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Hydrology and Earth System Sciences
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Discussions

Interactive comment on "Contrasting watershed-scale trends in runoff and sediment yield complicate rangeland water resources planning" *by* M. D. Berg et al.

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"Berg et al. presents reservoir sedimentation data from a series of watersheds in Central Texas and integrates it with long-term precipitation and streamflow data to evaluate the impact of landscape scale changes on water resources. Long-term hydrologic studies that span multiple scales are of high interest to readers of HESS."

We appreciate this perspective and agree with the reviewer that HESS makes an ideal fit for a finalized manuscript describing our work. We internally have gone through many iterations of this paper and believe it makes an important contribution to a key ecohydrological question. We thank Reviewer #1 for time and effort in providing input toward this end.

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Discussion paper

"1. Evaluation of type of vegetation change or changes in potential ET on rainfall-runoff relationships. Given that long-term runoff (Q) is considered as the difference between precipitation and evapotranspiration (Q=P-ET), the authors spend little time evaluating the potential impacts of temperature changes or plant rooting depth on changing ET and Q. If the actual vegetation changes did not result in a change in rooting depth or the length of the plant growing season, then we would logically not expect any change in Q. However if rooting depth and/or growing season length decreased while potential ET increased, then these changes would offset and ET would stay the same. The relationship between these parameters is the most important for predicting rainfall-runoff relationships in the future, yet no data are presented on these variables. Potential ET can be relatively easily calculated from the PRISM data (Oregon State), and the rooting depth and season length could be assigned to each cover type (woody cover, grassland, and crop land)."

We acknowledge the importance of precipitation and evapotranspiration to long-term streamflow and other components of runoff. However, the objective of this study was to quantify historical changes in streamflow. The important findings of our study are that neither precipitation nor streamflow has shown a directional trend over the study period.

This core question, with respect to streamflow, addresses a high-level conversation in the ecological community on the outcomes of woody plant encroachment of rangelands. As such, we examined the aggregate of multiple potential impacts as actual, direct measurements of streamflow. If neither precipitation nor streamflow has changed, the net changes in landscape-scale components of ET are also insignificant.

Further emphasizing this point are the following: (1) since interannual temperature fluctuations dwarf long-term temperature changes to date, temperature is not of primary concern here and (2) much of this region is characterized by shallow soils and karst geology that limit root penetration for nearly all species.

Clearly, field studies of historical changes in rooting depth are not possible given the timeframe we examined. However, an abundance of work by Susan Schwinning and others has indicated that the dominant woody plant species in this region do not access deep storage. The evergreen nature of these woody plant species and their allegedly enormous transpiration capacities have been put forward as reasons why woody plant removal should theoretically yield streamflow increases.

Evidence suggests it is precisely because ET is high, that woody plants are disconnected from deeper storage, and that assumptions of transpiration characteristics are unfounded, that local increases in woody vegetation will not appreciably affect runoff. As such, we focused on streamflow, interpreted with precipitation. New text to this effect has been added in 4.1.

"2. There is no discussion of the impact of slope on sedimentation. I know you focus more on relative changes across time, but I think including the discussion of slope impacts is particularly important, especially with respect to internal sediment storage from on farm ponds."

The region is characterized by 1-5% slopes for nearly all soils, and channel beds are rock. As the reviewer implies, while dams may have caused minor changes to stream channel slopes in very localized areas, neither average channel slopes nor upland slopes have changed.

"3. With respect to the baseflow analysis, it would be extremely helpful to know the average pond size across time (Fig. 3). Moreso than just the pond density, knowing the average size is critical for assessing potential baseflow contributions from pond recharge and reduction in overland runoff."

Nearly all ponds are less than 0.3 ha when full immediately after rain events. Pond size over time was not included because dramatic seasonal and interannual fluctuations in depth and area due to climatic variability make these data of extremely limited value. As water levels are unregulated, a single pond can cease to hold water in summer and then overflow in wet periods within the same year. Hydrological – and sediment – impacts from these features are more directly due to the impoundment of intermittent streams behind dams themselves. As a result, while the size of ponds may occasionally play a role in localized hydrological impacts, the extreme variability of local water storage makes the number of dams/ponds of much greater importance.

Specific comments: Section 2.1. Would be good to report mean air T, RH, and factors that affect PET.

For the reasons above, we elected not to include these secondary variables. Nonetheless, to enhance the site description and provide the reviewer a little better feel for PET factors, we have included average temperatures for both winter and summer.

Page 4, line 11: Would be good to included characteristic rooting depths and growing periods for each of these types of vegetation.

Again, since these were beyond the scope of this study and that the plant communities here are complex and limited by shallow soils, we elected not to include these data.

Figure 4: Not sure this figure is needed.

We believe this figure adds to the reviewers' ability to visualize our methodology, and internal reviews have consistently made suggestions to retain it.

Figure 7: This graph seems to duplicate Table 2. I would recommend adding rows to Table 2 with the data from this figure presented there.

Though not duplicative, we do recognize that Figure 7 is derived from the same data as Table 1. However, we feel that a separate Figure 7 illustrates in striking fashion the different linear sedimentation rates over time. Since this is one of two main objectives of this study, we feel it has an important place in the manuscript.

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