

THE TORTOISE, THE TANK, AND THE SAGE: WHAT REALLY MOVES MOJAVE DESERT PEBBLES

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To quantify short-term sediment movement rates across low gradient Mojave Desert piedmonts, sixteen hundred painted and numbered pebbles were surveyed six times at four sites over two years. The four sites represent geomorphically similar surfaces with different land use histories. Two sites are located on surfaces currently or previously impacted by military training activities including the use of wheeled and tracked vehicles. The two other sites are in undisturbed areas.

We infer three distinct mechanisms for pebble transport: ephemeral channels transport a few pebbles long distances (m) down gradient, bioturbation moves most pebbles small distances (cm) in any direction (although overall motion is down gradient), and vehicular disturbance transports pebbles varying distances in any direction. The recovery rate of pebbles in natural systems after two years was 98% and 93% (Chemehuevi and Goldstone). At East Range Road, where vehicles currently disturb the surface, recovery was only 76%. At Iron Mountain, where impact ceased nearly 60 years ago, the recovery rate was 87%. Off-road vehicle use is coincident with accelerated pebble movement. On average, net pebble movement is faster at the disturbed Iron Mountain and East Range Road sites, (0.71 m yr⁻¹ and 0.29 m yr⁻¹, respectively) than at the undisturbed Chemehuevi and Goldstone sites, (0.18 m yr⁻¹ and 0.04 m yr⁻¹, respectively).

Pebble movement is controlled by many factors. Significant pebble transport occurs only in channels, whereas on interfluvies, pebbles move only small amounts. None of the rainfall events we measured had anywhere near the intensity of precipitation necessary to initiate overland flow on any of the four sites; yet, flow occurred in channels at three of the sites moving pebbles down gradient. The size and permeability of the steep, mountainous drainage basins supplying runoff to the piedmont must be an important control on pebble speeds. Regression analysis was performed using many variables including piedmont slope, soil density, ephemeral channel cover, precipitation and statistics describing the number, size and frequency of shrubby plants. Plant cover is inversely correlated with pebble movement suggesting that well vegetated sites have less surface runoff and channelized flow.