

Estimating shrub forage yield and utilization using a photographic technique

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Abstract

We determined the potential of a photographic technique to assess shrub yield and utilization. Common snowberry (*Symphoricarpos albus* (L.) Blake), snowbrush (*Ceanothus velutinus* Douglas ex Hook.), and heart-leaved willow (*Salix rigida* Muhl.) found in mixed conifer rangelands were chosen for this study. Ten individuals of each species were selected. We determined the correlation between green leaf area size (LA) and forage yield (Y) and also compared plant utilization estimated by photographic technique (ULA) to actual utilization (UY) values.

The shrubs actual forage yield and utilization were determined by hand plucking in five to eight increments. Before the first plucking and after each of the pluckings, photos were taken from two directions, which were perpendicular to each other at the intersection of the shrub. Images were evaluated using image-processing software and this analysis produced red (R), green (G), and blue (B) color band images. Green leaf area was determined as follows: $\text{pixel} = [(G-R) + (G-B)] / [G+R+G+B]$; Green leaf area, $\text{cm}^2 = (\text{Calibration } (C), \text{cm}^2 \text{ pixel}^{-1}) \times (\text{LA}, \text{pixel})$.

Green leaf area calculated from the photographic technique was strongly correlated (r^2 ranged between 0.83 and 0.94, $P < 0.001$) with forage yield for all three shrubs. A strong negative correlation was detected ($r^2 > 0.97$, $P < 0.001$, $n = 142$) between shrub LA reduction due to hand plucking and percent utilization.

Sample size of shrubs required to determine forage yield interacted ($P < 0.05$) with research technique and shrub species. For example, to detect a difference of 20% of the mean forage yield with a probability of 80% and a 5% significance level, using the photographic technique required at least 25, 18, and 79 snowberry, snowbrush, and heart-leaved willow plants, respectively. However, to detect the above-mentioned difference, using the clipping (hand plucking) method required at least 21, 22, and 79 snowberry, snowbrush, and heart-leaved willow plants, respectively.

A strong correlation ($r^2 = 0.9504$, $n = 142$) was detected between utilization values estimated through green leaf area size and actual values. Utilization estimated by LA did not differ ($P = 0.6033$, $n = 142$) from actual utilization values.

In summary, our results indicate the photographic technique could be used to measure available browse yield and utilization of shrubs.

Key Words: shrub utilization and yield, vegetation inventory, and photography