point the microphone at the marmot, but away from the water. If calls are coming rapidly, be sure to record for at least 1 minute. Sometimes it's possible to record one animal by carefully propping the DAT up while processing other animals.
- 5) It's important to talk on the tape and identify the date, time, location and animal ID and then say END OF RECORDING before turning off the recorder.

6) Record this information in the little notebook that accompanies the DAT. At this point there is no formal data sheet for recording; calls get transferred to computers periodically.

### How to use the Sony PCM-M1 DAT

#### Checklist before recording:

Power cord in?

Tape in?

Spare batteries with you (4 C cells)?

Microphone mini in MIC/LINE IN

Headphones for monitoring required!

SP 44.1kHz

MANUAL

MIC/LINE IN: MIC

MIC ATT: 0dB

#### Setting the record level:

-hit RECORD button once and use the dial on the right; ensure that the digital level is not peaking

#### Recording:

Hit RECORD and PAUSE

Hit PAUSE, wait a moment and you should see the counter moving

**UNPLUG THE POWER CORD WHEN NOT USING THE RECORDER, otherwise it will drain the battery**

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### Instructions for using the Marantz PMD660 Solid State Recorder

Solid state recorders record directly to a compact flashcard. While they are less sensitive to bouncing around than DATs and video cameras (no moving parts), they nevertheless should be treated carefully. Moreover, like all electronic equipment, they are very sensitive to dust and water. Please keep them in a Ziploc bag and in the carrying case whenever possible and keep them dry and out of the dust.

#### Recording alarm calls

- 1) Be sure to plug the microphone into the L microphone input (it says MONO below it) before recording and unplug it after recording. The leverage from the XLR jack could break the equipment.
- 2) Turn on the recorder using the Power Switch on the right side.
- 3) Turn down the speaker volume by rotating the knob away from you as far as it will go. Otherwise, you may hear a loud whining sound (interference).
- 4) The screen has 3 digits for the track numbers, and then the time remaining on the compact flash card. Additionally, you should see 44.1K MIC. If you see anything else, ensure that the settings are correct. To do this, touch the MENU/STORE button and make sure it says Preset-1. If so, then touch the MENU/STORE button one more time until you see the screen with the track numbers and the time

- remaining. If not, select the >> Track Jump button until you toggle through to the Preset-1, then select the MENU/STORE button.
- 5) To record, push on the red REC button and then adjust the recording levels using the round knob on the right front of the recorder. The recording level should peak around orange led 6, the orange OVER led should NEVER be lit. Adjust the recording knob so that the alarm calls peak at around 6.
  - 6) To stop recording, push on the STOP button.
  - 7) You can turn off the device between marmots. When you turn it back on, you will see the remaining time and the track that you are on.

### **Transferring sound files onto a computer**

- 1) You must plug in the external power supply.
- 2) Push down on the USB/Copy button while turning the Marantz on. You should see USB on the monitor. Then you will see the Compact Flash card mount on the computer. Drag the files over onto the computer.
- 3) Re-name the files using the LTAG-DDMMYY-TIME format.

### **Changing batteries**

Keep an eye on the battery indicator level. Change them when it starts to drop. Be sure to put them in the correct way and with the piece of fabric below the batteries to aid getting them out.

NOTES: Preset 1 should be set at:

Input: MIC

Output: SP/HP+LINE

Date/Time

Rec Format: PCM-44.1K

RecChannel: MONO

PreRecord: On

Manual Trk: On

Auto Trk: 5 min

Auto Mark: Off

SilentSkip: Off

LevelCont. Manual

Meter Mode: Normal

Mic Atten.: 0dB

AutoPowOff: On

Battery: Alkaline

Beep: Off

Machine ID: MZ000

Default: DO NOT SELECT DEFAULT...it will remove all settings!

Use the EDIT button to enter the setup mode and use the ENTER and << >> buttons to toggle around and make selections.

### **4b) Trapping log**

**Data variables arrangement:** Columns, **Data variables description:** Each row is a unique trapping event, including information about the marmot trapped and its unique identifiers (e.g., ID number, ear tag numbers, mark) as well as samples collected during that specific trapping session. There are a total of 20 columns, with the following headers:

<b>Column</b>	<b>Variable</b>	<b>Description</b>
<b>A</b>	Colony	Distinct matriline or social groups (e.g., River, Marmot Meadow, Picnic, Town)
<b>B</b>	Trap Locality	Burrow location where the trap is set
<b>C</b>	Date	Date and time marmot captured (format: Day-Month-Year, e.g., 13-Jun-01)
<b>D</b>	Year	Calendar year during which marmot was captured
<b>E</b>	Left Tag	Current tag number on left ear (may be 3 or 4 digits)
<b>F</b>	Right Tag	Current tag number on right ear (may be 3 or 4 digits)
<b>G</b>	Marmot Mass	Weight of marmot at time of capture in grams after subtracting the mass of the empty bag
<b>H</b>	Sex (M/F)	M (male), F (female), or U (unknown)
<b>I</b>	A-G distance (mm)	Length from middle of anus to middle of genitals to 0.1 mm
<b>J</b>	Age	Exact age in years (added from database)
<b>K</b>	Repro status	Reproductive status: 1 = testes scrotal--almond sized, 2 = testes unknown--pea sized or smaller, 3 = nipples visible but mostly flat, 4 = nipples prominent--raised off the surface but not swollen, 5 = nipples swollen--more swollen both in the nipple and at the base of the nipple, 6 = lactating—nipples may leak milk (particularly if caught in the morning) and have hair loss around the base, they are longer and very full, 0 = no nipples seen
<b>L</b>	Defecated?	Pooped in trap?: 0 = no, 1 = yes if the marmot defecated in the trap, 2 = yes if the marmot defecated in the bag, 3 = the marmot defecated in the trap and in the bag
<b>M</b>	Tooth Chattered?	Teeth clicking in trap?: 0 = no, 1 = yes if the marmot tooth chattered in the trap
<b>N</b>	Called?	Alarm-called in trap?: 0 = no, 1 = yes if the marmot alarm called in the trap, If you record the calls, place and 'R' next to the 1, If called in the bag, put 1 and then make a comment
<b>O</b>	Struggled in trap?	Contested being trapped?: 0 = no, 1 = yes if the marmot was struggling or banging itself against the trap
<b>P</b>	Tried to bite through cage?	Biting of cage prior to being removed?: no = 0, yes = 1
<b>Q</b>	Immediately walked into bag?	Did marmot enter bag as soon as it was given the opportunity to do so?: 0 = no, 1 = yes if the marmot walked into the handling bag more-or-less immediately
<b>R</b>	Samples taken	B = blood sample, F = fecal sample, P = flea sample, R = recorded alarm call
<b>S</b>	LHF	Left hind foot length in mm
<b>T</b>	New Tags? Comments	Detailed notes about trapping event

**5a) Updating Individual IDs List**

- 1) Add any new individuals, tags, or marks, to the Master Individual ID list posted on the wall of the lab.
- 2) Put an "H" for any individual from which you collected hair (we only collect hair from individuals once a season, but it is fine if you accidentally collect more).

**5b) New animal/New ear tag log**

It is essential to keep track of individuals and ear tags. Any time you put an ear tag into an animal, please write NEW LEFT or NEW RIGHT tag in the comments line of the trap sheet and also fill out the new tag log which should be posted on the wall in the lab.

**Data variables arrangement:** Columns, **Data variables description:** Each row represents a unique event of adding a new ear tag to a marmot. Information includes old and new ear tag numbers. There are a total of 10 columns, with the following headers:

<b>Column</b>	<b>Variable</b>	<b>Description</b>
<b>A</b>	Date	Date and time marmot captured (format: Day-Month-Year, e.g., 13-Jun-01)
<b>B</b>	Time	Time blood and feces collected using the 24-hour clock (e.g., 17:42)
<b>C</b>	Colony	Distinct matriline or social groups (e.g., River, Marmot Meadow, Picnic, Town)
<b>D</b>	Trap Locality	Burrow location where the trap is set
<b>E</b>	Old Left Tag	Previous tag number on left ear (may be 3 or 4 digits)
<b>F</b>	Old Right Tag	Previous tag number on right ear (may be 3 or 4 digits)
<b>G</b>	New Left Tag	Current (newly added) tag number on left ear (may be 3 or 4 digits)
<b>H</b>	New Right Tag	Current (newly added) tag number on right ear (may be 3 or 4 digits)
<b>I</b>	New Animal?	N = no (animal trapped before), Y = yes (animal never trapped before)
<b>J</b>	Fur Mark	Description of symbols used to visually identify marmot

**When you are done trapping, please make sure you have:**

- 1) Processed any samples you may have.
- 2) Updated the Master Blood Log.
- 3) Updated the New Tags Sheet with any new tags.
- 4) Updated the Master Individual ID list (located on the side of the file cabinet) with:
  - a. Hair collected
  - b. Any new marks
  - c. Any new tags
- 5) Restocked your trap bag with any depleted supplies. It should be ready to go for the next person to grab the bag and run.

**6) Genetic and physiological measurements**

**6a) Parentage Assignment Log (Genealogical data)**

**Data variables arrangement:** Columns, **Data variables description:** Each row represents a specific marmot as well as information about its mother and its father. This table also explains whether behavioral and/or genetic data were used to make assignments. There are a total of 9 columns, with the following headers:

<b>Column</b>	<b>Variable</b>	<b>Description</b>
A	Year	Calendar year during which marmot was captured
B	Colony	Distinct matriline or social groups (e.g., River, Marmot Meadow, Picnic, Town)
C	Unique ID (UID)	Combined numbers separated by "-" of the original L and R ear tags (see below)
D	Pup log colony	Distinct matriline or social groups (e.g., River, Marmot Meadow, Picnic, Town)
E	Unique ID (UID) of Candidate mother	Combined numbers separated by "-" of the original L and R ear tags (see below)
F	Unique ID (UID) of Candidate father	Combined numbers separated by "-" of the original L and R ear tags (see below)
G	Method	Method used to assign parentage (e.g. behavioral and/or DNA based assignments)
H	Mother colony	Distinct matriline or social groups (e.g., River, Marmot Meadow, Picnic, Town)
I	Father colony	Distinct matriline or social groups (e.g., River, Marmot Meadow, Picnic, Town)
J	Genotype	Genetic loci identified based on genotyping

## 6b) Blood and Fecal data

### Protocol for blood collection

The objective is to quickly obtain the sample and ice it until processed. Thus, we've got two coolers in the lab freezer with ice in the bottom. Keep them frozen upright so as to keep the ice in the bottom.

#### Trap Kit

#### ICE BOX

Depending on how you're collecting blood you may use:

- Vacutainers (and 1 vacutainer holder along with needles for the vacutainer if using the vacutainer to collect blood—recently we've been using syringes)
- Needles and syringes
- Microcapillary tubes (and putty to close them off—recently we only use these for pups)
- Rubber bands
- Styptic stick or cornstarch to stop excess bleeding (wet styptic stick with alcohol swab before use).
- Cotton balls to staunch bleeding
- A pair of scissors
- Alcohol swabs
- gloves
- A sharpie for writing animal ID on vacutainer and the syringe
- Trash bag

Methods to collect blood.

- 1) Record the time you reach the trap and, if known, the time the marmot was initially in the trap, on the data sheet. If multiple marmots are caught in the same location, write the time you reached the marmot on a piece of paper and put it on the trap.
- 2) Immobilize marmot in handling bag and record this time on the data sheet.
- 3) Tie a rubber band around a hind leg, as far up as you can.

- 4) Wipe area with alcohol swab. This should expose the femoral vein on the leg. If not, cut hair off the leg over the vein and re-wipe area with alcohol.
- 5) Have the needle and syringe ready to go (PUMP THE SYRINGE ONCE TO BREAK THE SEAL! This will make collecting blood much easier). Be very careful with an uncapped needle: only decap the needle once you are ready to collect the blood. When the needle is decapped, be aware of your and your partner's movements to prevent accidents.
- 6) Once the vein is exposed, gently and in a direction parallel to the vein and with the bevel up, insert the needle into the vein at a shallow angle. Do your best to not go *through* the vein. Try to hold both the marmot's leg and the syringe in one hand, so that when it struggles, the needle doesn't come out or injure the marmot.
- 7) When the needle is in the vein, loosen the rubber band and gently pull back on the syringe. If you pull too quickly, you may collapse the vein. To encourage blood flow, you can also try rotating the needle in the vein, massaging the foot, lifting the leg vertically or bending it slowly. If you are using a syringe be sure that you do not inject anything into the marmot, and draw the appropriate amount of blood (typically 2 ml except for 'stress tests'). We also should have micro-hematocrit tubes that can be used to collect blood via capillary action. These must be sealed off with putty and put into a vacutainer for storage. If the marmot is struggling too much, you can always reposition and get a better hold of the marmot. It is better to take some time than it is to hurt the marmot!
- 8) Collect about 2-3 ml of blood (the vacutainers hold 5 ml). When sufficient blood is collected (detach the syringe or vacutainer) record this time on the data sheet. Hold the alcohol swab over the vein for a few moments to stop the blood flow.
- 9) When you pull the needle out of the vein, put pressure on the injection site with an alcohol pad until the bleeding has stopped (this should be fairly instantaneous if done correctly). If the marmot keeps bleeding, use the cotton balls, styptic stick and/or cornstarch to stop the bleeding.
- 10) Inject blood collected from the syringe into the vacutainer and shake gently to mix the heparin. Please do not invert as that gets blood in the cap.
- 11) Recap the syringe using the OSHA-approved one-handed re-capping procedure.
- 12) LABEL the vacutainer AND the syringe with the line on the **blood log**.
- 13) Immediately ice the blood in the vacutainer AND the syringe. Do not put the vacutainer in a pocket or leave it in the sun.

### 6c) Blood log

**Data variables arrangement:** Columns, **Data variables description:** Each row represents a unique sample of blood collected from a marmot during a trapping session. There are a total of 8 columns, with the following headers:

<u>Column</u>	<u>Variable</u>	<u>Description</u>
<b>A</b>	Date	Date and time marmot captured (format: Day-Month-Year, e.g., 13-Jun-01)
<b>B</b>	Left Tag	Current tag number on left ear (may be 3 or 4 digits)
<b>C</b>	Right Tag	Current tag number on right ear (may be 3 or 4 digits)
<b>D</b>	Year	Calendar year during which marmot was captured
<b>E</b>	Time in trap before handling	Time at which observers arrived at trap = start time (e.g., 16:02)
<b>F</b>	Time marmot in bag	Time at which marmot entered the bag (e.g., 16:08)
<b>G</b>	Time blood collected	Time at which blood collected (e.g., 16:13)
<b>H</b>	Volume of blood collected (ml)	Amount of blood extracted from marmot in ml

**Blood processing in the lab**

Centrifuge with vacutainer adaptor (or microcapillary centrifuge)

Pasteur pipettes

Pipette bulb or puller

Small cryotubes in which to store plasma

Slide for blood smears

Blood must be processed immediately after collection.

- 1) Remove the tops from the vacutainers
- 2) To make a blood smear, use the syringe that was used to collect blood and clean it out with water.
- 3) Then, draw a drop of the blood (just touching the needle on the slide may provide a large enough drop), and place it about 3/4 of the way on one side of a clean slide.
- 4) Hold another clean slide at a 45° angle and slowly back it onto the drop of blood. Allow capillary action to spread the blood along the edge of the slide you're holding at 45°.
- 5) When the blood is spread out, press firmly (but don't break the pushing slide) and push, in one smooth motion, the line of blood across the length of the slide. A successful smear creates a 'monolayer' of blood. It should be a pale red/yellow color and it should be smooth. It's essential that the slides be perfectly clean before you do this otherwise dust will interfere with the process.
- 6) Using the permanent marker, label the clean quarter of the slide with ear tags, date, and time.
- 7) To spin down the blood and isolate plasma. Now carefully insert the vacutainers without their tops into the centrifuge. Do your best to balance out the load, using blanks if needed.
- 8) Centrifuge at 3/4 speed for 5 min.
- 9) Remove the plasma on top with a Pasteur pipette or a syringe (be sure to wash out needle between pipettings) and put it into a cryotube.
- 10) Label the plasma and freeze it immediately.
- 11) Dispose of needles and glass in the red box.
- 12) Make sure you update the master blood log (located on the clipboard on the wall above the freezer) by writing the amount of blood drawn from each marmot in the box for the appropriate date time period.

**6d) Neutrophil and Lymphocyte Log**

**Data variables arrangement:** Columns, **Data variables description:** Each row represents data about the condition of marmots. These data are compiled in the lab from blood slides collected in the field. There are a total of 16 columns, with the following headers:

<b>Column</b>	<b>Variable</b>	<b>Description</b>
<b>A</b>	Year	Calendar year during which marmot was captured
<b>B</b>	Date	Date and time marmot captured (format: Day-Month-Year, e.g., 13-Jun-01)
<b>C</b>	Time	Time blood collected using the 24-hour clock (e.g., 17:42)
<b>D</b>	Unique ID (UID)	Combined numbers separated by "-" of the original L and R ear tags (see below)
<b>E</b>	Left Tag	Current tag number on left ear (may be 3 or 4 digits)
<b>F</b>	Right Tag	Current tag number on right ear (may be 3 or 4 digits)
<b>G</b>	Neutrophils	Number of this type of cell counted
<b>H</b>	Lymphocytes	Number of this type of cell counted

<b>I</b>	N/L	Ratio of neutrophils to lymphocytes counted
<b>J</b>	Monocytes	Number of this type of cell counted
<b>K</b>	Basophils	Number of this type of cell counted
<b>L</b>	Eosinophil	Number of this type of cell counted
<b>M</b>	Total N+L	Total number of neutrophils and lymphocytes
<b>N</b>	Total WBC	Total number of white blood cells (WBC)
<b>O</b>	Trypanosomes	Presence or absence of tyranosomes on the slide
<b>P</b>	Comments	Additional notes

**Fecal processing in the lab**

Feces are collected for future hormonal analyses as well as fecal parasite studies. Fecal samples should be iced on collection and processed quickly so that they can be frozen within an hour or so of collection. Ensure that the L and R ear tags, date, and time are written clearly on the fecal bags. Also write the group where you collected the feces.

We'll only need 1 gram of feces for parasite analysis so if you collect an 'egg-sized' sample, it should be fine. However, if there is more, collect it.

Ensure that samples are not covered with leaf litter, dirt, or other debris – these items may contaminate the samples.

When finished writing marmot ID info, store sample in ice cooler until you get to the lab.

Preserving samples for parasite analysis:

- First, write the marmot ID info from the Ziploc bag onto the specimen container.
- For preserving the feces, we want to preserve 1 part feces to 4 parts 10% buffered neutral formalin. This is equivalent to 1g feces to 4ml formalin solution.
- To avoid contamination from debris, take specimen from the center of the feces.
- TIGHTLY screw the cap on the container and store. The feces should be stored in a cool, dry place away from sunlight.
- Keep the remaining fecal sample for hormonal analysis.

Preserving the samples for hormonal analysis:

- Re-seal the zip-loc bag and freeze.
- NOTE: be sure there is something left for hormonal analysis. When in doubt, do not remove for parasite analysis.

Preparing the 10% buffered neutral formalin

- Mix 10ml of 100% Formalin (40% Formaldehyde gas dissolved in water) in 90 ml of physiologic saline.
- Prepare physiologic saline by dissolving 8.5g of NaCl in 1000ml distilled water (this prepares a 0.85% working solution).

**Method to conduct a fecal float:**

Using lab tape, label ALL beakers, containers, etc. to keep track of samples during processing. Do not write on beakers—it's difficult to remove.

Be careful not to cross-contaminate samples. Wash stirring rod, beakers, flasks, etc. between samples.

- 1) Using a wood applicator, and weighing paper, separate and weigh out 1 gm of freshly collected feces. NOTE: If there are many samples, immediately pre-weigh 1

- gm from each sample and store on labeled weighing paper so that the remainder can be frozen as soon as possible.
- 2) Using a stirring rod, homogenize 1 gm of feces in 30 ml of luke-warm tap water.
  - 3) Pour the entire solution through a 4 x 4" square of mesh that has been formed into a filter on a plastic specimen jar. Using the same stirring rod that was used to homogenize the sample, swill the sample through mesh to get the remainder of the solution. Discard the feces in the filter immediately and rinse the mesh before the feces hardens.
  - 4) Pour 15 ml of fecal solution into a 15 ml conical centrifuge tube. Spin at 3/4 speed for 3 min. Ensure the centrifuge is properly balanced.
  - 5) Pour out the supernatant and pour in 15 ml of filtered fecal solution. Spin again at 3/4 speed for 3 min and pour out the supernatant.
  - 6) Wash the pellet with tap water by spinning at 3/4 speed for 3 min until the supernatant is clear. (this often takes up to 3 washings)
  - 7) Fill centrifuge tube with 15 ml of saturated salt solution (36 gm / 100 ml of luke warm tap water—ensure it is fully dissolved), or ovafloat.
  - 8) Using the pointy end of the inoculation loop, swirl the fecal pellet with the liquid. Then, centrifuge for 4 min at 3/4 speed. (The parasites should float up to the meniscus).
  - 9) Bend the inoculation loop 90° and gently touch the edge of the meniscus with the loop. (Do not dip beyond the meniscus or the parasites will sink in).
  - 10) Spread the liquid in the loop on a labeled microscope slide. Repeat steps 9 and 10 a second time.
  - 11) Carefully cover the spread with a cover slip. Leave undisturbed on a flat horizontal space until the slide dries (about 30 min). Once dry, store in the 'fecal slide storage box'.

### 6e) Parasite Log

**Data variables arrangement:** Columns, **Data variables description:** Each row represents parasite presence or absence for a specific fecal sample collected from known marmot. These data are compiled in the lab from fecal floats. There are a total of 11 columns, with the following headers:

<b>Column</b>	<b>Variable</b>	<b>Description</b>
<b>A</b>	Year	Calendar year during which marmot was captured
<b>B</b>	Date	Date and time marmot captured (format: Day-Month-Year, e.g., 13-Jun-01)
<b>C</b>	Time	Time feces collected using the 24-hour clock (e.g., 17:42)
<b>D</b>	Unique ID (UID)	Combined numbers separated by "-" of the original L and R ear tags (see below)
<b>E</b>	Left Tag	Current tag number on left ear (may be 3 or 4 digits)
<b>F</b>	Right Tag	Current tag number on right ear (may be 3 or 4 digits)
<b>G</b>	Ascaris spp.	0 = parasite absent, 1 = parasite present
<b>H</b>	Eimeria spp.	0 = parasite absent, 1 = parasite present
<b>I</b>	Entamoeba spp.	0 = parasite absent, 1 = parasite present
<b>J</b>	Other	0 = parasite absent, 1 = parasite present (additional Genera added as identified in fecal specimens)
<b>K</b>	Notes	Additional comments or notes

## 6f) Cort (Fecal corticosteroid metabolites) Log

**Data variables arrangement:** Columns, **Data variables description:** Each row represents ( $N = 1,607$ ) results from fecal hormone corticosterone double antibody Radioimmunoassay (RIA) extracted from the feces of known marmot. Each sample was resuspended dried down extract (12.5uL) with 50uL assay buffer (4x dilution). There are a total of 18 columns, with the following headers:

<b>Column</b>	<b>Variable</b>	<b>Description</b>
A	Assay #	Calendar year during which marmot was captured
B	Sample ID	Unique identifier for this sample
C	% CV	Proportion of coefficient of variation
D	% bound	Proportion of sample bound to radioisotopes
E	Cort ng/mL	Cort measured in ng/mL
F	Cort ng/g	Cort measured in ng/g
G	recno	record number
H	Site of Cort Analysis	Lab in which RIA was conducted (e.g., Cres San Diego, UCLA,)
I	Year	Calendar year during which marmot was captured
J	Colony	Distinct matriline or social groups (e.g., River, Marmot Meadow, Picnic, Town)
K	Date	Date and time marmot captured (format: Day-Month-Year, e.g., 13-Jun-01)
L	Time	Time blood and feces collected using the 24-hour clock (e.g., 17:42)
M	AM/PM	Is feces from the morning (AM) or evening (PM) trapping?
N	Unique ID (UID)	Combined numbers separated by "-" of the original L and R ear tags (see below)
O	Left tag	Current tag number on left (L) ear (may be 3 or 4 digits)
P	Right tag	Current tag number on right (R) ear (may be 3 or 4 digits)
Q	Colony	Distinct matriline or social groups (e.g., River, Marmot Meadow, Picnic, Town)
R	Trap locality	Burrow location where the trap is set

## 7) Observing Marmots

You will be taking notes that should be useful and legible both this year and for the next 30 years. Please write on both sides of the page to save paper. Currently, our paper costs \$0.20/page. Please use it ONLY for marmot notes. Write only in pencil or ball-point pen (roller balls run when wet). Please try to write neatly. Remove and store original pages in the lab as you enter data into the various data sheets (e.g., observation log, alarm calling log, time watching log, etc.). There is no excuse for losing data and it's frustrating when this happens because we work so hard to collect it in the first place.

- 1) *Always write your name and the date* in the upper left hand corner of the page, write a cumulative page number on the upper right hand corner of the page.
- 2) At the beginning of an observation, write the start time and the weather: be sure to comment on the approximate temperature, cloud cover, wind, and precipitation.

- 3) Whenever you make an entry...enter the time on the left hand margin. Save the right hand margin for notes to help you locate key events (e.g., PREDATOR; ALARM CALL; CARRYING DRIED PLANTS, BURROW EXCAVATION, etc.).
- 4) Be sure to record all instances you see of:
  - A) Social interactions. Social interactions are defined when two animals are within 1 m of each other. This includes sitting together, greeting, allogrooming (often the neck is the target of allogrooming), play (which itself can be subdivided into boxing, wrestling, chasing and mounting), and aggressive encounters. We're particularly interested in trying to define all sorts of displacements—the observation of one individual moving away. These may be subtle! However, as long as you record the type of social interaction and IF one individual was displaced on the same line in the social log, we'll later be able to look at displacements in different contexts. Make sure to record the winner in dominance/aggressive contexts, or clearly indicate that the winner was unknown (do not leave column blank). NOTE: Play and aggression often employ the same motor patterns! Clearly specify whether the activity is play or dominance. For example, chasing, biting, or pushing may take place in either context, especially for pups. Use the comments column to describe what you saw if you are not sure. Try to keep your comments concise, but don't worry if they are longer. It's better to have a detailed comment that can be used later when we go back and analyze these observations. Finally, social play bouts can be long or short. Define them as ending when one animal moves apart. Thus, animals playing with each other for a while can engage in many bouts; all of which should be entered into the log. Be sure to clearly define any abbreviations (vette them with Dan first).

Here's the list of the social behaviors we're focusing on:

*Each of these behavior types are written with a focus on the initiator, or "dominant," marmot. Note how the receiver, or "subordinate," marmot behaves in the comments section.*

Type	Description
AGGRESSION (AGR)	After an aggressive interaction, the marmots will probably quickly separate rather than sit calmly near each other as the case may be for play. Aggressive interactions tend to be quicker than play interactions and you hear vocalizations (squeaks, yelps, growls, etc.) more often with aggression. <i>Generally, you should be able to specify the type of aggression using one of the following terms.</i>
aggressive bite (AGR Bite)	initiator marmot bites receiver marmot in an aggressive manner
aggressive box (AGR Box)	stands on hind legs, using paws to strike opponent in an aggressive manner
aggressive chase (AGR Ch)	initiator marmot chases receiver marmot in an aggressive manner
aggressive grab/slap/push (AGR grab/slap/push)	initiator marmot grabs, slaps, or pushes receiver marmot in an aggressive manner
aggressive mouth spar (AGR mouth spar)	when both initiator marmot and receiver marmot lunge at each other with open mouths in an aggressive manner

aggressive pounce (AGR pounce)	initiator marmot pounces on receiver marmot in an aggressive manner
aggressive snap/snarl/ hiss (AGR snap/snarl/hiss)	initiator marmot vocalizes in an aggressive way towards a receiver marmot
aggressive wrestle (AGR Wrestle)	initiator marmot and receiver marmot wrestle with each other in an aggressive manner
Allogroom (AGM)	one marmot grooming another or multiple marmots grooming each other. Often concentrated in places a subject cannot reach (back of neck).
cheek rub (CR)	when a marmot rubs its cheek on another marmot
displace simple (Displ. Simp.)	an episode in which there is contact between two marmots and one ends up changing locations
displace proximity (Disp. Prox.)	when one marmot displaces another by just approaching rather than physical means such as pushing, max. distance for displace proximity is 1 meter. If it is farther than 1 meter and you are sure it was a displacement, score it and make a note in the comments.
Follow	when one marmot approaches another and the approached animal moves and this whole interaction occurs three or more successive times
forage together (FG together)	marmots are together out feeding in an area with food within 1 meter of each other or obviously moving together (not greater than 5 meters apart)
greet (touch noses) (GRT)	initiator marmot touches nose of receiver marmot with its nose
sit less than 1 meter apart	two or more marmots sitting within 1 meter of each other but not in body contact
sit body contact	two or more marmots sitting in physical contact with each other
Mount	One marmot mounts another. This may be part of a complex bout of play, or it may simply be a mount. Score it as a mount unless it's an obvious play mount or sexual mount.
Nurse	a pup suckling from a mother
PLAY	In play interactions, the participants don't look as intense as in aggressive interactions. That is, they sometimes get interrupted, look around, pause, or do other things that make them seem less invested. Unlike aggressive interactions, after play bouts, marmots are likely to sit next to each other. Play is generally 'bouncier' than aggression and is often characterized by individuals changing roles repeatedly and shifting from one type of behavior to another regularly. <i>Generally, you should be able to specify the type of play using one of the categories below.</i>
play bite	initiator marmot bites receiver marmot in a playful/non-aggressive manner
play box	stands on hind legs, using paws to strike opponent in a playful/non-aggressive manner
play chase	initiator marmot chases receiver marmot in a playful/non-aggressive manner
play grab/slap/push	initiator marmot grabs, slaps, or pushes receiver marmot in a playful/non-aggressive manner

play pounce	initiator marmot pounces on receiver marmot in a playful/non-aggressive manner
Play mount	A mount in the context of play where one marmot places its forepaws on the others back and mounts it.
play wrestle	initiator marmot and receiver marmot wrestle with each other in a playful/non-aggressive manner
sniff annogenital region (Sniff AG)	initiator marmot sniffs butt-end of receiver marmot
SEX	Sex is rarely seen but is characterized by extended periods of foreplay (literally play behavior) punctuated by obvious lordosis displays by the female and mounting with thrusting, ejaculation, and then more play, etc.
sex thrust	male mounts a female and thrusts pelvis
sex lordosis	female solicitation of male by arching back in lordosis posture
sex Mount	male mounts female
	If you see what appears to be sex (it looks playful), please write detailed descriptions in your notes.

- A) All bouts of alarm calling—count alarm calls and note starting and ending times. If you're watching one group and hear alarm calls in another group, be sure to note that. Also, do your best to identify multiple callers.
  - B) Location of all identified animals (colony, area and burrow)—if a particular animal is seen in several locations, record all locations in a given day. Also note where the individual is check rubbing and carrying dried plants.
  - C) All predator visits in the area—coyote, fox, golden eagle, red-tailed hawk, other raptors, ravens. In addition to these potentially natural predators, record all visits of deer (marmots sometimes call to deer), people, dogs, etc. Log those predators that are not positively identified (e.g., raptor—possible *Buteo*).
  - D) It's essential to record observations of identified animals. If you don't know a clearly recognizable marmot, try to trap it and update your notes with the correct id.
  - E) Write down any additional impressions about social dynamics, etc. that you think might be important. Note the loss of any prominent individuals. Your impressions are valuable.
- 5) If you have multiple marmots interacting:
- A) Make a note of how many marmots were interacting in the Comments. For example, if there were 3 marmots interacting, write "triad" in the Comments, etc.
  - B) If you were able to ID the initiator, use as many lines in the **Social Interactions** log as there were marmots to link the initiator with each recipient. The goal here is to capture all the various interactions. For example, if you saw 3 marmots play wrestling, this is how you would enter it:

Date	Time	Colony	Area	Local ity	ID initiator Unique L tag	ID initiator Unique R tag	ID Recipien t Unique L tag	ID Recipien t Unique R tag	Type	Winne r (if domin ance) L tag	Winne r (if domin ance) R tag	Comm ents
18- May- 09	8:37	Picnic	Low er	Little Flat Rock	5657	5666	6051	6054	play wrestle			triad
18- May- 09	8:37	Picnic	Low er	Little Flat Rock	5657	5666	5618	5623	play wrestle			triad
18- May- 09	8:37	Picnic	Low er	Little Flat Rock	6051	6054	5618	5623	play wrestle			triad

If you had 4 marmots interacting, you would do the same thing, using 4 lines to link each pair, and so on.

**NOTE: The exact identity of animals is essential. Keep looking at individuals until you have a positive ID. If you see unmarked animals, consider trapping there later in the day or the next day and update your notes promptly.**

- 6) Write down the end time when you stop watching marmots.
- 7) Feel free to draw sketch maps or other aids to help pinpoint the location of marmots and verify these with Dan.
- 8) *Be sure to abstract notes into the Excel data sheets promptly.* Each marmot should be identified by both left and right tags (entered into separate columns). Information about location should be entered in three columns (colony, area, burrow location) for all logs (see separate spreadsheet "Database Colony Names" for allowable location names). You may put check marks or other visible marks in the notes as you abstract them to the data sheets. Do not cross out notes in a way to make them illegible (unless you're removing an observation).

### **Other critical behaviors to record all instances of during group observations**

All instances of aggression and play. Sometimes these are difficult to differentiate. When in doubt, ask Dan. These may include rearing up and boxing, mouth-sparring, chasing, biting, wrestling. The difficulties are distinguishing between play and aggression. Obvious aggression is obvious. One individual chases another around the meadow, or two individuals box in a fast-paced bout which results in one animal running off. Play bouts may be long, and may include a variety of behaviors. Roles will likely be reversed...thus, one individual may lie on its back and wrestle and then they may switch. A short bout of boxing may lead to a short chase, followed by a reversal. Write down as many details as you can and consult with others if in doubt about whether something is play or aggression.

Displacements. These may result from play or aggression or may be much more subtle (e.g., when one individual approaches another and the other one moves away).

Carrying dried plants (CDP). Be sure to note all instances of dried plant carrying and the burrow to which dried plants are brought.

Pup movement. If you're lucky, you'll see a mother carrying a pup in her mouth from one burrow to another. Note who is doing this and the burrows that are involved in a

movement. This can look initially like CDP—or it can look like infanticide—so write detailed observations.

Infanticide. If you see this, you'll likely know it. An adult may emerge from a burrow with blood on its mouth.

### 7) Observation Logs

The observation log supplements the trap sheet. However, unlike the trap sheet, the observation log is only found on the computer. Whenever you see a marked, or unmarked marmot, fill out an entry in the observation log. The columns are: date/time/left tag/right tag/colony/area/burrow location/comments. If you see an unmarked marmot moving around in a 'non-traditional' location, note it as well.

What goes in the observation log? Observations of marmots should include details of locations and miscellaneous behavior. For instance, if you record in your notebook that an animal was carrying dried plants (CDP) to a particular burrow, then this goes into the observation log: females CDP to natal burrows. If an animal moves around throughout the day, try to follow it and record the different burrow areas it visits in your notes and abstract these into the log. Don't worry about 'minor' movements (e.g., marmot moved 2 m up slope from a burrow). Your notes will likely be much more detailed than the log and will contain details of the comings and goings of the marmots. Remember, it is this observation log that will help us define social groups, a major purpose of the log.

#### 1 Time Observing

Data variables arrangement: Columns, Data variables description: Each row represents the amount of time a single member of Team Marmot spent time observing marmots a RMBL either during a morning or afternoon observation session. There are a total of 6 columns, with the following headers:

<b>Column</b>	<b>Variable</b>	<b>Description</b>
<b>A</b>	Date	Date and time marmot captured (format: Day-Month-Year, e.g., 13-Jun-01)
<b>B</b>	Start Time	Time at which observer started an observation session using the 24-hour clock (e.g., 17:42)
<b>C</b>	End Time	Time at which observer ended an observation session using the 24-hour clock (e.g., 17:42)
<b>D</b>	Total Time	Total amount of time during an observation period (e.g., hours (H) + minutes (M) in morning or evening session, using the format HH:MM)
<b>E</b>	Colony	Distinct matriline or social groups (e.g., River, Marmot Meadow, Picnic, Town)
<b>F</b>	Observer	Name of person collecting behavioral data on marmots

#### 2. Observation Log

Data variables arrangement: Columns, Data variables description: Each row represents data on events during which a unique marmot was observed during a given morning or evening observation session at a specific location within a colony. There are a total of 11 columns, with the following headers:

<b>Column</b>	<b>Variable</b>	<b>Description</b>
A	Observer	Name of person collecting behavioral data on marmots
B	Date	Date and time marmot captured (format: Day-Month-Year, e.g., 13-Jun-01)

C	Time	Time of behavior; use the 24-hour clock (e.g., 17:42)
D	Unique Left Tag	Original tag number on left ear (may be 3 or 4 digits)
E	Unique Right Tag	Original tag number on right ear (may be 3 or 4 digits)
F	Colony	Distinct matriline or social groups (e.g., River, Marmot Meadow, Picnic, Town)
G	Location/Area	Distinct locations of burrows or areas within colony sites
H	Burrow location	Specific location of burrow within an area
I	Cheek rub	No = 0, Yes = 1
J	Tail flag	No = 0, Yes = 1
K	Comments	Detailed notes about observation event

### 3. Alarm-calling Log

Data variables arrangement: Columns, Data variables description: Each row represents a unique alarm call (or series of calls) produced by one or more marmot at the same time. There are a total of 15 columns, with the following headers:

<u>Column</u>	<u>Variable</u>	<u>Description</u>
A	Date	Date and time marmot captured (format: Day-Month-Year, e.g., 13-Jun-01)
B	Colony	Distinct matriline or social groups (e.g., River, Marmot Meadow, Picnic, Town)
C	Time start calling	Time at which marmot started to alarm call; use the 24-hour clock (e.g., 17:42)
D	Unique Left Tag	Original tag number on left ear (may be 3 or 4 digits)
E	Unique Right Tag	Original tag number on right ear (may be 3 or 4 digits)
F	Unique ID (UID)	Combined numbers separated by "-" of the original L and R ear tags (see below)
G	Sex (M/F)	M (male), F (female), or U (unknown)
H	AgeSex (M/F)	Age = (A = adult, Y = yearling, J = juvenile,), Sex = (M = male, F = female, or U = unknown)
I	Age min.	If exact age unknown, then minimum age of marmot (in years)
J	Age exact	Exact age of marmot (in years)
K	Stimulus	Species eliciting alarm call (e.g., fox, coyote, human)
L	Time end calling	Time at which marmot started to alarm call; use the 24-hour clock (e.g., 17:42)
M	N calls	Number of calls produced in series by the same marmot
N	Identity of other callers	ID of other callers or "none" if no other callers present
O	Comments	Detailed notes about observation event

**4. Social Interactions Log**

**Data variables arrangement:** Columns, **Data variables description:** Each row represents the amount of time a single member of Team Marmot spent time observing marmots a RMBL either during a morning or afternoon observation session. There are a total of 13 columns, with the following headers:

<b>Column</b>	<b>Variable</b>	<b>Description</b>
A	Date	Date and time marmot captured (format: Day-Month-Year, e.g., 13-Jun-01)
B	Time	Time at which social interaction transpired; use the 24-hour clock (e.g., 17:42)
C	Colony	Distinct matriline or social groups (e.g., River, Marmot Meadow, Picnic, Town)
D	Location/Area	Distinct locations of burrows or areas within colony sites
E	Locality	Position relative to burrow
F	ID initiator Unique L tag	Original tag number on left ear of initiator (may be 3 or 4 digits)
G	ID initiator Unique R tag	Original tag number on right ear of initiator (may be 3 or 4 digits)
H	ID Recipient Unique L tag	Original tag number on left ear of recipient (may be 3 or 4 digits)
I	ID Recipient Unique R tag	Original tag number on right ear of recipient (may be 3 or 4 digits)
J	Type	Nature of social interaction (e.g., allogrooming, play)
K	Winner (if dominance) L tag	Original tag number on left ear of winner, if dominance (may be 3 or 4 digits)
L	Winner (if dominance) R tag	Original tag number on right ear of winner, if dominance (may be 3 or 4 digits)
M	Comments	Detailed notes about observation event

**5. Predator Sightings Log**

**Data variables arrangement:** Columns, **Data variables description:** Each row represents the amount of time a single member of Team Marmot spent time observing marmots a RMBL either during a morning or afternoon observation session. There are a total of 6 columns, with the following headers:

<b>Column</b>	<b>Variable</b>	<b>Description</b>
A	Date	Date and time marmot captured (format: Day-Month-Year, e.g., 13-Jun-01)
B	Time	Time at which social interaction transpired; use the 24-hour clock (e.g., 17:42)
C	Colony	Distinct matriline or social groups (e.g., River, Marmot Meadow, Picnic, Town)
D	Species	Name of predator species observed
E	Location/Area	Distinct locations of burrows or areas within colony sites
F	During observations?	0 = no, 1 = yes
G	Comments	Detailed notes, including number, age and activity of predator(s)

## **8a) Foraging Focals**

### **Marmot ethogram for foraging focals**

An ethogram is a catalog of behaviors. For different aspects of this study, we're interested in different behaviors. For instance, when you're conducting a vigilance focal, we're interested in a limited list of behaviors which are scored when they begin. Because all behaviors are mutually exclusive, you only have to note the transitions.

Stand forage (f): marmot is quadrupedally standing and has its head down, nose to ground. Chewing may be seen.

Rear forage (g): marmot is standing only on its hind feet, nose to food. Chewing may be seen.

Stand look (l): quadrupedally standing and has its head up, off the ground. Chewing may be seen if the animal is looking and chewing. NOTE: each time the head moves, score another look.

Run (n): marmot is running.

Out-of-sight (o): the marmot is out of sight. It may disappear into a burrow or behind a rock or other vegetation. Be sure that when/if it re-appears, you're watching the same marmot.

Rear look (r): marmot is standing only on its hind feet, head up off the substrate. Chewing may be seen if the animal is looking and chewing. NOTE: each time the head moves, score another look.

Other (t): other behaviors (which may include social behaviors).

Walk (w): marmot is walking.

These data are collected by means of **2-minute foraging focals**. We conduct 2-minute focal animal samples where the goal is to record the initiation of every behavior during a 2-minute bout of foraging. Speak these focals into a tape recorder and 'score' them promptly in your computer using JWatcher. Be sure to fill out a focal data sheet and draw the animal's mark on the focal data sheet.

*The goal is to try to have >1 different 2-min focals for every animal every week.* In some groups this is impossible; other groups it should be relatively straightforward. Ideally, you will have a list of all animals in a group and you will 'cycle' through this list, conducting focals on the next animal in the list. In large groups this may be less effective than simply looking for whomever is foraging and then initiating a focal. You really have to work to try to collect these. **Please don't forget to conduct the focals if this is one of your assigned tasks.** If you have already collected a focal that day, don't do another one on the same animal. If you collected a focal the day before, consider looking for another animal on which to conduct a focal.

2-min sounds short, until the vegetation begins to grow. Be sure to say "out-of-sight" when the animal moves out of sight and then resume your narration when it comes back in sight.

Be sure to fully fill out the data sheet when you do the focal. Please draw the animal's mark on the data sheet.

When you score these in JWatcher, the protocol for file naming is:

Left permanent ear tag-right permanent ear tag-date-time

For example: 1399-1400-04may05-0711

Be sure that each entry has the same number of characters and that dashes are used between entry elements.

**8b. Focals Log (foraging focals)**

**Data variables arrangement:** Columns, **Data variables description:** Each row represents information about a single foraging focal animal survey (FAS) performed on a specific marmot. This information is combined then combined with the FAS data entered into J-Watcher to determine the proportion of time during each 2 minute focal that a marmot allocates to vigilance, foraging and locomotion ( $N = 2,058$  foraging focals). There are a total of 13 columns, with the following headers:

<u>Column</u>	<u>Variable</u>	<u>Description</u>
A	Observer	Name of observer
B	Colony	Distinct matriline or social groups (e.g., River, Marmot Meadow, Picnic, Town)
C	Location/Area	Distinct locations of burrows or areas within colony sites
D	Fur Mark	Name (in words) of mark (drawing) used to recognized marmot as an unique individual
E	Unique Left Tag	Original tag number on left ear (may be 3 or 4 digits)
F	Unique Right Tag	Original tag number on right ear (may be 3 or 4 digits)
G	Date	Date and time marmot captured (format: Day-Month-Year, e.g., 13-Jun-01)
H	Time	Time at which focal started; use the 24-hour clock (e.g., 17:42)
I	N marmots w/in 10 m	Number of marmots within 10 meters or less of the focal marmot; note IDs of all marmots within 10 m radius
J	N marmots w/in 50 m	Number of marmots within 50 meters or less of the focal marmot; note IDs of all marmots within 50 m radius
K	Angle (0-10°, 10-30°, > 30°)	Slope of marmot's position to the vegetation
L	Substrate (*)	Substrate encountered focal animal survey: LV = low vegetation (marmot in open area), HV = high veg (marmot covered by vegetation), D = dirt, S = stones, T = talus)
M	Weather and other comments	Detailed notes about focal, including weather conditions (e.g., windy)

### 8c) Foraging Log from JWatcher

**Data variables arrangement:** Columns, **Data variables description:** Each row represents a summary of descriptive statistics generated by JWatcher from a single focal animal survey (FAS) on a foraging marmot. There are a total of 40 columns, with the following headers:

<b>Column</b>	<b>Variable</b>	<b>Description</b>
A	cd.res file	cd.res file name from JayWatcher
B	L tag	Original tag number on left ear (may be 3 or 4 digits)
C	R tag	Original tag number on right ear (may be 3 or 4 digits)
D	Observer	Name of person collecting behavioral data on marmots
E	Colony	Distinct matriline or social groups (e.g., River, Marmot Meadow, Picnic, Town)
F	Date	Date focal survey performed (format: Day-Month-Year, e.g., 13-Jun-01)
G	trap area	Distinct matriline or social groups (e.g., River, Marmot Meadow, Picnic, Town)
H	trap locality/area foraged	Burrow location where the trap is set
I	N-stand forage	Number of times this behavior occurred during the focal observation
J	N-rear forage	Number of times this behavior occurred during the focal observation
K	N-stand look	Number of times this behavior occurred during the focal observation
L	N-run	Number of times this behavior occurred during the focal observation
M	N-out of sight	Number of times this behavior occurred during the focal observation
N	N-rear look	Number of times this behavior occurred during the focal observation
O	N-other	Number of times this behavior occurred during the focal observation
P	N-walk	Number of times this behavior occurred during the focal observation
Q	TT-stand forage	Total time in ms allocated by marmot to each behavior
R	TT-rear forage	Total time in ms allocated by marmot to each behavior
S	TT-stand look	Total time in ms allocated by marmot to each behavior
T	TT-run	Total time in ms allocated by marmot to each behavior
U	TT-out of sight	Total time in ms allocated by marmot to each behavior
V	TT-rear look	Total time in ms allocated by marmot to each behavior
X	TT-other	Total time in ms allocated by marmot to each behavior

Y	TT-walk	Total time in ms allocated by marmot to each behavior
Z	X-stand forage	Mean bout length of behavior in milleseconds (ms)
AA	X-rear forage	Mean bout length of behavior in milleseconds (ms)
BB	X-stand look	Mean bout length of behavior in milleseconds (ms)
CC	X-run	Mean bout length of behavior in milleseconds (ms)
DD	X-out of sight	Mean bout length of behavior in milleseconds (ms)
EE	X-rear look	Mean bout length of behavior in milleseconds (ms)
FF	X-other	Mean bout length of behavior in milleseconds (ms)
GG	X-walk	Mean bout length of behavior in milleseconds (ms)
HH	PropIS-stand forage	Proportion of time when the marmots was in sight that it allocated to this behavior
II	PropIS-rear forage	Proportion of time when the marmots was in sight that it allocated to this behavior
JJ	PropIS-stand look	Proportion of time when the marmots was in sight that it allocated to this behavior
KK	PropIS-run	Proportion of time when the marmots was in sight that it allocated to this behavior
LL	PropIS-out of sight	Proportion of time when the marmots was in sight that it allocated to this behavior
MM	PropIS-rear look	Proportion of time when the marmots was in sight that it allocated to this behavior
NN	PropIS-other	Proportion of time when the marmots was in sight that it allocated to this behavior
OO	PropIS-walk	Proportion of time when the marmots was in sight that it allocated to this behavior

**9) Protocol for habitat assessment**

Goals:

- a) to determine environmental factors that differentiate colony from satellite sites and/or explain differences in turnover rates
- b) to develop a logistic regression model that will differentiate sites from non-sites
- c) to begin collecting data that will allow us to validate a simple GIS model

**Sampling colony and satellite sites**

50 m x 2 m transects/plots  
 5 per colony site 'early season'  
 +5 more later season?  
*Standardized size patch to be sampled*

**Sampling no occupancy sites**

Focus on areas where marmots could be (i.e., exclude willows and dense forests).  
 Within these larger habitat patches, sample smaller sites randomly using sampling protocol.  
*Standardized size patch to be sampled.*

At each site (after first round of sampling):

- a) walk the perimeter of the habitat opening in 'track' mode to calculate area

At each starting point:

- a) record a compass bearing of the slope
- b) note the GPS location
- c) note the fall line

While walking the plot:

- a) count all burrows (or potential burrows) within the plots
  - a. defined as a hole that a marmot can hide in
- b) count all boulders that you cross
  - a. we need to have a more detailed way of describing boulders and rocks
  - b. flush with ground? Overhanging ground? By size?

At 0, 10, 20, 30, 40, and 50 m

- a) note percent ground cover of trees, shrubs, herbaceous plants, grasses, bare ground, and rock (one person can do this by telling the other what the cover is). 1m x 1m plots?
- b) Estimate vegetation height (0-10 cm, 10-100 cm, > 100 cm)
- c) on the 'graph' cross out areas without visibility

### **10a) Protocol for conducting flight initiation distance (FID) experiments with marmots**

**Identify an animal.** If you have just arrived at a site, wait at least 10 minutes. This will control for flushing that can occur when the experimenter arrives at the site. After 10 minutes of observation, and a focal animal has relaxed (it's standing looking or foraging or lying down and looking; it's not rearing up and nervously looking around), begin the experimental approach. Do not begin an experimental approach if you think that another person is walking towards your subject. Do not begin an experimental approach if a predator or alarm calls have been recently seen or heard; the goal is a relaxed animal that you're going to scare.

**The approach.** Stand and walk directly toward the focal marmot at a speed of a 0.5-meter step per second (a funeral pace). Minimize up-and-down movement and extraneous motions. If the focal marmot is more than 100 meters away, it's OK to periodically check its location with binoculars, but it's best to not stop; keep walking at a consistent pace. Note, please start a stopwatch when you start the approach and stop it when the marmot first initiates flight. This time will be used to calculate your velocity.

There are two ways to make these measurements. First drop flags at relevant locations, and then either count your paces (and convert to meters) or use a rangefinder (or both).

**What to record.** First, record, the observer (i.e., your name), the date, and the time. Write the marmot's mark on the data sheet. Write the colony you're at on the data sheet along with the starting behavior (again, the goal is a relaxed marmot-- sit, forage, look, or stand look).

While maintaining the same speed drop flags when the marmot first looks, initiates flight (FID), moves again (if it does), and disappears out of sight into its burrow.

Now, fill out the data sheet.

Straight-line d from start to initial location: The distance between where you started walking towards the marmot and where the marmot initially was; the 'starting distance'.

Method of first escape: run, walk, out of sight.

Method of second escape: run, walk, out of sight.

N w/in 10 m: number of other marmots within 10 meters.

Initial substrate where the marmot was when you began the experimental approach: low veg, high veg, dirt, stones, talus

Substrate encountered during escape: low veg, high veg, dirt, stones, talus

Slope of marmot's initial position: What was the incline where the marmot was initially?

Marmot escape incline (only if moved, if not, no entry): If the marmot ran away, what was the incline that it ran over?

Start to marmot incline: The incline from where you started your experimental approach to where the marmot was when you started your experimental approach (note, this should be from the marmot's perspective. Thus, if you were below the marmot, it should be negative).

Alert distance: the distance from the marmot to the person when the marmot oriented its head to the person. It's not always possible to record this.

Flight initiation distance (FID): The distance from the marmot to the person when it moved.

Time (Stop watch time): the time it took you to walk from the starting point to the point where the marmot initially fled (i.e., FID).

2nd movement: The distance from the person to the marmot at the 2nd movement. Note: this may be an oblique angle. Also note, there may be no second movement.

Distance to burrow at FID: The distance between the marmot and the burrow when it initially moved.

Distance to burrow at 2nd movement: The distance between the marmot and the burrow when it moved the second time. This may not happen.

IF YOU ARE NOT SURE OF AN EVENT, DO NOT ESTIMATE IT, RATHER LEAVE IT BLANK.

## 10b) Flight initiation distance (FID) Log

**Data variables arrangement:** Columns, **Data variables description:** Each row represents a unique flight initiation distance (FID) experiment. There are a total of 18 columns, with the following headers:

<b>Column</b>	<b>Variable</b>	<b>Description</b>
<b>A</b>	Date	Date and time marmot captured (format: Day-Month-Year, e.g., 13-Jun-01)
<b>B</b>	Time	Time flight distance recorded using the 24-hour clock (e.g., 17:42)
<b>C</b>	Colony	Distinct matriline or social groups (e.g., River, Marmot Meadow, Picnic, Town)
<b>D</b>	Init Beh	Initial behavior of marmot prior to the experiment
<b>E</b>	N w/in 10m	N w/in 10 m: number of other marmots within 10 meters.
<b>F</b>	D. start	Starting distance: the distance from the marmot to the person at the start of the experiment. It's not always possible to record this.
<b>G</b>	Alert dist.	Alert distance: the distance from the marmot to the person when the marmot oriented its head to the person. It's not always possible to record this.
<b>H</b>	1st esc.	Method of first escape: run, walk, out of sight.
<b>I</b>	2nd esc.	Method of second escape: run, walk, out of sight.
<b>J</b>	1st FID	Flight initiation distance (FID) of first escape: The distance from the marmot to the person when it moved.
<b>K</b>	2nd FID	Flight initiation distance (FID) of second escape: The distance from the marmot to the person when it moved.
<b>L</b>	Slope init. Terr	Slope of marmot's initial position: What was the incline where the marmot was to its terrain before it fleas?
<b>M</b>	Slope of esc.	Marmot escape incline (only if moved, if not, no entry): If the marmot ran away, what was the incline that it ran over?
<b>N</b>	Init Sub	Initial substrate when experiment starts: LV = low vegetation (marmot in open area), HV = high veg (marmot covered by vegetation), D = dirt, S = stones, T = talus)
<b>O</b>	Esc Sub	Substrate during escape: LV = low vegetation (marmot in open area), HV = high veg (marmot covered by vegetation), D = dirt, S = stones, T = talus)
<b>P</b>	D. Burrow at FID	Distance from the burrow at flight initiation distance.
<b>Q</b>	Start Slope	Slope of marmot's initial position to the observer: What was the marmots slope relative to the observer before it fleas?
<b>R</b>	Comments	Additional comments or notes