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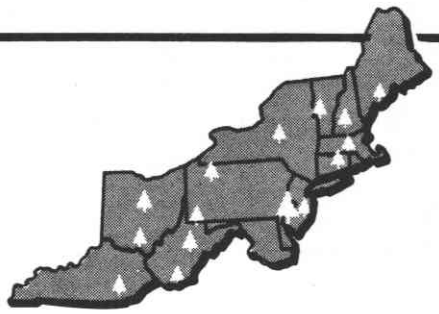

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TRAIL DETERIORATION AS AN INDICATOR OF TRAIL USE IN AN URBAN FOREST RECREATION AREA

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Abstract. The average width of a trail was used to predict trail use in an urban forest recreation area. Results show that width indicates use only very generally at best. Consequently, simply inspecting the physical condition of a trail may lead to erroneous conclusions about its use. Managers requiring more than a simple light use/heavy use classification should adopt more elaborate schemes to determine use levels.

Managers of recreation areas are often faced with the difficult job of making decisions about the carrying capacity of an area. As a concept, carrying capacity is multifaceted—a final decision reflects many factors. Among the most important are total use and use distribution; it is essential to know what use a particular trail or site is receiving before one decides what use level is optimal.

Total use can be estimated in a variety of ways. Observers can be used to simply count the number of visitors, or there are a number of ingenious devices available to accomplish this mechanically. Over the years, however, perhaps the most common method of determining the amount of use a trail or site receives has been the simple visual inspection of physical condition. Physical condition is assumed to be directly correlated with use—the greater the use, the more physically deteriorated a site is liable to be.

Conversely, so the reasoning goes, we should be able to estimate use levels from physical condition. For trails, use should be reflected in the width of a trail—heavily used trails should be wider than lightly used ones due to greater trampling of vegetation.

Yet just how reliable is physical condition as an indicator of use? Several studies have examined this relationship explicitly. In Montana, Dale and Weaver (1974) found that trail width increases linearly with logarithmic increases in the number of users; that is, widths approximately doubled with a tenfold increase in the number of users between 1,000 and 10,000. Helgath (1975) found trail use in the Selway-Bitteroot Wilderness to be less consistently related to trail deterioration (including both width and depth of erosion) than expected. Weaver and Dale (1978) found trail width varied with type of use; it was greatest on horse trails, moderate on motorcycle trails, and lowest on trails used only by hikers. In this paper, I examine the width/use relationship for a system of trails in a day-use, urban forest recreation facility.

METHODS

To assess the relationship between use and trail width, 27 pressure-plate trail traffic counters (Leonard et al. 1979) were buried in trails at Pleasant Valley Wildlife Sanctuary, a day-use urban forest area operated by the Massachusetts Audubon Society in Lenox, Massachusetts. This 650-acre area offers 7.5 miles of interconnected trails covering a variety of terrain and vegetative types common to eastern hardwood forests. The area was opened in 1929 and the trail system is well established. The trails consist of footpaths through the woods; they have not been widened or surfaced artificially. Hiking is the only form of use permitted.

Trail use was monitored with the counters from July 1, 1976, to October 31, 1976. The counters consist of mat switches buried in the trail. Each time a person steps on the switch, a connection is formed, tripping a counter buried along the side of the trail. The total number of users of each trail during this period was entered in the analysis.

Trail width data were obtained at the end of August, 1976. Bayfield (1973) noted that three trampling zones usually can be identified along trail corridors: bare ground, heavy trampling, and light trampling. In this study, width was considered the length of bare ground only. Width was measured at 100-foot intervals with a steel tape. For each trail or segment of trail on which a counter was located, the width measurements were averaged to obtain an overall mean width for use in the analysis.

The data were analyzed using simple linear regression to predict use (Y) from width (X), and one-way analysis of variance.

RESULTS AND DISCUSSION

As in many recreation areas, the use of these trails was unevenly distributed, ranging from a high of 4,777 users to a low of 64. Mean trail widths also varied widely, ranging from more than 7.6 feet to less than 1.8 feet (Table 1). As might be expected, the

Table 1.—Trail conditions and use at Pleasant Valley Wildlife Sanctuary

Variable	N	Minimum value	Maximum value	Range	Mean	Standard deviation
Number of users on each trail	27	64	4777	4713	1352	1339.2
Mean trail width	27	1.76	7.68	5.9	3.8	1.6

regression analysis indicated a significant positive relationship between use and width ($p < 0.001$, $r^2 = 0.28$)—as the mean trail width increases, so does trail use (Fig. 1), though this does not imply a causal relationship.

From a predictive standpoint, however, the relationship is none too strong, with mean trail width accounting for only 28 percent of the variance in use. The actual equation for predicting the use of a trail from its average width is:

Number of users of trail i =
-292 + 437 (mean width of trail i)

The standard error of regression ($s_{y \cdot x}$) is 1158 users. Thus, estimates of trail use from trail width are likely to be very imprecise.

Part of the reason for this imprecision seems to be the greater variability in the use that the wider trails receive. It may be, for instance, that as increasing numbers of people use a trail, it begins to widen. At some point, however, the trail is sufficiently wide to accommodate additional users with no further change. To test this, I divided total range of use into thirds and compared the mean widths of high, moderate, and lightly used trails using a one-way analysis of variance (Tables 2 and 3). The results indicated that the moderately used trails were significantly wider than lightly used trails ($p < 0.001$), but there was virtually no difference in width between moderate and heavily used trails. This tends to confirm the hypothesis that width is a good indicator of trail use only very generally at best.

Figure 1.—Relationship between trail width and number of users.

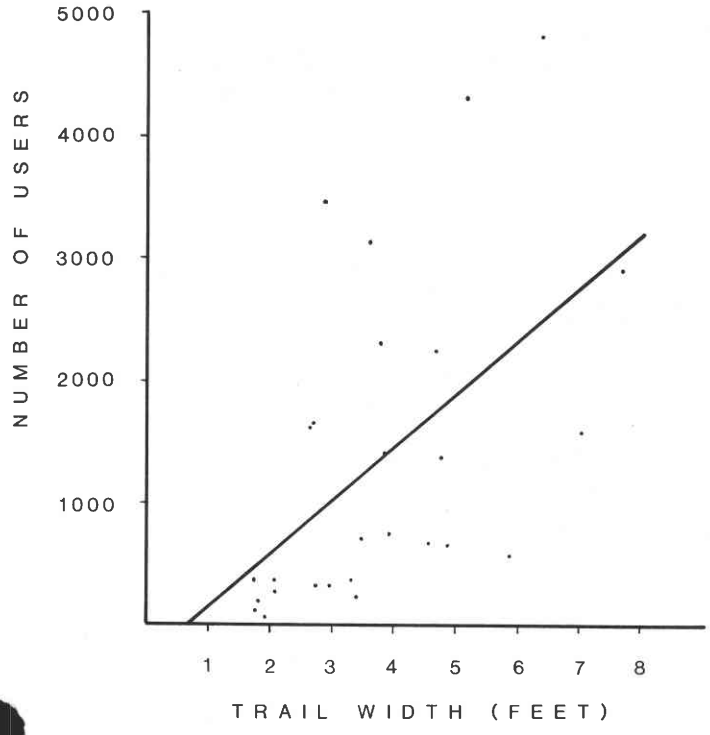

Table 2.—A comparison of mean widths for light, moderate, and heavy use trails

Use category	N	Mean Width
light (64 to 1635 users)	10	2.4
moderate (1636 to 3207 users)	7	4.5**
heavy (3208 to 4777 users)	10	4.6
All categories	27	3.8

**The difference in width between light and moderate use trails is significant ($p < 0.001$). The difference in width between moderate and heavy use trails is not significant.

Actually, the width of a trail is influenced by a number of site factors other than use. Slope, for instance, is positively related to width (Helgath 1975, Weaver and Dale 1978) because hikers may wander across a trail in search of footing, or may zigzag during descents to slow down. Slope may also interact with soil type to influence the roughness of the trail tread because of erosion, prompting hikers to form a new trail alongside the original. Wetness, too, makes a difference as hikers spread out to avoid muddy conditions (Bayfield 1973). In general, it may be that a well-located trail receiving heavy use may actually show less wear than a poorly located trail receiving light or moderate use.

Table 3.—Analysis of variance table for mean trail widths under different levels of use.

Source	Sum of squares	Degrees of freedom	Mean squares	F	P
Treatment	29.942	2	14.971	9.270	0.001
Error	38.759	24	1.615		
Total	68.701	26			

How good, then, is trail width as an indicator of trail use? More generally, how possible is it to make judgments about the amount of use a site receives from simply examining the physical condition? The answer is mixed and depends on management objectives and the information needed to fulfill them. For example, if only very general information is required, a simple visual inspection of physical conditions might well be sufficient to divide trails or sites into categories of light and heavy use. This is especially true for trails and sites at the extreme ends of the range; one will probably make some mistakes classifying those in the middle of the range. Where more detailed information is needed, managers should adopt one of the more elaborate methods of measuring use mentioned previously. The persistent belief that one can make fine judgments about use on the basis of casual nonsystematic observation may lead to incorrect conclusions.

LITERATURE CITED

Bayfield, N.G.
1973. Use and deterioration of some Scottish hill paths. J. Appl. Ecol. 10:635-644.

Dale, D. and T. Weaver.
1974. Trampling effects on vegetation of the trail corridors of North Rocky Mountain forests. J. Appl. Ecol. 11:767-772.

Helgath, S.F.
1975. Trail deterioration in the Selway-Bitterroot Wilderness. USDA For. Serv. Res. Note INT-193. 15 p.

Leonard, R.E., H.E. Echelberger, H.J. Plumley, and L.W. VanMeter.
1979. Management guidelines for monitoring use on backcountry trails. For. Serv. Res. Note NE-286. 48 p.

Weaver, T., and D. Dale.
1978. Trampling effects of hikers, motorcycles and horses in meadows and forests. J. Appl. Ecol. 15:451-457.

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