CHARACTERIZING MOJAVE DESERT SHRUB ECOTYPES TO ESTABLISH SEED TRANSFER ZONES FOR MILITARY RANGE RESTORATION

Project # 16-820

Background:

The training grounds on Military installations are disturbed frequently by training activities or wildfire, diminishing over time their ability to provide realistic testing and training conditions. In a desert environment, rates of vegetation recovery are slow and depend on rare occurrences of favorable years with high shrub recruitment. Ecological restoration seeks to supplement natural recovery by broadcasting seed or transplanting greenhouse-raised saplings. The success of these costly practices depends on selecting appropriate genotypes that have high survivorship under present and future climate conditions. Before this study, no information has been available to guide genotype selection for shrub revegetation efforts in the Mojave Desert.

Objective:

The primary objective was to develop best-practice guidelines for range restoration and the delineation of 'seed transfer zones' or areas within which seed can be collected and distributed without risk of maladaptation to the environment. This objective directly supports Fort Irwin's mission as the Army's premier training center for combat in desert environments and by extension, other Military installations in the Mojave Desert including the Marine Corps Air Ground Combat Center (MCAGCC) Twentynine Palms.

Summary of Approach:

The growth and survivorship transplants, comprised of 38 populations representing 15 ecotypes across three species, were monitored for three years in three common gardens. The shrub species, *Larrea tridentata* (creosotebush) and *Ambrosia dumosa* (burro-weed), and the early-successional sub-shrub *Sphaeralcea ambigua* (desert globemallow) are ubiquitous across the Mojave Desert and the two shrubs dominate much of the vegetation cover in the Mojave Desert. The gardens were located at Fort Irvin, near MCAGCC Twentynine Palms to the south and near St George, Utah at the northern edge of the Mojave Desert. Multiple trait values were documented to assess phenotypic variation and plasticity across and within populations in leaf and flower phenology, specific leaf area and leaf N content (%N in leaf dry mass), drought response, water use efficiency and photosynthetic capacity. Growth rate, survivorship and trait values were correlated with climate norms at the populations' respective home sites to determine lead indicators of climate adaptation.

Benefit:

The project will provide science-based, location-specific selection criteria for plant materials that best fit the management objectives of range and ecosystem restoration projects in the Mojave Desert. In doing so, the project also addressed emerging threats to military ranges, including preparedness for extreme climate events and pre-emption of range degradation by conversion of native shrublands into annual grasslands composed of highly flammable invasive grasses.

Accomplishments:

The fieldwork has been completed and a Texas State University Master's thesis has been published. The study revealed novel, key insights, not previously appreciated in the restoration community, but critical for appropriate genotype selection. Multiyear monitoring of burro-weed transplants showed that population-specific responses to the greenhouse environment can have long-lasting effects on field survivorship. Seedlings from winter-warmer, summer-wetter climate zones achieved higher growth rates in the greenhouse and were larger at the time of transplanting. Across gardens, survivorship was positively correlated with initial transplant size, thereby distorting the relationships between traits and climate adaptation. To control for this bias, it is recommended that performance comparisons of transplanted populations always use initial transplant size as a covariate in the analysis. It was further discovered that populations of creosotebush and burro-weed from drier climate regions, which also had traits indicative of enhanced drought tolerance, had significantly higher survivorship across gardens. This suggests that transplant survivorship can be increased by selecting plant materials from drier regions. However, this selection does not guarantee future recruitment, which should be investigated in future experiments. The study contributed significantly to the growing knowledge base for ecological restoration in the Mojave Desert.

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