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On the ecohydrologic function and disturbance effects of ephemeral desert stream channels

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Ephemeral stream channels are widespread features throughout desert landscapes, particularly on alluvial fans. These channels range in width from a few tens of centimeters to many meters. Runoff in these channels can redistribute water from upper portions of the landscape in response to rare high-intensity or long duration rainstorms. Visual observations suggest that shrubland vegetation is often clustered at higher cover alongside these channels. We are using transect studies, mapping, monitoring and manipulation experiments to investigate the hydrologic relations of these features to vegetation in the eastern Mojave Desert of the USA. We use a piedmont that is perpendicularly transected by a $\sim$100 year old railroad that alters natural flow by diverting it through staggered culverts to areas below the railroad. This creates an opportunity to study: 1) relatively undisturbed areas above the railroad, 2) areas below the railroad that receive enhanced flow where water is diverted through culverts (enhanced) and, 3) areas below the railroad where water flow from upslope has been blocked (deprived). In all areas we found that vegetation cover and density is higher alongside stream channels and decreases with distance from the channels. In all but the deprived areas, vegetation is nearly absent in the stream channels. Relative to the upper undisturbed areas, vegetation cover is higher in the enhanced areas, and lower in the deprived areas; however, when diversion is not considered cover above and below the road is equal overall. Furthermore, species-specific differences were present. The drought deciduous sub-shrub Ambrosia dumosa shows increased cover in deprived areas and in all areas peaked closer to the channel margin than the evergreen drought-tolerant shrub Larrea tridentata, we believe due to differences in root morphology. In a simulated channel runoff event, we found that vegetation within 3 meters of the stream channel physiologically responded (elevated water potentials and stomatal conductance) to the water pulse and persisted for over a month. Up to six months following the water application there was a continued visual effect on vegetation greenness compared to the surrounding area. Spatial analysis of the effects of these stream channels reveals that the ecohydrological area influenced by the channels is much larger than the area covered by channels, thus amplifying the impact footprint of the otherwise small, linear (railroad) disturbance. These results suggest that the spatial distribution of channels and climatic conditions that generate stream flow can have significant implications for understanding landscape responses to future land use and climatic conditions in this sensitive arid ecosystem.