

DIRECTIONS FOR DETERMINING BITE SIZE

This variable is one of the most difficult to collect. You will not be able to just go out and get this information at will, but must be ready when the opportunity presents itself. In addition, the specific method depends on the species being consumed. For example, browse bite size estimates are done a little differently than bunch grasses and forbs.

Bunch Grasses

To be able to estimate bite size on grasses, the angle of viewing is almost as important as distance. What works best is being across a draw from the sheep with them feeding on a steep hill side slightly below you. A person also needs to be close enough to identify and see individual bunches. It takes spending some time with the sheep to get a feel for how close you can approach without altering their behavior. Their "space" needs vary; for example, if they have any young lambs with them, they will not let you within 100 yards or more. However, the same ewes without lambs might let you "bed down" within 10 yards at another time and place. Therefore, using the high powered binoculars or a spotting scope is usually necessary. Angle and brightness of lighting are also factors.

The basic method is to pick out a bunch before an animal starts feeding on it, count the number of bites once feeding begins, then go find that same exact bunch, visually estimate the amount of grass consumed, then find a similar size nearby bunch of the same species that has not been fed upon, clip an amount of grass equal to your estimate of the amount consumed, place this material in its individual paper sack, and label with species, date, number of bites, and general area where collected. Obviously, it is no small feat to be able to find the bunch that was fed upon. A person needs to note landmarks, such as, distinct rocks, pieces of wood, and other plants etc., that will help you find it. Things will look a lot different once you climb over to the feeding site, and not all searches are successful. Tracks can be quite helpful. I always recorded the notes and bite counts into a small cassette recorder while I observed through the binoculars, then I played it back once I climbed over to the feeding site. I also waited until the sheep left the area, so as not to disrupt their normal behavior.

On counting bites, sheep move their lips very rapidly while feeding. Most of this movement is their sensing and manipulating the vegetation before they actually "bite" it (horses do this also). So, do not attempt to count all these small lip movements. When they actually take a bite they pull their head back sharply, or sometimes up or sideways. These movements are what I have defined as a "bite". A person can see this movement from a considerable distance, even when you can not see the exact plant being fed upon. However, it is highly desirable to be able

to see the sheep's mouth when counting bites.

Forbs

Tall ones - Some forbs, such as Tragapogon dubius and Thellyphodium sp. stand up high and the sheep bite the terminal ends of the flowers or flower buds off and occasionally some of the stalk. A person can use a similar technique to the one described above to estimate bite size.

Medium size - Some forbs, such as Cirisium sp. and Balsamorhiza sagittata are distinct plants and it is possible to use a system similar to the one described above.

Small forbs - There are species of small to very small forbs that are mixed in with all the other forage species, such as Collinsia sp. It is very difficult to obtain bite size estimates on these species. In this situation, about all a person can do is use a generic bite count, then while on a feeding site try to keep an eye out for small forbs that have been fed upon, and estimate bite size from them. Obviously, the sheep may often consume all of some individual plants, pulling up roots and all. Therefore, it is a good idea to collect some whole small forbs, and label them as such.

Annual Grasses

Annual grasses consist mainly of cheatgrass, which greens up early and dries out early. Even later in the summer the sheep spend a considerable amount of time foraging in areas where it is ubiquitous. They consume portions to entire plants. It is difficult to estimate the amount consumed, because there are no distinct bunches, and once cheatgrass dries out it is real easy to pull up an entire plant, plus much of it gets trampled down etc. Therefore estimating bite size on cheatgrass is similar to estimating bite size for small forbs. You just have to use a generic bite count, and examine feeding sites carefully for partially consumed plants, as well as collect some whole plants.

Browse species

Even though bighorn sheep are classified as a grazing animal, in Big Creek (and other places as well) they consume a significant amount of shrub species. The major species consumed are mountain mahogany, bitterbrush, and elderberry. However, I have observed them feeding vigorously on ninebark, Ribes sp., hawthorne, and serviceberry on numerous occasions. They also have been observed consuming sryinga, rabbitbrush, mountain maple, Oregon grape, snowberry, and Prunus virginiana occasionally. Only once have I observed them feeding on sagebrush.

Once again they feed a little differently on some species compared to others. Therefore, I measure bite size a little bit differently on some species.

Elderberry (Sambucus) - The sheep probably won't begin to feed heavily on this species until late summer or early fall, when it has berries. They basically reach up and break off large clumps of leaves and berries and engulf the whole thing. Also they consume individual leaves. While observing through the binoculars I would count the number of bites (recording into a cassette recorder) and also estimate the size of bites. For example, if the ewe reached up and broke off a whole clump of berries with 5-6 leaves, she would probably engulf the whole thing before reaching up again. This would be considered one bite. The next bite may be one individual leaf or a partial bite of a leaf. After the sheep left the area I would hike over and emulate the bite sizes while I played the cassette back. Place the material in paper sacks for drying and label with species, date, number of bites, and general location. The ewes don't seem to consume a lot of gross woody material when feeding on this species. They seem primarily interested in the green leaves and berries.

Bitterbrush (Purshia tridentata) - There is not a lot of bitterbrush available, but the sheep really like it. They feed upon it primarily by clamping their teeth over a twig and lifting their head back, thus stripping off leaves and outer bark. Sometimes the very end of the twig snaps off also. They also bite individual leaves on occasion. I would count the number of bites, differentiating between strips and individual leaf bites while recording into a cassette recorder. Then hike over to the feeding site once the sheep left and emulate the stripping by using my finger nails to strip off leaves and outer bark. Before doing this I would measure "strip lengths" in cm where the sheep had been feeding, and record these strip lengths in a notebook for a permanent record. Using this information I would copy the same strip lengths, including snipping off the soft terminal end with the strip. Place the "bites" in small individual paper sacks, labeled with species, date, and general location. Also collect a few individual leaves. Ship these "bites" to my Lewiston address. Since deer and other sheep definitely have fed on the same plant before, it is necessary to develop an "eye" for what is fresh browsing. A person can strip a twig and watch how long it takes to age and turn a different color. In hot, dry weather it doesn't take that long, therefore, a person needs to get up to the plant relatively soon after the sheep finish.

Mountain mahogany (Cercocarpus ledifolius) - and other shrubs - Sheep feed on CELE three ways: 1. They feed on it just like they feed on bitterbrush, by clamping their teeth over a twig, jerking their head back, stripping off leaves and bark, and possibly breaking off a little bit of the very end. 2. They bite off individual leaves. 3. They bite off whole twigs.

While recording into a cassette recorder while observing through high-powered binoculars describe the feeding behavior. For example if a ewe is stripping, just say "strip" into the recorder, for individual leaves, say "leaf" every time you can tell an individual leaf is bitten off (this can be hard to see),

for whole twigs, say "bite". Bite size, for the first way of feeding, can be estimated the same way bitterbrush is estimated, by measuring actual strip lengths, recording them, then emulating them by stripping off leaves and bark of unbrowsed twigs, using the measured lengths as a guide, placing "strips" in individual paper sacks, and sending them to my home address in Lewiston. For the second method just collect individual leaves.

Estimating bite size for the third method of feeding is the most complex, but also lends itself to long-used methods developed for other browsing ungulates. Once we climb over to the plant all we see is the bitten off end of the twig. So how do we know how much was there to start with. We don't, but we can use regression to "predict" the amount. At the plant, measure with calipers the actual diameter at point of browsing (DPB) in centimeters at least to the nearest tenth (hundredths if possible). Record these readings in a permanent record (i.e. on paper to be used later). Then clip some unbrowsed twigs, measure the "DPB", and place them in individual paper bags. Get approximately 10 per plant. We don't want to take too much of the available CELE, because only so much is actually within the reach of sheep. For each individual clipping make sure to record its DPB on the outside of bag, with date, and general location. Ship these clippings to my address in Lewiston, I'll dry and weigh them and develop equations to predict the amount of material removed from the actual DPB's where the sheep fed. These clippings can also double as plant collections for chemical nutritional analysis later. Once I have the weight and DPB numbers.

CELE is also heavily used by deer and elk, and the elk have browsed much of the CELE you see from a distance out of the reach of sheep. However, the sheep are willing and capable of climbing out on rocks to browse CELE where the elk won't go. Therefore, it is really kind of rare to be able to observe the feeding behavior and then safely climb over to the exact plant. Frequently, you can find the exact plant okay, but it is just too dangerous to climb out where the sheep did. Don't take any risks. Therefore, clip some twigs and measure DPB's from some plants that are safe, if all else fails. Be sure and note this in the shipment. In the shipment of all bite size estimates be sure and label them as such, and separate them from plants collected just for nutritional analysis. However, as mentioned above some of the bite sizes may still be used later for nutritional analysis.

DIRECTIONS FOR BITE RATE (BITES PER MINUTE)

The overall goal is to estimate the amount of plant material consumed by the ewes while they are foraging. If we can estimate the size of bite and the number of bites/min, then we can estimate the amount of material consumed/min/species.

METHOD - Use the high-powered binoculars, and set up where (ideally) you can see what species the sheep are consuming. Once again, angle of view, lighting, and sheep behavior all have to come together for this to be possible, just like for bite size estimation. A person needs to be prepared when the situation presents itself, and learn to recognize when its a good situation. That means packing the cassette recorder, cassettes, stopwatch, tripod, and binoculars; just in case it happens. However, for bite counting, things don't need to be quite as perfect as for bite size estimation.

Once you can see well enough, and the focal animal looks like it might feed on one species for at least 1 min., start the stopwatch and record bites into the cassette recorder. Saying "bite", "leaf", or "strip" every time you observe one. Also, note periods of head-up chewing, standing alert, and moving behaviors, that is indicate when the ewe is not actually biting. Hopefully, the ewe will stay on one species for at least 60 s. The watch is used so you have some idea of the time frame. Many times you start counting, but the ewes do not feed on one species for 60 s, sometimes they go longer, 2-3 mins. If they keep going keep counting, or if they switch species momentarily, keep counting, but note the switch into the recorder. If they are switching species all over the place, then wait for a better opportunity. Or, do what I call a "generic" bite count, that is where you can tell the sheep are taking bites by their head movements etc., but you can't identify the species. Generic bite counts are really the only rate we can realistically obtain for small forbs and annual grasses.

Later on, back at the ranch, sit down with the recorder, stop watch, and bite count form, and play the tape back. Now, there are 2 ways to approach this data. At times during a minute, most sheep will raise their head and chew, maybe look around for a few seconds and then go back to actually biting. So, a person could include this time in the bite rate per minute, or subtract it out leaving only the "pure" rate, that is the rate when the animal is actually biting and nothing else. Naturally, you must record into the cassette these head-up chewing, looking around (stand alert), and moving behaviors in order to subtract them out later. Both kinds of bite rates are useful and valid.

Methods:

1. Play back the tape in conjunction with a stopwatch, just letting the tape run, marking down a "1" on the bite count form for every bite, an S for each strip if the animal is browsing like that. Be sure to mark where 1 min ends, 2 min ends etc. Identify species, date, time of day, where changes in species being consumed occurred, if any, or if the count is generic.

This method includes all of the head-up chewing etc. behaviors in the rate.

2. Play back the tape a second time and subtract out the times when the ewe is not actually biting. Record these times on the sheet and label the behavior as head-up chewing, moving, or standing alert, etc. In between these non-biting behaviors, the ewe should be biting vegetation, so mark a 1 down for each bite, or S for a strip. The point on the tape where a cumulative of 60s of pure biting occurs will be different than in the first method. You have to keep a running tally so that you can indicate where 60s intervals occurred. This method is a pain compared to the first method, but it will be valuable information for model development. Naturally, you must start and stop the tape many times, and rewind it a little bit each time so that you start the watch as close to where you stopped it as possible. A person's reaction time and alertness come into play using this method. There are computer-aided devices available for this stuff, and most animal behavior studies done in a lab would have a sophisticated set up that did all this for you, but \$\$\$\$\$.

DIRECTIONS FOR DISTANCE MOVEMENTS

We are interested in estimating the energy expenditures of bighorn ewes. One of the variables of interest is the amount of energy expended for moving across terrain. There are several methods to get at this variable.

1. Estimate the amount of distance covered during a feeding bout. You must find the sheep bedded, start observing their movements when they start feeding, and follow their movements until they bed down again, i. e. stop feeding. A feeding bout may last hours and cover a lot of terrain. In the summer the sheep move around a lot. The best place to do this is from the south side of Big Creek, like from the trail behind the Taylor Cabin or Rush Creek Ridge - opposite Lobear Basin. It can sometimes be difficult to find the sheep, telemetry equipment and binoculars are very useful. Take some of the laminated photos into the field and trace the movements across the photo with a fiber tip pen, then later transfer the pattern to some acetate laid over an orthophoto map, then you can easily measure the distance with the acetate scale-protractor overlay. Record the distance on a permanent form. We can get the number of feeding bouts/day from the Rustrak recordings, and use the 2 data sets to estimate the amount of distance moved/day.

2. Estimate the amount of distance covered in an entire day. This involves a long hard day of watching sheep. However, at certain times of year they don't really move that far in a day. In summer they move much farther than in winter, plus the days are longer. Therefore, its easier to get this information in winter and early spring. Basically, you use the same method as above only for an entire day. Be sure and record it as a whole day to differentiate these distances from the above number 1. method.

Using either method, the sheep may move so far and fast that you can't see or keep up with them. Also, you don't want to push the sheep. This information is best obtained from a considerable distance. Some days you can even do it from Taylor Ranch with binoculars while you are doing other things. Or, you may be watching the sheep in a place like Lobear Basin for bite counts etc. and you just keep this distance data, (especially) the first method), going while you collect other information. I would give the first method priority in the summer, but I would like to get some of the second method as a check.

DIRECTIONS FOR RUMINATION TIMES
AND BEDDED BEHAVIOR

Rumination is an energy cost in itself, and therefore an important variable to estimate. The sheep usually ruminate when they bed down, however, they will occasionally ruminate while standing. I consider a ewe ruminating when she is chewing her cud. This movement is clearly visible in the binoculars from a considerable distance.

Method - Sheep should be up and feeding etc. then move over to talus (most likely place to bed). Once they bed down pick out 1 to 3 individuals that you can see their mouth clearly, and start watching them. Note the time they bedded, then note the times they each start chewing. Keep timing them until they stop chewing, then mark down the time for each sheep. But, keep watching and timing them, because they may start again in a few minutes. They may lay their head down for a while then start chewing again later; also time the amount of time they lay their head down. Make notes in a notebook of start-stop times for sheep #1, #2, or #3. It's hard to handle more than 3 sheep at a time. Keep watching them and timing the ruminating from the non-ruminating until they get up to feed again. This can be anywhere from 20 min. to several hours. It can get long and is not extremely exciting after you've done it a few times, but the information is very valuable. Transfer your field notes to an easy to read summary, if the field notes are hard to read. Please record the day, general location, and a short description of the weather.

DIRECTIONS FOR 15 MINUTE DIRECT OBSERVATIONS
OF ACTIVE-FORAGING BOUTS

*I ~~did not~~ enclosed
forms for this. I use
the Rustrak
forms for this*

The Rustrak recordings do a good job of delineating foraging bouts. They are quite distinct and easy to interpret on the chart. However, within a foraging bout sheep engage in several other behaviors besides just biting vegetation. For example, they periodically lift their heads to chew, move to a new plant, scan the distance for predators, and engage in social interactions to name a few. Although, the overall foraging-activity bout is well delineated from inactive periods on the Rustrak chart paper, within a foraging bout you cannot tell these behaviors from one another with any certainty. Therefore, I rely on 15 min periods of direct observation. From these 15 min periods I will at least get some idea of the percentage of time sheep spend in these different behaviors. I set up the binoculars, start a stopwatch, and record the behaviors into a cassette recorder, then play back the tape while timing each behavior and recording the times on a form. Once again, alertness and reaction time of the person interject some variation into the data. This could be partially reduced with the use of computers in the field, but \$\$\$\$ rears its ugly head.

Below I will define and number the behaviors:

1. Feeding low on grass and forbs, i.e. ground level vegetation
2. Feeding high on grass and forbs, for example biting the ends off of tall forbs or grasses without lowering their head.
3. Browsing, feeding on shrub species.

A NOTE ON INTEGRATING DATA COLLECTION. In the above, try to identify the species if possible, and count bites if possible. This essentially is collecting bite count data at the same time your collecting this type of data. Also, you may be able to count bites on individual plants that you can find later and get some bite size estimates. So, it is possible to collect more than one kind of data at the same time. But, if you can't identify the species, or see bites on individual plants, you can at least get this "head-up head-down" kind of behavioral data.

More behaviors:

4. Pawing. Once things dry out the sheep will start digging up roots. Try if possible to count the number of strokes, and record this on the form.
5. Moving-side hill
6. Moving-up hill
7. Moving-downhill

8. Moving and feeding at the same time. It is just a judgement call as to when this behavior should be recorded instead of just plain feeding. Usually the sheep lift their head before moving to a new plant, but sometimes they just keep it down biting vegetation as they move. There are shades of gray between the 2 behaviors.

On movement behaviors try to estimate as best you can the distance moved. This can be hard to do and easy to forget. Rough estimates in meters is could enough. Just give it your best guess.

9. Head-up chewing, head is raised, and the animal is chewing, but it is not tense. Although, the animal may look around some.

10. Standing alert, head is up and the animal is tense and scanning the distance for danger. This behavior can last up to 45 min., but usually only 30-60 s. They will stop chewing even if they have vegetation in their mouth.

11. Social interaction: This includes, playing, reproductive behavior (during the rut), nursing bouts, fighting (Fighting includes stare-outs with other sheep, horning brush, and shaking their horns at other sheep). Identify the type of social behavior on the form, and try to time them like the other behaviors.

It takes some practice to get used to this system. Eventually, it may be easier to say the number of the behavior into the cassette recorder than to say the whole behavior's name. Sheep can change behaviors quickly at times making it difficult to keep up. I had developed a kind of short-hand slang, that would be difficult to pass on. At the beginning of each tape be sure and identify the date, time of day, and if the focal animal is one of the collared sheep, note its number (i. e. frequency). If the focal animal is not collared describe it, like adult ewe, yearling, or lamb. Concentrate on adult ewes, but collect some data on lambs and yearlings. Try to choose focal animals randomly.

OBTAINING DATA TO CHECK THE ACCURACY OF

RUSTRAK RECORDINGS

This data can coincide directly with following the movements of sheep through a day or part of a day to determine the distance moved. The focal animal must be one of the collared ewes, and it should be dialed in on one of the Rustraks. Then for a day, or span of several hours note its behavior as to whether it was active (up and foraging), bedded with head up, bedded with head down, standing alert for > 1 min i.e. not foraging and not bedded, or moving without foraging at all (a very rare event).

