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## Spatio-temporal dynamics of erosion and deposition in a partially restored valley-bottom gully

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Soil erosion by water is a frequent soil degradation process in rangelands of SW Spain. The two main erosive processes in these areas are sheetwash erosion in hillslopes and gully erosion due to concentrated flow in valley bottoms. Land use changes and overgrazing play a key role in the genesis and development of gullies and gully erosion is a frequent process with negative consequences at the valley bottoms of these landscapes.

The development of new techniques allows monitoring of gully dynamics with an increase at spatial and temporal resolutions. Here we present a detailed study of a valley-bottom gully in a Mediterranean rangeland with a savannah-like vegetation cover that was partially restored in February 2017. Restoration activities included check dams (gabion weirs and fascines) and livestock enclosure by fencing. The objectives of this study were: (1) to analyze the effectiveness of the restoration measures, (2) to study erosion and deposition dynamics before and after the restoration activities, (3) to examine the role of micro-morphology on the observed topographic changes and (4) to compare the current and recent channel dynamics with previous studies conducted in the same study area through different methods and spatio-temporal scales, quantifying medium-term changes. Topographic changes were estimated using multi-temporal high-resolution DEMs produced using Structure-from-Motion (SfM) photogrammetry and aerial images acquired by a fixed-wing Unmanned Aerial Vehicle (UAV). DEMs and orthophotographs with a Ground Sampling Distance of 0.02 m were produced by means of SfM photogrammetric techniques. The average Root Mean Square Error (RMSE) estimated during the SfM processing was 0.03 m.

The performance of the restoration activities was satisfactory to control gully erosion. Check dams were effective favoring sediment deposition and reducing lateral bank erosion. Nevertheless, erosion was observed immediately downstream in 9% of the check dams. Livestock enclosure in the most degraded area promoted the stabilization of bank headcuts and revegetation. The sediments retained behind check dams reduced the longitudinal slope gradient of the channel bed and established a positive feedback mechanism for channel revegetation.

**Keywords:** gully erosion, restoration, topographic change, UAV+SfM, rangeland.