Assessment of stream crossing impacts to ephemeral streams on military lands throughout the southwestern United States

Project # 15-774

Background:

Ephemeral stream riparian zones provide essential ecosystem services, but their integrity and extent have declined in many regions. Roads are widespread in military training areas, and resource managers across the southwestern United States have identified road impacts to ephemeral streams as serious concerns. However, there is little information describing the prevalence, extent, or mechanisms of stream crossing impacts to riparian ecosystems in arid regions. Maintaining functional riparian zones supports the military mission by providing sustainable landscapes for training and testing and helps to avoid costs associated with environmental degradation.

Objective:

The potential impacts of stream crossing infrastructure on ephemeral stream hydrology, channel geometry, and riparian plant communities were assessed on four military installations across the warm desert regions of North America. The findings were used to develop general guidelines for road placement and stream crossing infrastructure to minimize impacts, and the study methods were adapted into a rapid assessment protocol for use at other installations.

Summary of Approach:

The frequency, extent, and mechanisms of road impacts to ephemeral stream riparian ecosystems were quantified for a spatially balanced random sample of stream crossings at Fort Irwin, CA, Yuma Proving Ground, AZ, Barry M. Goldwater Range-East, AZ, and White Sands Missile Range, NM. Downstream changes in channel geometry and plant community characteristics in paired reaches above and below each stream crossing were compared to roadway characteristics such as crossing type, topographic modifications, and the presence of roadside ditches and berms. Streamflow was continuously monitored for approximately two years at a subset of stream crossings to quantify how changes in flow frequency, duration, and magnitude can alter channel geometry and vegetation.

Accomplishments:

Analysis of 84 streamflow events at 14 representative stream crossings demonstrated that above-grade roadbeds, berms, and ditches can significantly diminish the frequency, magnitude, and duration of downstream flow events. Streamflow inputs from roadways can also augment downstream flow frequency, but these runoff subsidies did not increase mean streamflow duration or peak stage relative to upstream reaches. The hydrologic effects of roadway infrastructure depend strongly on local topographic setting and channel characteristics.

Data from 228 sites across the four installations showed that streamflow connectivity was altered at 46% of stream crossings. Downstream flow was diverted or impounded in at least 27% of crossings, while streamflow additions occurred in at least 15% of crossings.

Stream crossings that diminished downstream flow altered plant community composition and structure, reducing plant species richness by an average of five species and significantly lowering species diversity compared to upstream communities. The effects of streamflow reductions varied considerably across the study region due to differences in climate, physiography, and biota.

Streamflow augmentation from roadways, berms, and ditches caused downstream channel enlargement that varied across installations. Riparian communities downstream of these crossings sometimes had higher species richness and diversity, but these effects were highly variable within and among installations.

These findings were used to develop guidelines for road placement and stream crossing infrastructure to minimize impacts to dryland riparian ecosystems. The study methods were summarized to provide a rapid assessment protocol for quantifying potential impacts to riparian ecosystems at other installations.

Benefit:

These findings facilitate strategic planning and sustainable management of natural resources on military lands, allowing managers to mitigate the degradation of critical habitats and potentially prevent the listing of additional threatened and endangered species. The use of stream crossing infrastructure that commonly degrades downstream riparian zones can be avoided, and problematic stream crossings can be targeted for rehabilitation and environmental restoration.

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