MAIL SURVEYS OF HUNTING - PRECISION AND SAMPLE SIZE

by

David W. Turner
Institute of Statistics, North Carolina State University
Raleigh, North Carolina

ABSTRACT

Several Southeastern states using mail surveys currently apply an estimation procedure to adjust for non-response bias. Efficient planning of these surveys requires an idea of the precision obtainable for a specified number of questionnaires mailed, *i.e.* an idea of the sample size required. This paper graphically describes the empirical relation between sample size and relative precision of estimates of hunters, effort, and harvest for three game species, deer, turkey and dove. The data were selected from records on hand from six states and over the period from 1964-1969.

INTRODUCTION

The increasing need for reliable information on hunter activity and success has led many states to implement mail surveys. This is an empirical presentation of the observed relation of precision to sample size for an estimation procedure employed by the Southeastern Cooperative Fish and Game Statistics Project in working with a number of states of the Southeast. The procedure was originally devised by W. Scott Overton when employed by Florida, and later it was described in a report by Chapman, Overton and Finkner (1959). Abramson (1963) published an approximation of the method in a more formal way and a brief summary was presented by Legler and Hayne (1967). It is hoped that the experience described here will aid in planning future surveys by indicating the approximate range of precision which may be expected for a given sample size.

MATERIALS AND METHODS

Data used in this paper were obtained from Project files for various state mail surveys over the period from 1964-1969. Each file contained estimates, by license type or geographical stratum within license type, of number of hunters, effort and harvest along with their estimated variances. Estimates based on combined license types or strata were included where available. The data were derived from the files of six states (Alabama, Georgia, Florida, Maryland, South Carolina and Virginia). All surveys represented involved an original mailing and two follow-up mailings to licensees who did not respond.

Three species were selected to allow comparisons of broad scope. That is, deer was chosen to represent a species taken in moderately large numbers, dove to represent a species taken in large numbers and turkey to represent a species taken rarely. Proportional standard error, the standard error of the estimate as a proportion of the estimate, was chosen as the measure of precision for comparison. Note that low precision is represented by a high proportional standard error.

The relation between proportional standard error and sample size, ignoring the finite population correction factor, can be theoretically described as

$$s_{\bar{x}}/\bar{x} = (s/\bar{x})(1/n^{1/2})$$

where $s_{\bar{x}}$ = standard error of the mean estimate
$\bar{x}$ = mean estimate
s = standard deviation of the responses
n = effective sample size, *i. e.* number of questionnaires received by licensees

For convenience this function can be made linear by a logarithmic transformation with the result that

$$\log (s_{\bar{x}}/\bar{x}) = \log (s/\bar{x}) - \tfrac{1}{2} \log n.$$

The relation in this linear form has a slope of -.5 and an intercept which is the logarithm of the coefficient of variation for sample size of one. A linear regression was fitted by least squares to logarithms of the proportional standard error ($s_{\bar{x}}/\bar{x}$) against logarithms of sample size (n) for hunters, effort and harvest of each of the three species. These regression lines were then graphically displayed along with the logarithms of the observed values.

RESULTS

The observed proportional standard errors of hunters, effort and harvest plotted against their sample size on log-log paper appear for deer in Figures 1-3, dove in Figures 4-6 and turkey in Figures 7-9, respectively. All graphs indicate considerable dispersion of the observed points but the expected trend of lower proportional standard error with increasing sample size is clear. The slope of the linear relation is a measure of the rate of decrease in proportional standard error per unit increase in sample size. The slopes for hunters, effort and harvest estimates range between -.43 and -.52 for deer and dove and between -.27 and -.46 for turkey. For all three species the slope is greatest for hunters and least for harvest with the slope for effort intermediate (Table 1).

DISCUSSION

The large dispersion of the proportional standard errors might have been expected since the data represents six states over a six-year period. No obvious difference in the relation of proportional standard error and sample size is evident between deer and dove but the propotional standard error for turkey does appear to decrease at a lower rate per unit increase in sample size than is the case for either deer or dove. This may be due to a characteristic of sampling rare items, which requires that very large sample sizes be used to obtain reasonably good precision when the item occurs rarely in the population sampled (Hansen, Hurwitz and Madow, 1953). A turkey hunter is generally a rare item in a population of hunters for a state.

The graphed regression lines should yield a quick approximation to the precision to be expected for a given sample size. Although only three species were examined, other species of interest could be expected to fall somewhere between the values for turkey and either deer or dove. It might also be expected that the number of hunters and their effort will be estimated with greater precision for the same sample size than will harvest.

SUMMARY

1. A graphical presentation of the empirical relation between precision and sample size of estimates of hunters, effort and harvest for three species, deer, turkey and dove, is discussed.

2. The empirical relation of proportional standard error and sample size in turkeys is different from that of deer and dove. This is attributed to the fact that turkey hunters occur rarely in the populations usually sampled.
3. Use of these graphs to approximate the sample size required for a specified precision is suggested.

REFERENCES

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Hansen, M. H., W. N. Hurwitz and W. G. Madow. 1953. Sample Survey Methods and Theory. Wiley and Sons, New York, 638 p.

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TABLE 1

Statistical constants describing the relation between logarithm of proportional standard error $(s_{\bar{x}}/\bar{x})$ and logarithm of sample size (n)

Species	Item	Number of Observations	Slope	Intercept log units	Intercept as coefficient of variation
Deer	Hunters	108	-.517	.297	1.982
Deer	Effort	105	-.434	.296	1.977
Deer	Harvest	106	-.436	.554	3.581
Dove	Hunters	57	-.502	.431	2.698
Dove	Effort	57	-.484	.617	4.140
Dove	Harvest	57	-.406	.392	2.466
Turkey	Hunters	64	-.453	.469	2.944
Turkey	Effort	64	-.382	.426	2.667
Turkey	Harvest	60	-.277	.372	2.355

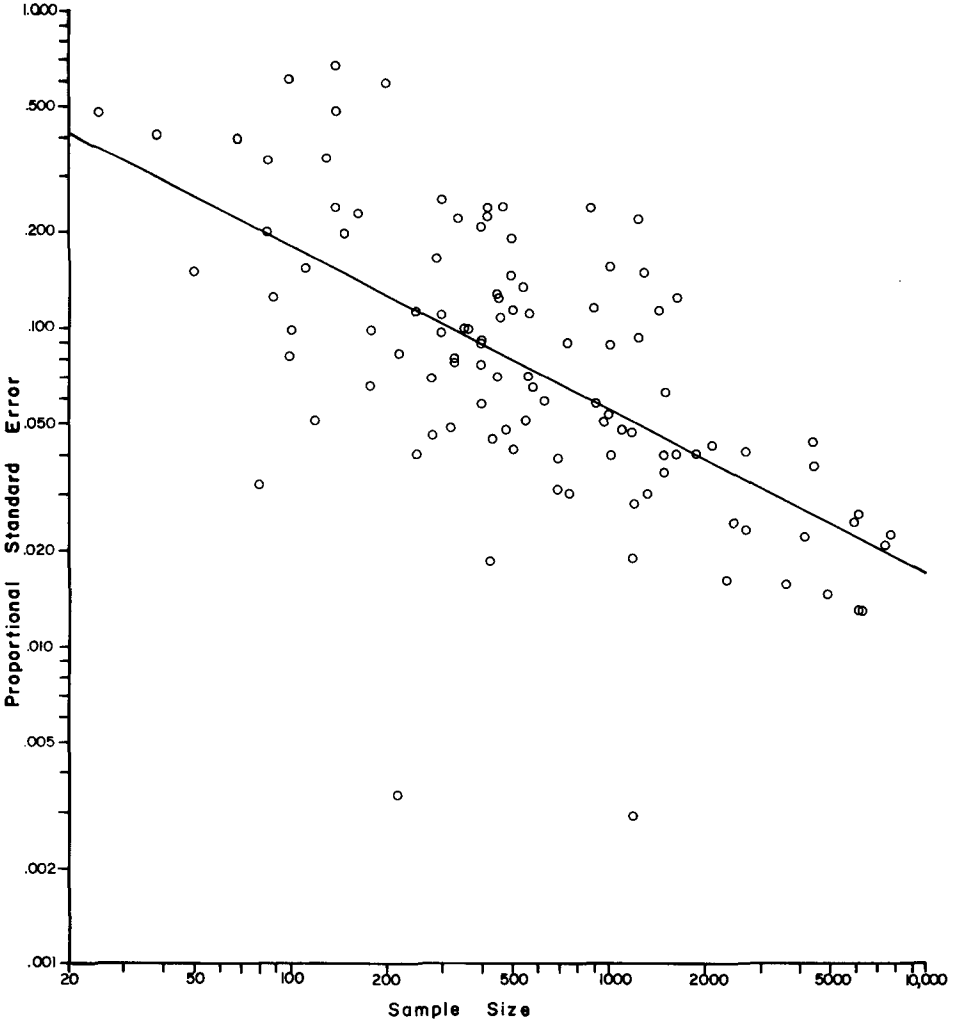

FIGURE 1. Proportional standard errors of estimated number of deer hunters as a function of sample size.

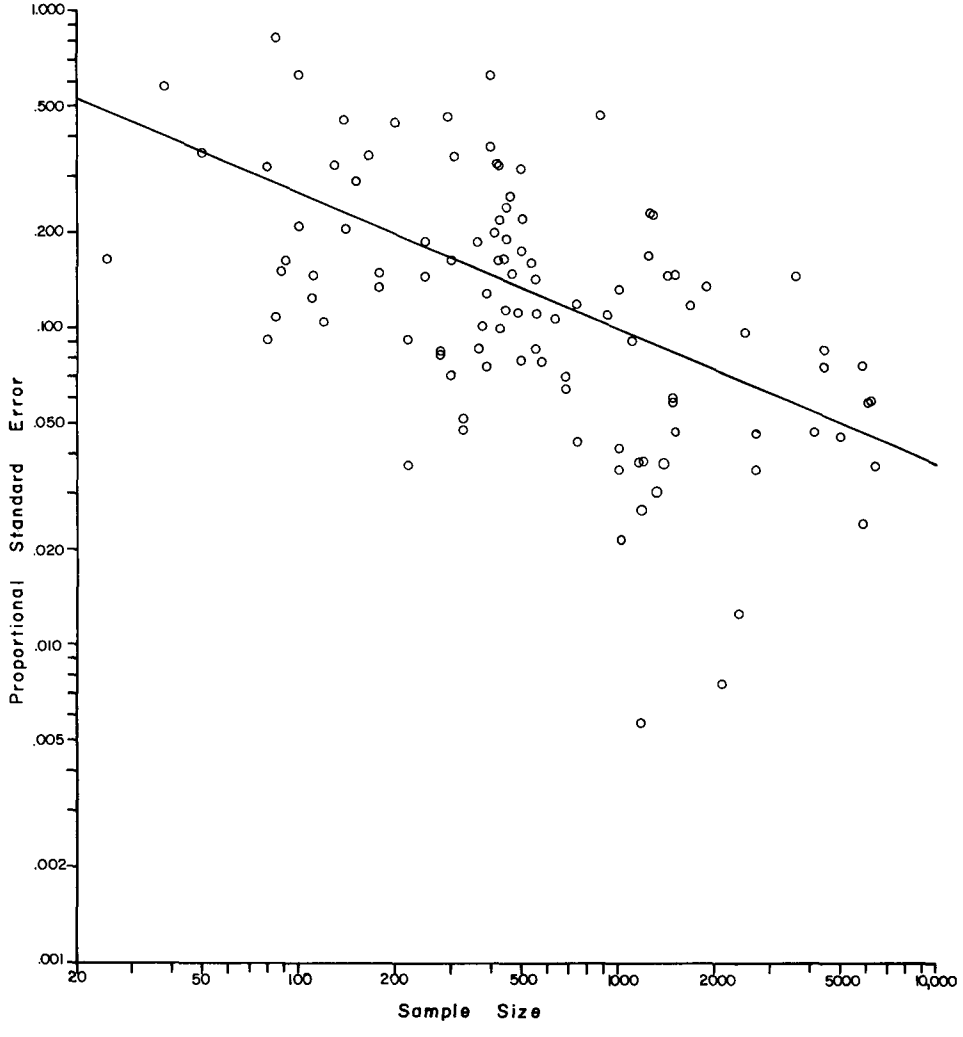

FIGURE 2. Proportional standard errors of estimated effort of deer hunters as a function of sample size.

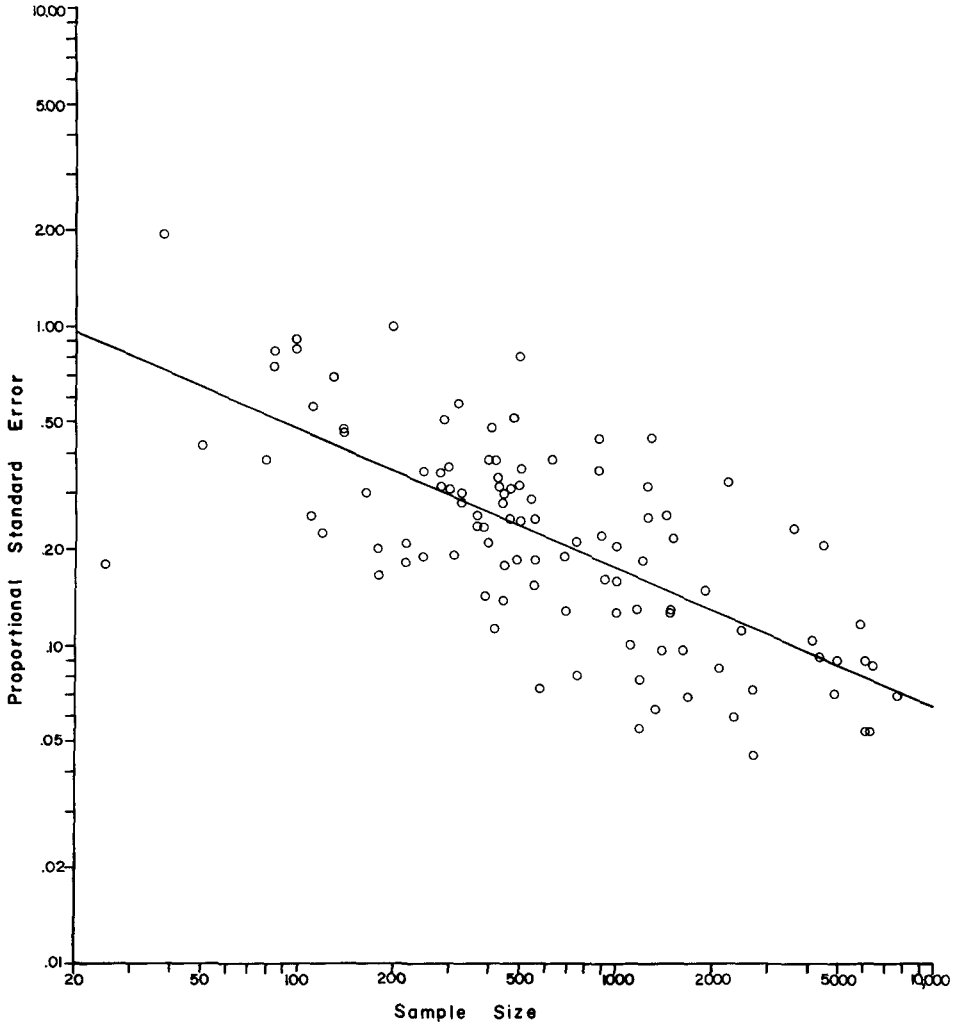

FIGURE 3. Proportional standard errors of estimated harvest of deer hunters as a function of sample size.

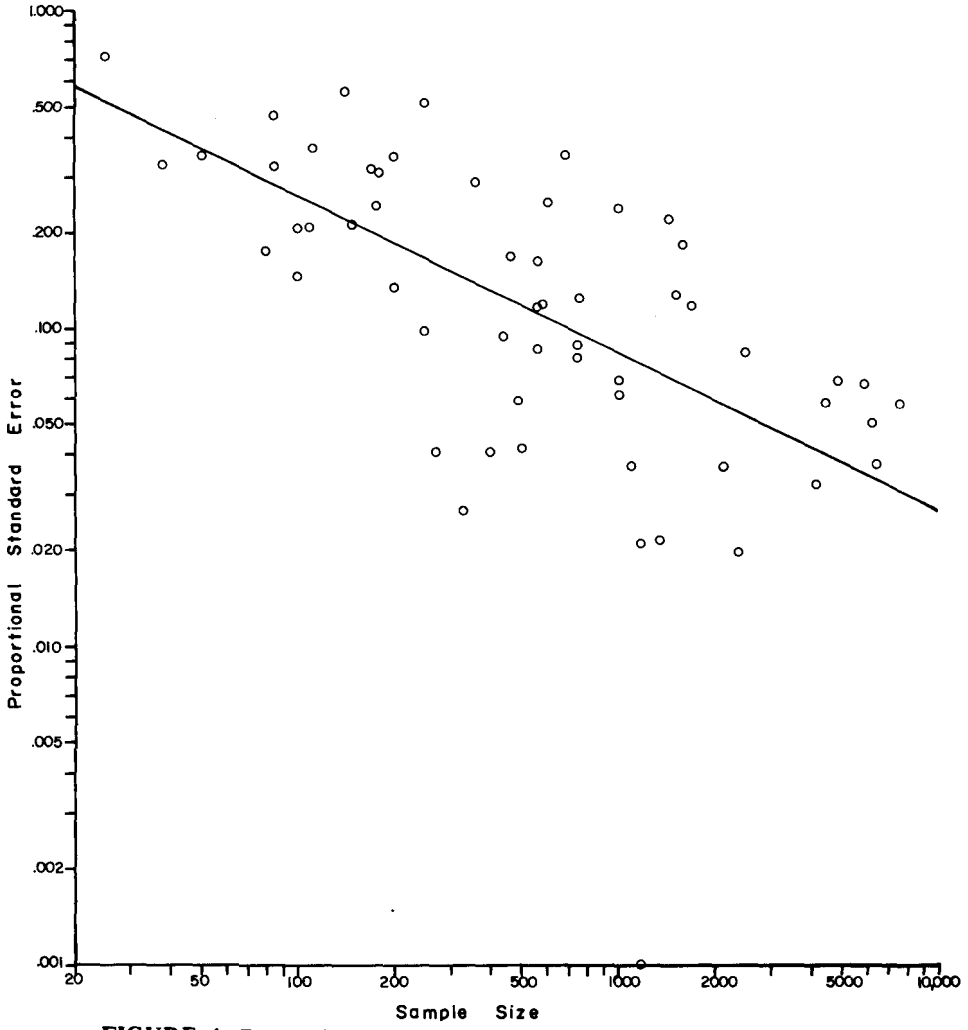

FIGURE 4. Proportional standard errors of estimated number of dove hunters as a function of sample size.

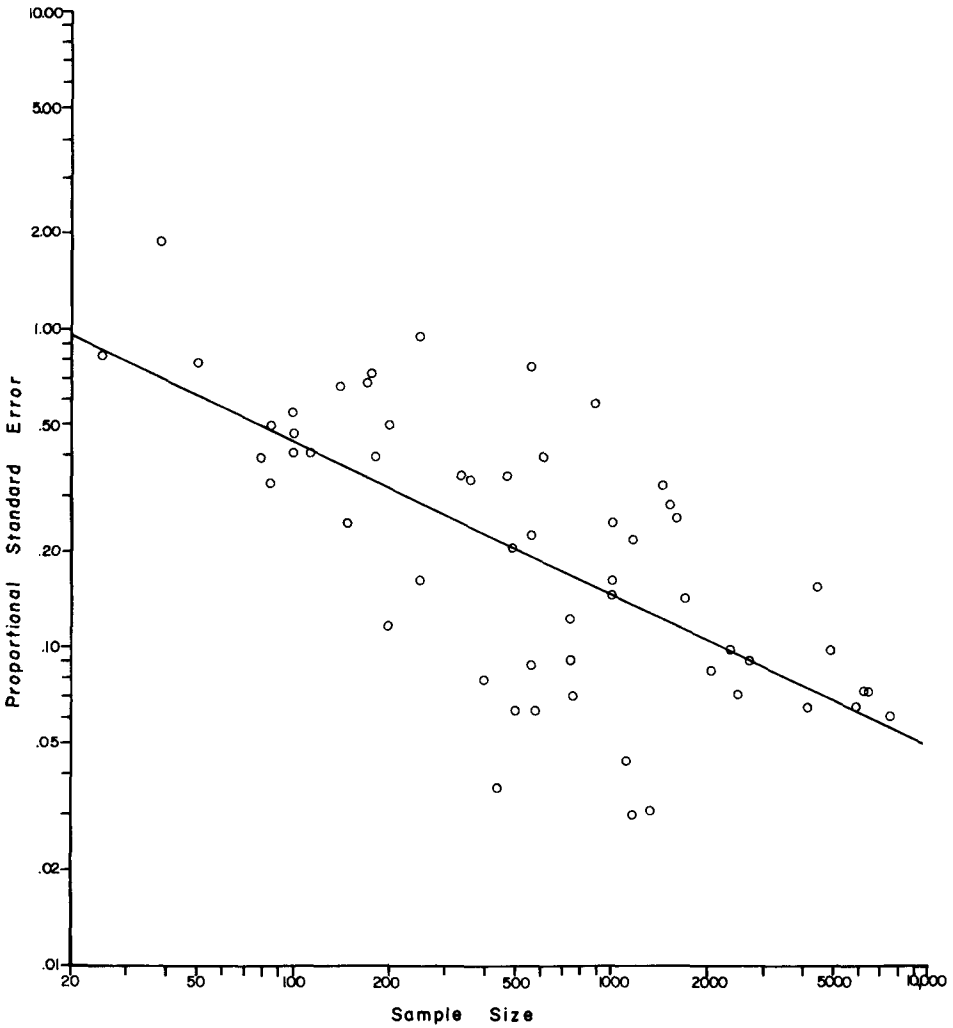

FIGURE 5. Proportional standard errors of estimated effort of dove hunters as a function of sample size.

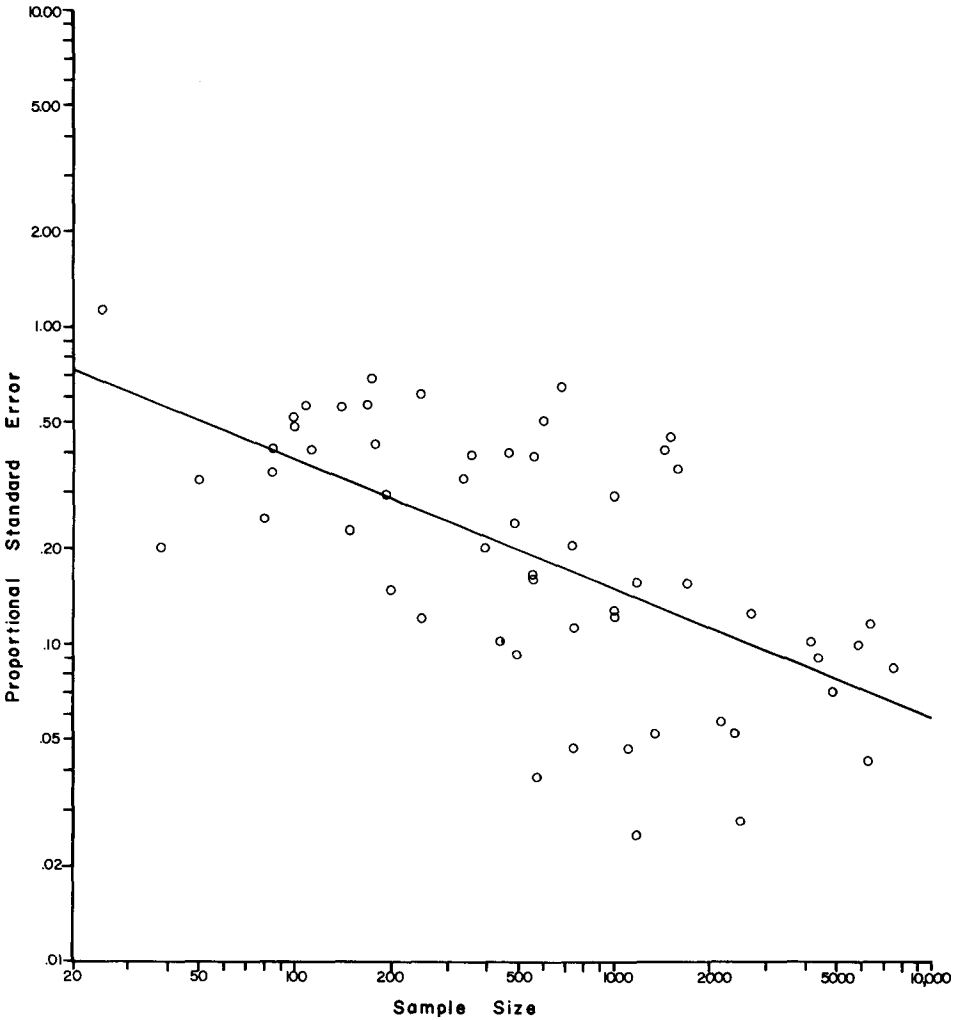

FIGURE 6. Proportional standard errors of estimated harvest of dove hunters as a function of sample size.

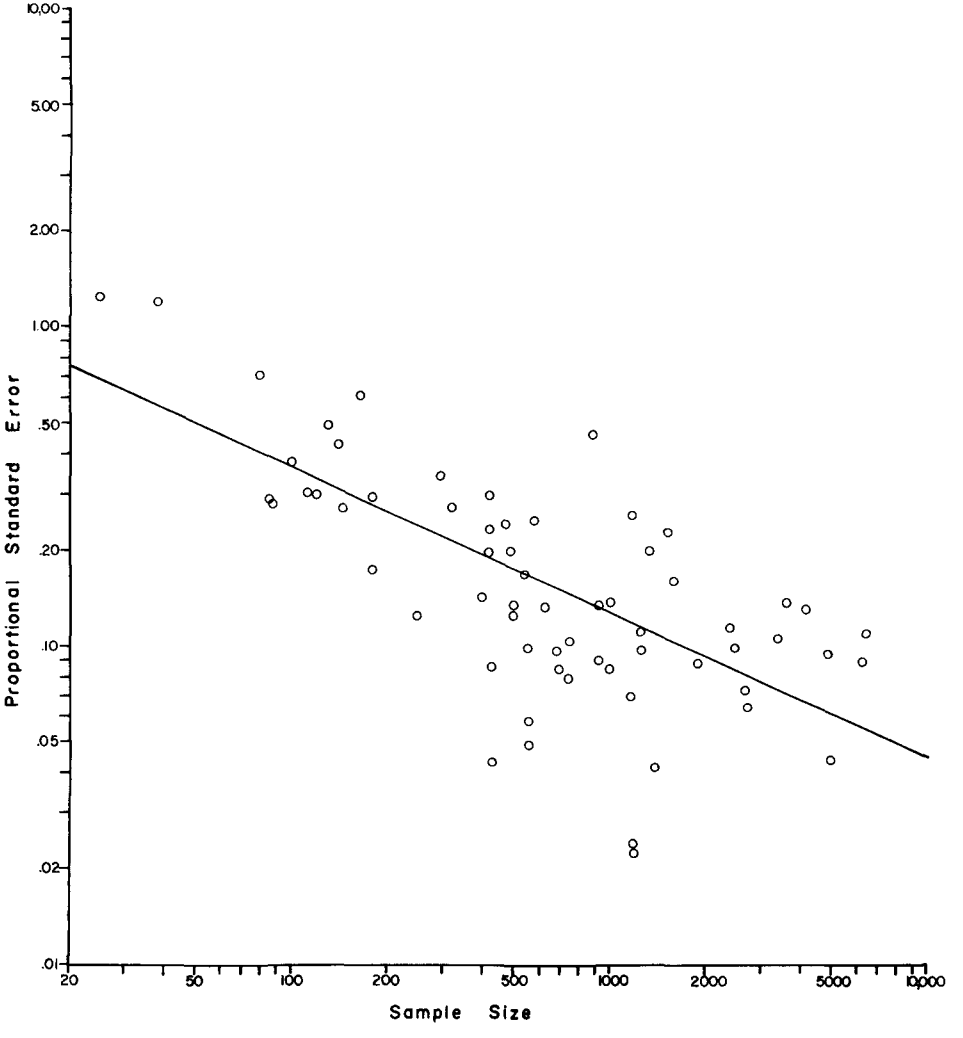

FIGURE 7. Proportional standard errors of estimated number of turkey hunters as a function of sample size.

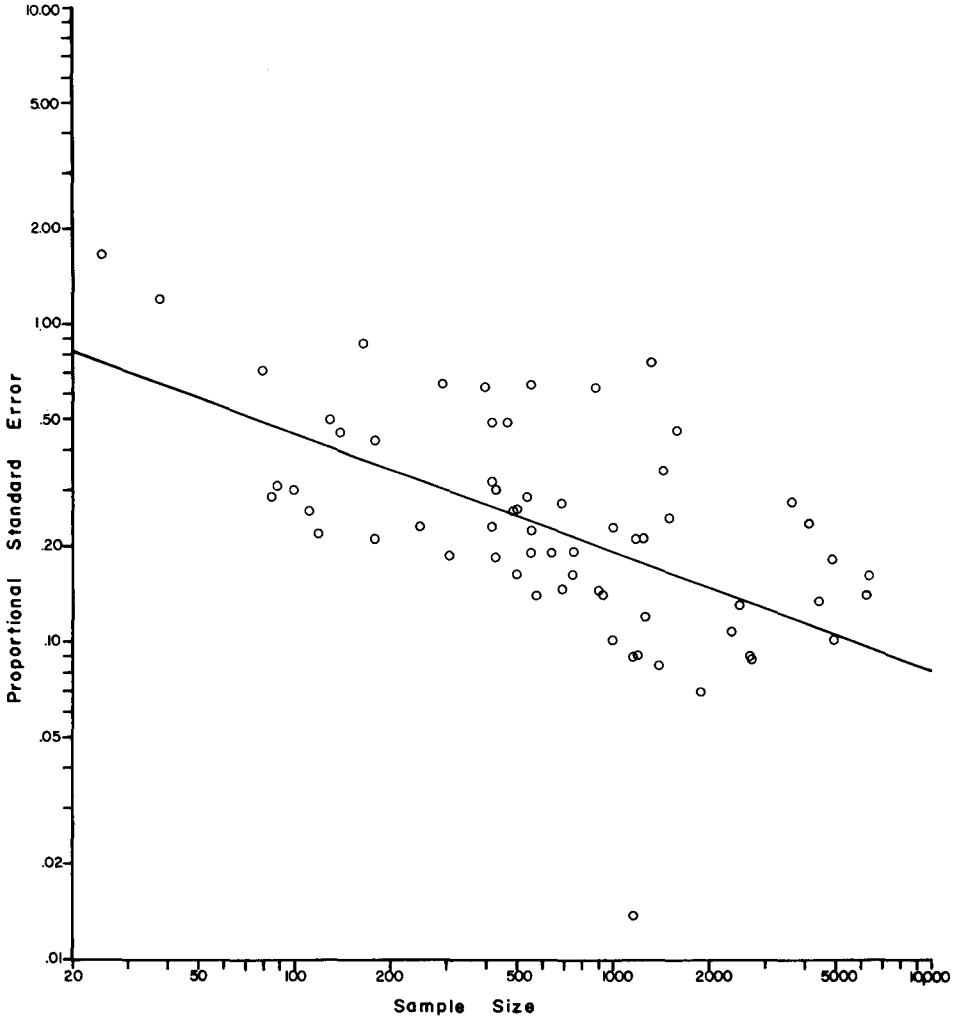

FIGURE 8. Proportional standard errors of estimated effort of turkey hunters as a function of sample size.

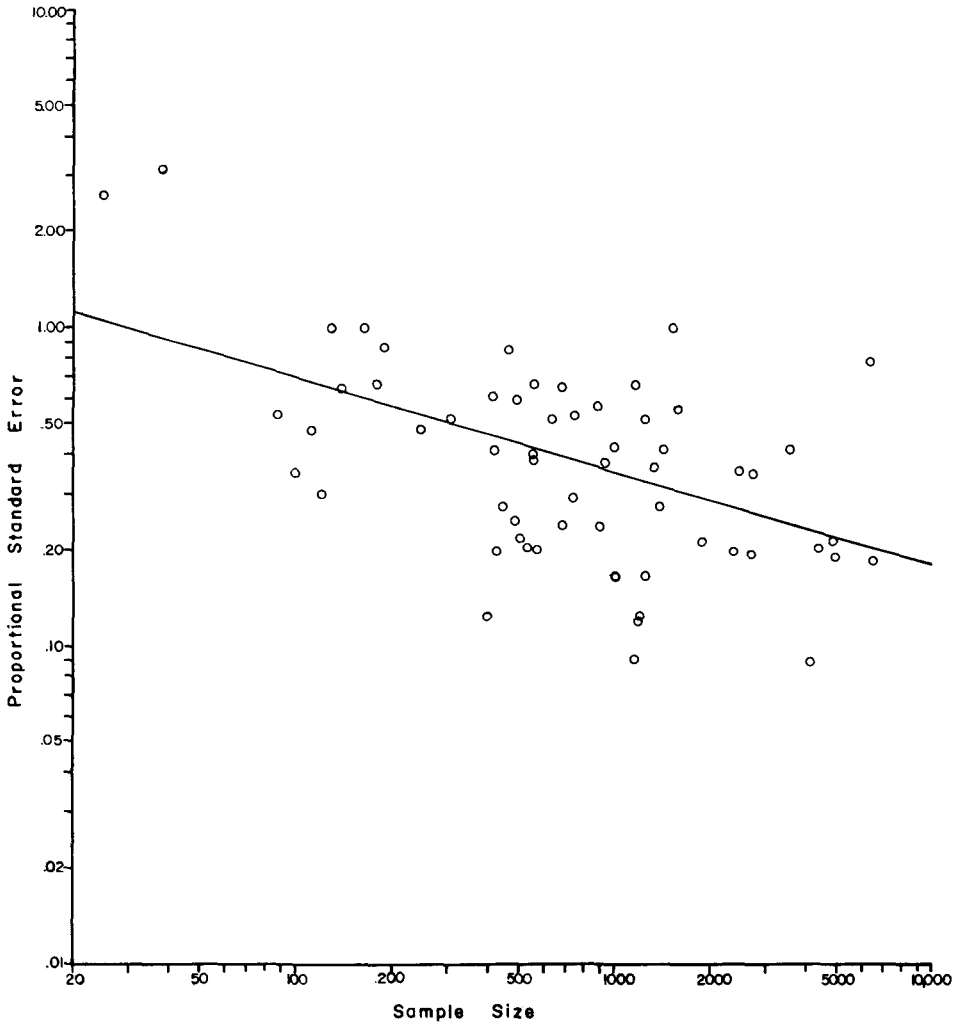

FIGURE 9. Proportional standard errors of estimated harvest of turkey hunters as a function of sample size.