

## Invasion process of tamarisk and Russian olive into Canyon de Chelly National Monument

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Canyon de Chelly National Monument in northeastern Arizona has been invaded by tamarisk and Russian olive, resulting in the development of predominantly exotic riparian vegetation and river channel change. Tamarisk and Russian olive first established in the canyons between 1920 and 1940, and have since expanded throughout the canyons. Concurrent with the introduction of these exotic plants has been dramatic stream channel change. Historically, the stream beds in Canyon de Chelly contained wide, open, braided channels, as evidenced in historical photographs. In most of the upper canyons the stream beds are channelized and incised. This appears to have resulted in a water table decline on floodplains. Irrigation and traditional farming practices of the Navajo canyon residents have become nearly impossible. The changes in vegetation and stream channel morphology have inspired efforts to study the causes of these changes and develop strategies to mitigate their negative effects. I am investigating three components of exotic plant invasion in Canyon de Chelly and the role of exotic plants in the riparian landscape; (1) the historic patterns and processes of exotic plant invasion to understand the timing of exotic plant invasion relative to the timing of climate changes, river regulation and purposeful introductions, (2) processes that allowed tamarisk and Russian olive to successfully invade Canyon de Chelly and the characteristics of the floodplain that made it invasible, and (3) the biotic and abiotic characteristics of the floodplain that will shape future plant communities, and whether native riparian plant communities could be restored.

Historic establishment patterns of exotic plants throughout the canyon will be determined by precision aging of tamarisk and Russian olive plants in selected locations around the canyon to understand the temporal and spatial pattern of invasion, correspondence with climate, and whether tamarisk and Russian olive invaded before or after they were planted in the canyon. To understand why tamarisk and Russian olive were successful, I am testing research questions involving seedling establishment requirements of both native and exotic riparian plants as well as assessing available habitat in the canyon to understand where empty ecological niches exist in the canyon. I am also studying the biotic and abiotic characteristics of the riparian habitat that will shape future plant communities after tamarisk and Russian olive have been removed from our study sites. I am comparing the effect of two removal methods (cut-stump and whole-plant extraction) on the composition of vegetation in our study sites, as well as on airborne seed availability and the ground water table. Preliminary results suggest tamarisk seed rain is dramatically reduced in cleared areas and the ground water table is too deep for riparian plant establishment in the future. Thus, in areas cleared of tamarisk and Russian olive there may only be potential for the return of a xeric, rather than a riparian plant community. I am analyzing the soil seed bank throughout the canyon to understand the role of the seed bank in recovery of the native vegetation following exotic plant removal. Preliminary seed bank results indicate the existence of historic wetland plant species as well as native and exotic grasses. These results allow me to develop an understanding of why tamarisk and Russian olive have been successful colonists in southwestern floodplains, and inform future management and restoration of riparian habitats.