Evaluating stem conducting tissue as an estimator of leaf area in four woody angiosperms¹

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Four woody angiosperm species representing an evergreen tree (*Castanopsis chrysophylla* (Dougl.) A.DC.), a deciduous tree (*Acer macrophyllum* Pursh), an evergreen shrub (*Rhododen-dron macrophyllum* G.Don), and a deciduous shrub (*Acer circinatum* Pursh) were sampled to assess the relation of cross-sectional area of conducting tissue in the stem to leaf area. For the first three species listed, a linear relation between conducting area and leaf area was obtained with r^2 values ranging from 0.89 to 0.96. For *Acer circinatum* the relation only approached linearity with a log transformation of both axes with $r^2 = 0.80$.

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Quatre espèces d'angiospermes ligneuses représentant respectivement un arbre à feuilles persistantes (*Castanopsis chrysophylla* (Dougl.) A.DC.), un arbre à feuilles caduques (*Acer macrophyllum* Pursh), un arbuste à feuilles persistantes (*Rhododendron macrophyllum* G.Don) et un arbuste à feuilles caduques (*Acer circinatum* Pursh) ont été échantillonnés pour examiner la relation entre la surface des tissus conducteurs de la tige en section transversale et la surface foliaire. Dans le cas des trois premières espèces énumérées, il y a une relation linéaire entre la surface foliaire ($r^2 = 0.89$ à 0.96). Cependant chez l'*Acer circinatum* la relation n'approche la linéarité qu'avec une transformation logarithmique des deux axes ($r^2 = 0.80$).

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Introduction

In assessing the rates at which forest ecosystems recover from a disturbance, an accurate estimate of leaf area is essential (Sollins et al. 1974). This is particularly true when angiospermous trees or woody shrubs are present because they can transpire water and assimilate carbon dioxide at high rates (Cline and Campbell 1976; Wareing 1966; Krueger and Ruth 1965). Unfortunately, a suitably accurate means of estimating leaf area of woody angiosperms has not been available. Recent investigations with conifers (Grier and Waring 1974) and earlier studies on Acer pseudoplatanus L. (Dixon 1971) demonstrated that accurate estimates could be obtained from a relation between cross-sectional area of conducting tissue and foliar biomass or surface area. Our hypothesis was that a relation between conducting tissue and leaf area exists for both deciduous and evergreen angiosperms.

Study Area and Methods

An evergreen shrub (Rhododendron macrophyllum G. Don.), a deciduous shrub (Acer circinatum Pursh), and an evergreen tree (Castanopsis chrysophylla (Dougl.) A.DC.), and a deciduous tree (Acer macrophyllum Pursh) were chosen to test the general hypothesis. Sampling was completed in conjunction with other efforts to estimate component biomass of trees (Grier and Logan 1977) and a comparative study of ecosystem leaf areas (Gholz et al. 1976). Field research was conducted in the western Cascade Mountains of Oregon on the H.J. Andrews Experimental Forest, latitude 44° N, longitude 122° W. The forest is dominated by Douglasfir (Pseudotsuga menziesii (Mirb.) Franco var. menziesii), typically with a lower stratum of western hemlock (Tsuga heterophylla (Raf.) Sarg.). Acer circinatum and Rhododendron are common in the understory of most plant communities as well as in open areas created by disturbances (Zobel et al. 1976). Acer macrophyllum grows along streams and beneath gaps in the canopy, but Castanopsis is generally restricted to the open understory of drier habitats (Zobel et al. 1976).

Sample plants of Rhododendron and Acer circinatum

ranged in height from was cut just above to and immediately pl solution of methyl r solution, the plant v the stem was taken cut where the conduleaves were carefully to the laboratory.

The conducting arr was determined by and cutting out the u of the silhouette wa surface-area meter accuracy of $\pm 1\%$.

At least 40 leaves selected randomly. If blade area was dete meter. Leaves and p 24 h and weighed to a conversion factor (blade) was calculated and total leaf area multiplying the weig conversion factor, a petioles.

The Acer macroph from 7.6 cm to 35 cm to 32 m tall. The Cas at breast height and y two species, obvious sapwood and heartw shows that the hear change, does not con (Panshin et al. 1964). on the cut surface alc breast height, permitt of sapwood to be ca petioles were remove phyllum twigs. Fresh 100 g were obtained u Representative subsan the nearest 1.0 g, then placed in cold storag termined within 4 da computed from ratios field leaf weights. On all leaves were taken f

For *Castanopsis*, the clipped from individual into current and older separated into current foliage, and older twig computed for each su total weight of foliage

Surface-area-to-weig were made from sub diameter cut from lea were oven-dried at 70° as a total of both sur described in more deta

The two trees A

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