Weight-Length Relations in Flowering Dogwood Twigs[1]

L. K. HALLS AND R. F. HARLOW

Range Scientist, Wildlife Habitat and Silviculture Laboratory, Southern Forest Experiment Station,[2] Nacogdoches, Texas; and Wildlife Biologist, Wildlife Habitat Improvement Laboratory, Southeastern Forest Experiment Station,[2] Blacksburg, Virginia.

Highlight

Ratios of twig weight or twig plus leaf weight to twig length in flowering dogwood plants vary meaningfully by season, geographic location, and year. Where the weight of new growth is predicted from twig lengths, the ratio of weight to length should be determined for the population being studied.

Estimating browse production by clipping and weighing twigs from sample plants is expensive, and since clipping may disrupt or alter growth, new plants must be found for each sample. It is usually more convenient to predict weight from an easily measured and closely associated plant character, such as twig length. Length can be measured quickly and accurately, and it is closely correlated with weight (Kinsinger and Strickler, 1961; Basile and Hutchings, 1966; and Schuster, 1965). The study reported here was done to learn whether the ratio of weight to length for a plant species varies with season, year, location, and growing conditions. Flowering dogwood (*Cornus florida*) was selected for testing because it occurs widely, is important to game, and has easily recognizable current-year twigs.

In 1963, 440 1-year-old flowering dogwood seedlings were planted in an open abandoned field near Nacogdoches, Texas, and the same number on a site near Asheville, North Carolina. Beginning in 1964 near Asheville and in 1965 near Nacogdoches, a predetermined but variable number of twigs with their leaves attached (current season's growth) were clipped from one-half of the plants in late winter (March) and from the rest of the plants in summer (July). Twigs were then clipped at 1-year intervals through 1968 from all surviving plants. In addition, during 1967 and 1968 twigs were taken from a set of 200 plants growing naturally in a mature pine-hardwood forest near Nacogdoches.

For each collection, the number and length of twigs were recorded for each plant. Twig diameters were measured in 1965 at Nacogdoches. The clipped twigs and their leaves, when present, were ovendried at 65 C and weighed separately to the nearest 0.1 g.

Various functions of stem diameter and length were explored as potential predictors of weight through regression analyses. Total length was the best single variable for predicting weight ($r = 0.977$). Schuster (1965) showed that multiple variables gave a significantly better prediction of weight than twig length alone, but in the present study addition of a second variable did not greatly increase the accuracy of estimates.

Curvilinear trends in the relation between length and weight were not apparent and both data and reasoning suggested that the equation pass through the origin. Plottings of the weight over length relationship also indicated that the standard deviation of weight for a given value of length increased in a linear fashion with the length value. These circumstances suggested a model with the mean of the ratios (Freese, 1962) as regression coefficient.

Table 1. Ratio of twig weight (g) to twig length (mm) for planted dogwoods in open fields.

Time of collection	Nacogdoches, Texas		Asheville, N. C.	
	Mean	Std. error	Mean	Std. error
Winter				
1964	—	—	0.00193	0.00010
1965	0.00296	0.00008	0.00264	0.00028
1966	0.00424	0.00017	0.00220	0.00016
1967	0.00418	0.00012	0.00278	0.00028
1968	0.00351	0.00012	0.00224	0.00020
Summer				
1964	—	—	0.00116	0.00008
1965	0.00218	0.00005	0.00122	0.00008
1966	0.00203	0.00005	0.00097	0.00004
1967	0.00201	0.00005	0.00126	0.00011
1968	0.00154	0.00003	0.00124	0.00007

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Ratios of weight to length were computed for each plant at each collection, and averages of these ratios were computed for each geographic source at each season. Both weight of twigs and weight of twigs plus leaves were considered when data were available.

Results

Ratios of twig weight to length were inconsistent among years. They differed by as much as 30% for dogwoods clipped during the winter at Nacogdoches (Table 1). For twigs clipped in summer the ratios in Nacogdoches were quite similar for the first 3 years of the study, but in 1968 the ratio was 26% less than the average for the previous years. For the dogwoods at Asheville the differences between ratios ranged up to 30% for winter-clipped twigs and 23% for summer-clipped twigs.

Weight/length ratios for twigs collected during the winter were approximately twice as large as those developed from summer twigs at both Nacogdoches and Asheville (Table 1).

Weight/length ratios developed for dogwood in the open field at Nacogdoches averaged about 60% larger than those at Asheville (Table 1). Likewise, the ratios for dogwood growing in the open at Nacogdoches were about twice those for plants growing naturally in the woods (Table 2). Thus, weight/length ratios developed for one location cannot be used to predict twig weight from length at another location.

The twig plus leaf weight/twig length ratios were larger but showed the same general relations among years and locations as did the twig weight/length ratios. At Nacogdoches when samples were taken from the same plants each year (open field), the ratios differed by as much as 18% between years (Table 3).

The magnitude of differences among years, seasons, and locations indicates that ratios developed for dogwoods at a particular time and place are not reliable for predicting twig and twig plus leaf weights at another time or place. When yields are to be predicted from twig lengths, the ratios should be calculated currently by double-sampling of plants within the population being studied.

Table 2. Ratio of twig weight (g) to twig length (mm) for plants grown in an open field and in the woods at Nacogdoches, Texas.

Time of collection	Open field		Woods	
	Mean	Std. error	Mean	Std. error
Winter				
1967	0.00418	0.00012	0.00103	0.00003
1968	0.00351	0.00012	0.00175	0.00004
Summer				
1967	0.00201	0.00005	0.00132	0.00003
1968	0.00154	0.00003	0.00106	0.00004

Table 3. Ratio of twig plus leaf weight (g) to twig length (mm) for dogwoods at Nacogdoches, Texas.

Year of collection	Open field		Woods	
	Mean	Std. error	Mean	Std. error
1965	0.01208	0.00021	—	—
1966	0.01000	0.00021	—	—
1967	0.01136	0.00019	0.00962	0.00035
1968	0.01220	0.00025	0.00680	0.00018

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