INITIAL ESTIMATE OF SOIL EROSION ON THE CASCABEL WATERSHEDS IN THE OAK SAVANNAS OF THE MALPAI BORDERLANDS REGION

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Abstract. Soil erosion on watershed landscapes can lower the productivity of these upland sites and can adversely impact downstream or off-site areas. It is not surprising, therefore, that excessive soil erosion and the resulting sedimentation represent significant costs to the people affected. This paper presents the first known estimates of soil erosion on a watershed basis in the oak savannas of the southwestern United States, obtained on the Cascabel watersheds after the summer monsoon season of 2004. These measurements will continue to provide a longer, more comprehensive picture of the magnitude of soil erosion on these watersheds. Comparable measurements that will be made after the anticipated burning treatments to be applied on the Cascabel watersheds (Gottfried et al. 2000a) will provide a framework to evaluate the impact of these burning treatments on soil erosion in the oak savannas of the region.

STUDY AREA

The study area consists of 12 small watersheds in the oak savannas on the eastern side of the Peloncillo Mountains of southwestern New Mexico. These watersheds can be used to evaluate the impacts of cool and warm season prescribed burning treatments on their hydrologic and ecological characteristics. Together these watersheds, called the Cascabel watersheds, comprise 451.3 acres, situated between 5380 and 5590 ft in elevation. The nearest long-term precipitation station (a gage at the Cascabel Ranch headquarters) indicates that annual precipitation in the vicinity averages about 23.5 inches, with nearly 55 percent of this precipitation occurring in the summer monsoon season of late June–early July through the middle of September. Geological, physiological, and vegetative characteristics of the watersheds have been described by Gottfried et al. (2000a, 2000b) and others.

STUDY PROTOCOL

Between 35 and 45 sample points have been permanently located along transects perpendicular to the main stream system and situated from ridge to ridge on each of the Cascabel watersheds. The intervals between the sample plots varied depending on the size and configuration of the watershed sampled. In total, 421 sample points were located on the 12 watersheds. Three erosion pins that were installed around every third sample point on each of the watersheds in May of 2004 formed the basis to estimate soil erosion. Two erosion pins were placed 6 ft upslope and one erosion pin was placed 6 ft downslope of the points, for a total of 427 erosion pins. Initial measurements of soil loss were made in October of 2004 after the summer rains. The erosion pins were reset after this measurement to facilitate estimates of future soil loss. A bulk density value obtained from soil samples collected on the watersheds was used as the basis to convert measurements of average soil loss on a watershed to corresponding erosion rates in terms of tons per acre. Precipitation gages have been installed throughout the watershed area to provide a basis for analyzing precipitation-runoff-erosion relationships in the future. The estimates of soil erosion are presented at the 95% level of significance.

RESULTS AND DISCUSSION

The reported estimates of soil erosion represent only a partial year; annual rates of soil erosion remain to be estimated. Moreover, the estimates presented are indicative of soil erosion after only one regime of summer monsoon rainfall events on the Cascabel watersheds. Precipitation for this study period was 8.4 inches, a value somewhat below the longer-term average of 12.7 inches reported for the summer at the Cascabel Ranch headquarters.

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Future measurements of soil erosion should encompass a greater range of the variability associated with highly irregular and unpredictable summer rainstorms. Within the context of these conditions, however, the estimates presented provide initial insight on the magnitude of soil erosion that might be expected in the oak savannas.

Estimated soil erosion averaged 10.58 ± 0.30 tons per acre on the 12 Cascabel watersheds (collectively) for the measurement period. Estimates on the individual watersheds ranged from a low of 4.76 ± 0.91 to a high of 17.03 ± 1.14 tons per acre. It is important to note that these estimates were associated with below-average summer monsoon rains. The larger of these rainfall events occurred in the latter part of the summer, following a prolonged drought in the Peloncillo Mountains and throughout the region.

No meaningful relationships between the magnitude of the estimated soil erosion on the individual Cascabel watersheds and the corresponding watershed size, stream-channel network, or physiography (slope position, slope percent, aspect) were evident in this initial analysis. A longer period of measurement is needed to detect these relationships if they exist.

CONCLUSION

The initial estimates presented in this paper are the first known measurements of soil erosion in the oak savannas of the southwestern United States; they are therefore noteworthy. Whether the magnitude of these estimates of soil erosion continues into the future remains to be seen. Such estimates of soil erosion are needed on an annual basis to present a more comprehensive picture.

REFERENCES

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