Estimating Rangeland and Pastureland Biomass

from vegetation measurement website – Module 6: http://www.cnr.uidaho.edu/veg_measure/Modules/module06.htm

Basic Procedures for Estimating Biomass

It takes a lot of time to clip many plots to make good estimates of biomass. However, with a little training most field technicians can become skilled in estimating the amount of biomass in a plot.

- To accurately estimate the amount of biomass in a plot, the observer must spend time training.
- The training procedure basically entails weighing representative units of a plant and establishing an "eye" for what 5-, 10-, or 15-grams etc., of forage looks like.
- Estimating biomass is both visual and tactile. Good estimates generally require looking at the plant or plot and then "feeling" it to assess density.

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</td><td>These examples are from
Chapter 4 of the
National Range and Pasture Handbook</td></tr>
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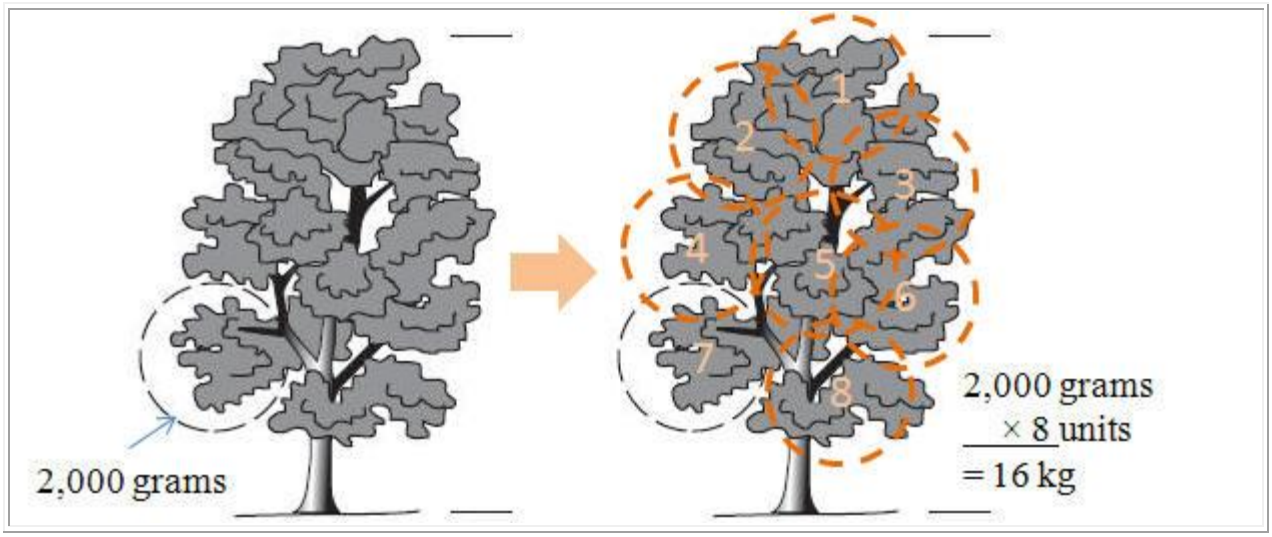
This procedure of estimating biomass can be easily accomplished for small herbaceous plants. It is more difficult to gain excellence in estimating shrubs and trees but, it is possible. For example:



Basic Procedures for Directly Measuring Biomass

The basic idea of **Direct** or **Destructive** methods are simply to remove and weigh all the biomass occurring in several small areas or quadrats then estimating biomass that occurs across the landscape, site, or pasture. The basic steps are as follows:

1) Place a round, square, or rectangular quadrat (of known dimensions) along line or in location set by desired sampling protocol.

Measuring biomass in Oklahoma. Photo by Jeff Vanuga (http://photogallery.nrcs.usda.gov)

2) With a pair of clippers, remove all vegetation in a three dimensional area above the quadrat. Clip to ground level. Grass shears, sheep shears, power grass shears, sickles, and hand lawnmowers equipped with grass catchers can be used to accomplish clipping.

Photo from http://www.rittenhouse.ca/

3) Weigh the vegetation clipped. This can be done in the field and recorded on a data sheet. Or, samples can be collected and brought back to the lab for weighing.

Photo from Rangeland Monitoring in Western Uplands on http://forestandandrange.org

4) Clip enough quadrats to capture the variation in biomass across the landscape of interest. The more variation among plots placed across the area -- the more plots will need to be clipped. (Clipping at least 10 quadrats is recommended).

Clipping biomass in Idaho. Photo by K. Launchbaugh

5) Dry biomass samples, or a sub-set of plots clipped, in a forced air oven. Alternatively, fresh field weights can be converted to dry weights based on "book values." (see below)

6) Convert grams of dry mass per quadrat to lbs/acre or kg/ha.

● **Detailed step-by-step guidelines** for this 'clip-and-weigh' or 'harvest' method can be found on pages 112-115 of the Interagency Publication Sampling Vegetation Attributes

Considerations for Clip-and-Weigh Techniques

- Clipping vegetation to ground level and then weighing it is the most direct and objective way to measure herbaceous biomass.
- Before clipping, the field technician must clarify which plants in a plot will be clipped.
  - All plants or just forage plants?
  - Current season's growth or total standing crop?
  - All plants rooted in the plot or those that occur within or above the perimeter of the quadrat?

  Most researcher believe that plants within or in a vertical projection above the perimeter should be sampled. However, in grasslands, it is usually easier to clip all stems rooted in the plot and not worry if they hang into or out of the plot.
  - Will species be clipped and weighed separately, will plants be clipped by functional group (e.g., cool season grasses, annual forbs, etc.) or will all plants be clipped and weighed?

Weighing and Drying Harvested Material

The weight of clipped plant material includes water inside the plant (within and between cells) and water on leaves and stems such as dew and precipitation. Therefore, the weight of freshly harvested plant material is highly variable and depends on recent weather, atmospheric conditions, and the water status of the plant. For more meaningful interpretation of production, phytomass is expressed on an air-dried or oven-dried basis.

- Generally, the weight of all fresh, or "green", samples are weighed in the field and then a subset of these samples are brought back to the lab to be air-dried or oven-dried. Alternatively, all the samples can be collected and brought back to the lab.
- Once a sample is dried the % dry matter = (Dry Wt./Fresh Wt.) *100 where the "Dry Wt." is the weight of the sample after oven drying and "Fresh Wt." is the weight of the sample recorded in the field.

► Recommended Drying Procedure:

(1) Dry sample within 24 hours of clipping. The sooner the better.

(2) Place samples (in paper bags) in a warm place (like outside in a hot shed or building) or forced-air oven 140-160°F (60-70°C)

(3) Most samples will take 24-48 hours to dry in oven several days in a warm place.

(4) To determine if a sample is dry, a few bags can be removed from the oven, weighed and then returned to the oven. A few hours later (4-8 hours) the bags can be removed again and weighed. Samples are dry when no changes in weight occur between reweighing. This is called "drying to a constant weight".

(5) Once a sample is dried, it must be stored in a dry place or it will absorb atmospheric moisture and gain weight.

Estimated Dry Weights

If it is extremely difficult to dry samples, a few book values or "rules-of-thumb" can be used to convert fresh field weights to dry mass:

Grass:
- before heading = 35-30% dry matter
- headed out = 35-40%
- after bloom = 45-50%
- mature seeded = 55-60%
- leave dry/stem partly dry = 80-85%
- apparent dormancy = 90-95%

Forbs:
- very lush = 15-20%
- mature, seed-stage = 35-40%
- seed rip, leaves drying = 60%
- dry and dormant = 90-100%

Shrubs/Trees (deciduous):
- lush new leaves = 20-35%
- older, full-sized leaves = 50%

Shrubs/Trees (evergreen):
- lush new leaves = 55%
- older, full-sized leaves = 65%

Conversions from Plot to Landscape

Plots are generally clipped and weighed in grams. Then, drying or estimating procedures convert field weights to dry weights in grams/plot. However, to be useful for reporting information, biomass should be expressed in pounds per acre or kilograms per hectare. Here are a few useful conversions taken from the National Range and Pasture Handbook (http://www.glti.nrcs.usda.gov/technical/publications/nrph.html; Chapter 4 page 4-6).

To convert grams per plot to pounds per acre, use the following conversions:
- 1.92-square foot plots then multiply grams by 50
- 2.40-square foot plots then multiply grams by 40
- 4.80-square foot plots then multiply grams by 20
- 9.60-square foot plots then multiply grams by 10

- 96.0-square foot plots then multiply grams by 1

To convert grams per plot to kilograms per hectare, use the following conversions:

- 0.25-square meter plots then multiply grams by 40
- 1-square meter plots then multiply grams by 10
- 10-square meter plots then multiply grams by 1
- 100-square meter plots then multiply grams by 0.10
- 400-square meter plots then multiply grams by 0.025

Other useful conversions:

To convert	to	Multiply by
Metric units:		
Kilograms per hectare	Pounds per acre	0.891
Kilograms	Pounds	2.2046
Hectare	Acres	2.471
English units:		
Pounds per acre	Kilograms per hectare	1.12
Pounds	Kilograms	0.4536
Acres	Hectares	0.4047