

Fall 1971

Productivity of an urban park

Mary Herte

University of Wisconsin-Milwaukee

Nic Kobriger

University of Wisconsin-Milwaukee

Forest Stearns

University of Wisconsin-Milwaukee

Follow this and additional works at: https://dc.uwm.edu/fieldstation_bulletins



Part of the [Forest Biology Commons](#), and the [Zoology Commons](#)

Recommended Citation

Herte, M., N. Kobriger and F. Stearns. 1971. Productivity of an urban park. Field Station Bulletin 4(2): 14-18.

This Article is brought to you for free and open access by UWM Digital Commons. It has been accepted for inclusion in Field Station Bulletins by an authorized administrator of UWM Digital Commons. For more information, please contact open-access@uwm.edu.

PRODUCTIVITY OF AN URBAN PARK

Vegetation serves many needs; it provides shade, shelter, food and beauty. Vast quantities of water pass through roots and leaves into the atmosphere. Innumerable sound waves are reflected from massed vegetation and are damped and quieted while quantities of airborne effluvia are absorbed or adhere to the surfaces of leaves and stems.

Basic to all plant processes is the ability of the green cell to trap a fraction of the daily flow of solar energy and to lock it in organic form for future use and release. An acre of corn may produce 100 bushels of grain (average yield in Wisconsin 93 bu.) in addition to greater weights of leaves, stems, roots, and cobs. The 2.8 tons of grain alone represent almost 13 million Kcal. of energy. Likewise, each year an acre of oak forest may produce a cord or more of usable bole wood (1.5 to 2 tons) plus several times as much material in branches, roots, twigs and leaves. Expressed in metric units, the total production of the oak trees may be 4 or 5 metric tons (M.T. = 1.1 U.S. tons) per hectare (ha = 2.47 acres) while a field of corn may synthesize 13 M.T./ha. in a four month season. The magnitude of these values indicates the scale of photosynthetic activity and implies the rates at which water and minerals are utilized.

We have moderately good knowledge of the yields of crops and of commercial forest land. In contrast, little is known of the productivity of urban park areas. Parks are neither grassland nor forest—in structure they most closely resemble savanna, i.e., grassland spotted with trees bearing large crowns. How much energy is trapped by these communities? How much oxygen is liberated? What are the water requirements and recharge potentials of such areas? How can vegetation be best managed to promote the aesthetic and recreational needs of the urban citizen—and at the same time maintain its vital function as a living filter?

To begin examining these questions, we studied the productivity of an open portion of the Downer Woods located on The University of Wisconsin—Milwaukee campus. A plot of one half hectare (approximately 1.2 acre) was chosen in the northeast corner of the woods. The area was bounded by shrubs and a parking lot on the west and by a chain link fence along Downer Avenue on the east. The north and south edges of the plot lay within the “park” type. The vegetation consisted of an open stand of large oaks with scattered smaller hawthorns, clumps of several shrub species and a weedy lawn (Tables 1 and 2). Productivity was estimated separately for each stratum of the vegetation. Diameters were measured for all trees and heights were estimated. Tree productivity was calculated with the aid of regression equations developed for twig and branch production (Whittaker, Cohen and Olson, 1963). The regression equations estimate annual growth of various tree components based on easily measured dimensions. Time was not available for more precise methods involving individual determination of radial growth. The production values calculated for trees appear somewhat conservative, but fall within the range of published data for similar stands.

Table 1.

Composition and structural characteristics of tree strata in the Downer Woods parkland.

Species	Number of stems	Mean stem diameter (cm)	Mean height (m)	Total net annual production (Kg)
<i>Quercus alba</i> ^(a)				
White oak				
Over 60 cm diameter	8	69	23.2	540.43
45 to 60 cm	12	55	20.4	788.38
30 to 45 cm	2	37	17.5	72.48
<i>Ulmus americana</i>				
American elm	1	36	15.2	36.07
<i>Fraxinus nigra</i>				
Black ash	1	28	15.2	25.65
<i>Fraxinus americana</i>				
White ash	5 ^b	25	15.2	121.39
<i>Pinus resinosa</i>				
Red pine	1	19	6.1	21.16
<i>Acer negundo</i>				
Box elder	1	17	9.1	6.86
<i>Crataegus spp.</i>				
Scarlet haw	40 ^c	10	7.1	212.05
Cockspur haw	21 ^d	9	6.5	98.27

a) Includes *Q. Schuettii*, a white oak hybrid, 2 stems over 60cm diameter, one stem 50cm and one 39cm.

b) Five stems of single individual.

c) Nine clumps of 40 stems total.

d) Four clumps of 21 stems total.

In each case, 25 percent of the above ground production was added to represent the increase in biomass of main roots and the replacement of feeder roots. The net annual increase in biomass was assumed to represent the amount of primary production and no attempt was made to estimate losses from respiration or insect consumption.

Height and average crown diameter were measured for each clump of shrubs. Net annual production of large-leaved shrubs was estimated from these measurements by means of a regression equation developed for beaked hazel (Peck, 1970). Production for the smaller-leaved bridal wreath (*Spiraea Van-Houttei*) was based on the results of sampling elsewhere on the UWM campus.

Table 2.

Composition and structure of the shrub stratum in the Downer Woods parkland.

Shrub species	Number of plants	Average plant height (in meters)	Average crown area (m ²)	Total net annual production (kg)
<i>Lonicera tatarica</i> (Honeysuckle)	5	3.11	16.28	29.9
<i>Physocarpus opulifolius</i> (Common ninebark)	4	1.87	1.11	0.90
<i>Cornus racemosa</i> (Dogwood)	5	1.86	0.87	0.97
<i>Syringa vulgaris</i> (Lilac)	1	3.96	3.57	0.60
<i>Spiraea Van-Houttei</i> (Bridal Wreath)	4	1.45	0.15	0.19
Unidentified	2	1.14	5.44	1.08

An open weedy lawn covered most of the ground surface. The area of bare ground under shrub clumps and the total basal area of all trees was subtracted from the area before production was calculated. Measurements made by the senior author on a similar lawn near the west edge of the Downer Woods were used to estimate lawn production. A value equal to 25 percent of the above ground production was added for root production.

Estimated production for the 0.5 hectare plot was 3.12 M.T. metric tons (dry weight) or 6.24 M.T./ha. Production is itemized by vegetation stratum in the tabulation below:

Stratum	Production (Metric Tons) 0.5 hectare plot
Lawn	1.16
Shrubs	0.03
Hawthorn (small trees)	0.31
Oaks (large trees)	1.62
Total	3.12

Tree crowns covered approximately 50 percent of the area. We assume that, with complete crown cover, production of the large and small tree strata might reach or exceed 8 M.T./ha. This is a relatively high value when compared with estimates for oak stands in Wisconsin but it is within the range of production reported for oak and other deciduous forest stands elsewhere (Ovington, Heitkamp and Lawrence 1963; Whittaker and Woodwell 1969). Average net annual production for the tree stratum of oak forests in southeastern Wisconsin is conservatively estimated to approach 2.5 M.T./ha. (Stearns, Kobriger, Cottam and Howell, 1971). However, many Wisconsin oak forests are ragged, partly open stands growing on relatively poor sites. Productivity of other Wisconsin forest types appears to be considerably greater.

Shrubs comprised a relatively small portion of this stand. Thus, despite good production per stem, total production was low. Under other types of management a much more abundant shrub layer could be developed and total production might be increased by several tons. A vigorous shrub community, arranged in a patchy distribution, would have considerable value in reducing wind speed and decreasing transmission of sound.

The estimate of lawn production, under the conditions imposed by the open tree canopy and infrequent mowing, appears reasonable. Despite the long summer drought in 1971 production was 2.32 M.T./ha. Grasses developed as crops, fertilized and undisturbed by mowing or soil compaction, are capable of much higher rates of production. Yields of timothy-clover hay in Wisconsin range from 4 to 8 M.T./ha. Where a grass sod is of particular importance, i.e., in areas of moderate or heavy recreational use, careful attention should be given to soil conditions to reduce compaction. Frequency of mowing, fertilization and other treatments should be regulated to maintain a vigorous stand with a strong root system. Light is adequate under the open forest canopy.

Our calculations suggest that the savanna-like city park should not be neglected in considerations of productivity. Although the direct result of such production is rarely if ever measured in cords of wood or bales of hay, the values that accrue are important to the city dweller. Large areas of leaf surface provide opportunity for gas exchange, removal (on a local scale) of certain gases such as SO_2 and the release of oxygen. The weight of oxygen liberated to the air by plants is approximately equivalent to the amount of photosynthate stored. Thus the Downer Woods releases over 6 M.T./ha of oxygen every year.

Particulate material is screened out of the air because such material sticks to the leaves and because wind speed is reduced thus permitting particle fallout.

Noise transmission likewise is influenced by density and distribution of vegetation, and appreciable noise reduction can be obtained using trees and shrubs (Cook and Van Haverbeke, 1971). Similarly, healthy vegetation diminishes

soil erosion and increases infiltration of water into the soil. Finally, masses of green or colored foliage have recognized aesthetic and psychological effects. There is little question of the importance of urban vegetation but much remains to be done to quantify productivity and develop management concepts to maximize the usefulness of parks and plantings.

LITERATURE CITED

- Cook, David I., and David F. Van Haverbeke. 1971. Trees and shrubs for noise abatement. *U.S. Forest Service and Univ. of Nebraska Agr. Exp. Sta. Research Bull.* 246. 77 pp.
- Ovington, J. D., Dale Heitkamp and Donald B. Lawrence. 1963. Plant biomes and productivity of prairie, savanna, oakwood and maize field ecosystems in central Minnesota. *Ecology* 44:52-63.
- Peek, James M. 1970. Relation of canopy area and volume to production of three woody species. *Ecology* 51:1098-1101.
- Stearns, F., Nic Kobriger, Grant Cottam and Evelyn Howell. 1971. Productivity profile of Wisconsin. *IBP Deciduous Forest Biome Memo Report #71-14.* 35pp.
- Whittaker, R. H., Neil Cohen and Jerry S. Olson. 1963. Net production relations of three tree species at Oak Ridge, Tennessee. *Ecology* 44:806-810.
- Whittaker, R. H. and G. M. Woodwell. 1969. Structure production and diversity of the oak-pine forest at Brookhaven, N.Y. *J. Ecology* 57:155-174.

Mary Herte
 Nic Kobriger
 Forest Stearns
Department of Botany
The University of Wisconsin—Milwaukee