A Refinement of Rice and Plog's Method of Estimating Areas Sampled by Trenches

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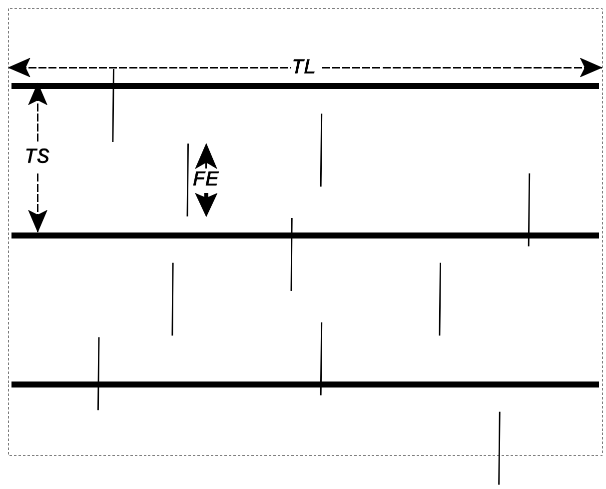
Rice and Plog present a persuasive argument for the use of mechanical trenching as a sampling strategy for the identification of features that have little or n surface visibility. I suggest a refinement of their argument and formulae for the estimated sampled area (*ESA*) that allows for the explicit treatment of a broader class of problems.

Rice and Plog rather vaguely use the terms "feature width" and "average feature dimension" in deriving their formulae. However, the attribute of feature size that is significant from the standpoint of figuring a sampling fraction for a trenching strategy is the *average length of the perpendicular exposure of a class of features to the trenches* (see Figure). This can be most easily seen by looking at a simplified model in which a set of evenly-spaced parallel trenches (of negligible width) overlay a set of features idealized as lines representing their perpendicular exposures. If trenches are 10m apart, and the features have an average exposure of 5m perpendicular to the trenches, then, on the average, 50% of the features will be located by the trenches. If the average feature exposure was 2m, the sample fraction drops to 20%.



It turns out that if the features are randomly located, in general, a trench of negligible width samples a strip of width *FE*, where *FE* is the average length of a perpendicular exposure of a class of features to the trench. Assuming the trench spacing (*TS)* is greater than the feature exposure, if only one side of a trench of length *TL* is profiled and evaluated, for estimation purposes, the trench may be assumed to have negligible width and the estimated sample area, *ESA*, is:

1. $ESA_{FE} = FE \times TL$ (analogous to Rice and Plog's equation 1).

If both sides of the trench are profiled (and $FE >> TW$) then a trench of width, *TW*, samples an area:

2. $ESA_{FE} = (FE+TW) \times TL$ (analogous to Rice and Plog's equation 3).

The sample fraction p_{FE} for a given feature exposure dimension is simply the total area sampled (*TA*, including overlapping sampled areas only once) divided by the estimated sample area.

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3. $p_{FE}=ESA_{FE} / TA$

The key point here is that the sample fraction is not a constant but is a function of the feature exposure. The estimated number of features can be obtained by dividing the number of features located of a particular size (exposure) class by the sample fraction for that size class of features.

Thus in the examples of trenches spaced 10m apart the sample fractions for 5m- and 2m-exposure features (e.g., pithouses and pits) are .5 and .2. If we locate 5 of the 5m features in trenches then the estimated number of features of that size class is 5/.5=10. If we locate 5 of the 2m exposure features then the estimated number in the sampled area is 5/.2=25.

The advantage of this statement over Rice and Plog's formulae is that it allows us to deal explicitly with other than circular features. The formulae given by Rice and Plog are only correct where the "width" is of an "ideal," i.e. circular, feature. They do not state how they obtained feature widths for non-circular features, notably pithouses.

Clearly, the length of the perpendicular exposure of a circular feature is simply its diameter. For randomly oriented rectangular features the length of the perpendicular exposure is not so obvious, but it is obtained by averaging the perpendicular exposure of a feature as it is rotated around a circle. For a rectangular feature of length *FL*, and width *FW*, the average perpendicular exposure is:

$$4.\ FE = 2(FW + FL) / \pi = \frac{2}{\pi}\int_0^{\pi/2}(FL\sin\theta + FW\cos\theta)\partial\theta$$

By way of application, it is probably preferable to assume that pithouses are rectangular rather than circular. At Snaketown, the mean house width is 3.7m and the mean length is 6.2m (81 19). Substituting in equation 3 (i.e., assuming the pithouses are rectangular), we get an average exposure of 6.3m, which, it may be noted, is longer than the average pithouse length (this effect is exaggerated the more nearly square a feature becomes).

Once the key concept of perpendicular exposure is accepted, it is possible to deal with arbitrary shapes and orientations of features. For simple shapes with random orientations, calculus will provide a solution to the problem of determining the average perpendicular exposure. For more complex shapes and when orientations are non-random, simple computer modeling may be required (see Abbott 1985). For example, we know that Hohokam pithouses are not randomly oriented, but at least in some cases show systematic orientations (Wilcox 1981).

References Cited

Abbott, David. 1985. Unbiased Estimates of Feature Frequencies with Computer Simulation. *American Archaeology* 5(1): 4-11.

Wilcox, David R., Thomas R. McGuire, and Charles Sternberg. 1981. *Snaketown Revisited: A Partial Cultural Resource Survey, Analysis of Site Structure and an Ethnohistorical Study of the Proposed Hohokam-Pima National Monument*, Arizona State Museum, Archaeological *Series* No. 155.