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THE ROLE OF TRANSPORTATION CORRIDORS IN PLANT MIGRATION IN AND AROUND AN ARID URBAN AREA: PHOENIX, ARIZONA

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Abstract

While the potential importance of corridors has been acknowledged for both native and non-native species, little is known about how corridors actually function in developed and fragmented landscapes. Transportation corridors, such as roads and freeways, provide fairly consistent habitat conditions traversing nearly all man-made developments, including cropland, suburbs, reserves, and cities, and connect them with undeveloped areas. The combination of the particular conditions along road and freeway verges and the characteristics of the plants that reach these corridors will ultimately determine which species, native or not, will be able to move within cities and developed areas, as well as to and from cities and surrounding undeveloped areas.

This study will advance ecological understanding of the plant species that are able to move through existing corridors in arid and semi-arid urban areas. Urban areas, including freeway corridors, are intensively managed. This study will consider human management and urban development as integral and natural parts of the ecosystem under study. Understanding the similarities and differences in traits that affect movement of plant species along corridors will provide evidence as to whether native and non-native or functional groupings of species actually move differently in corridors. It will contribute to the literature on assessing the potential for particular plant species to invade new areas. Linking local plant processes to the larger landscape scale of movement between cities and undeveloped areas will have important implications for conservation planning in both environments.

Twenty sites were selected along the four major freeways in the cardinal directions around the Phoenix Metropolitan Area. Beginning in March 2004, vegetation surveys have been performed seasonally at each site. In addition, seed-bank samples and bulk-soil samples were collected at each site. The seed-bank samples are germinating in the greenhouse to determine the seed-bank composition; analysis of physical soil characteristics and available and total levels of soil nutrients (nitrogen and phosphorus) is nearly complete.

Initial soil-chemistry results show that levels of plant-extractable nitrate are significantly increased in the surface soil located directly adjacent to the asphalt (ANOVA using log surface soil concentration; $F = 5.556$, $P = 0.005$). There were also significant differences between sites located adjacent to different land uses, with the sites located in the more densely developed city areas having higher nitrate levels than those at the edges of developed areas. The urban residential sites had the highest levels, followed by croplands, then lower density "fringe" development, and desert sites had the lowest levels of extractable nitrate (ANOVA using log surface soil concentration, $F = 123.67$, $P < 0.001$; Fisher's multiple comparison, all combos $P < 0.001$).

The plant community composition and seed-bank composition at these sites will be compared with nutrient levels to determine whether similar patterns emerge. It is likely that in the typically nitrogen-limited Sonoran Desert, the addition of nitrogen as a result of exhaust from combustion engines is significantly impacting which plant species are most likely to grow along the roadsides. This raises the question of whether heavily traveled roadsides in naturally nutrient-limited ecosystems should be considered as potential vegetation reserves, since intense maintenance would likely be needed to maintain a native community. Perhaps these areas are best landscaped with species unlikely to move along the highway corridors, whether native or not.

The results of this research will advance ecological understanding in several ways. I will elucidate the suite of plant traits that allow effective dispersal in fragmented landscapes with well-defined corridors, clarifying whether these corridors favor plants with particular traits, rather than native or non-native species. This study will increase understanding of the connection between urban and extra-urban environments and will have important implications for conservation planning in both types of environments. Finally, this research specifically incorporates humans into ecological theory, including human management and urban development as an integral and natural part of the ecosystem under study.

The project results will also be useful to highway and road managers, particularly in arid areas. The results will illuminate potential management techniques that will enhance or prevent plant migration along transportation corridors, as well as providing information on how management of transportation verges for objectives other than plant dispersal is likely to affect plant community composition.