Gage Dayton

Department of Wildlife & Fisheries

Nature of the Problem

Despite the growing body of research on global amphibian decline, there are surprisingly few studies aimed at understanding factors that determine the makeup and persistence of amphibian communities in desert regions. The paucity of research that has focused on xeric adapted amphibians is surprising, considering the fact that deserts make up approximately 33% of the terrestrial environment (Whitford 2002), that arid-adapted amphibians are interesting model organisms for ecological questions (Pfennig and Murphy 2002), and that some of the most vulnerable amphibians in North America are found in arid regions (Bradford pers. Comm). Naturally, the problem of amphibian decline has focused on the disappearance of populations from the landscape. However, I suggest there is much to be gained by turning the question on its head. What are the factors that allow the persistence of amphibian species? Addressing the problem this way is powerful because if we understand the pattern of population loss, and are armed with an understanding of the mechanisms that allow species to persist, then we should be able to design systems that will mitigate population loss and allow restoration of amphibian populations. Unfortunately, there is a paucity of baseline distribution data and knowledge of the natural and anthropomorphic factors that structure and ultimately influence persistence of species across the landscape. This problem is particularly evident when we examine the status of our knowledge of amphibian species that inhabit desert regions throughout the world. While there have been tremendous research and monitoring efforts over the past three decades geared towards understanding community dynamics and conservation issues of amphibians (Heyer et al. 1994), there is an enormous gap in baseline data on amphibians inhabiting desert regions throughout the world. Even more alarming is the fact that the majority of anurans in the United States primarily rely on temporary pools for successful reproduction, and like fishes (Moyle 1995, Fagan et al. 2002), some of the most vulnerable amphibians inhabit arid regions (DF Bradford pers. Comm.). The only amphibian species known to be extinct in North America, for example, was a spring-dwelling species, Rana fisheri, from the Great Basin Desert near Las Vegas, Nevada (RD Jennings pers. Comm.). This fact combined with the recent changes in United States policy, relaxing the protection of temporary and isolated wetlands (Solid Waste Agency of Northern Cook County vs. United States Army Corps of Engineers, 531 U.S. 159 2001) highlights the need to better understand the importance of isolated temporary wetlands for amphibian biodiversity.

Previous research on amphibian communities in temperate and tropical regions supports the hypothesis that a balance between permanency of water, water chemistry, competitive ability of tadpoles, and presence of predators may largely determine how many species of amphibians live together, and how they are distributed across the landscape. I will test this hypothesis via a combination of site-level studies of amphibian communities and mesocosm experiments to determine factors that influence the persistence of amphibian species in a desert landscape. I will describe how abiotic and biotic factors may affect

distribution of amphibian species in the Big Bend National Park and the surrounding Chihuahuan Desert in southwestern Texas.

Specifically, I will quantify presence and absence of anuran species and the habitat associations of adults and larvae at several spatial scales, ranging from temporary breeding sites to landscape level habitat associations such as soil type, vegetation community, water chemistry, and elevation. Mesocosm experiments will elucidate the roles of competition and predation in determining species co-occurrence at breeding sites. This part of the study will also provide inventory and monitoring data on anuran distributions in this region, including status of the two species that have declined. The results of this study will lead to a better understanding of ecological factors that influence the ability of amphibian species to persist in temporary wetlands at multiple locations across a desert landscape.

References

Fagan, W.F., P. J. Unmack, C. Burgess, and W.L. Minckley. 2002. Rarity, fragmentation, and extinction risk in desert fishes. Ecology 83:3250-3256.

Heyer, W. R., M.A. Donnelly, R.W. McDiarmid, A.C. Hayek, and M.S. Foster. 1994. Measuring and monitoring biological diversity standard methods for amphibians. Smithsonian Institution, Washington D.C.

Moyle, P.B. 1995. Conservation of Native Fresh-Water Fishes in the Mediterranean-Type Climate of California, USA - a Review Biological Conversation 72:2711-279.

Pfennig, D.W., and P.J. Murphy. 2002. How fluctuating competition and phenotypic plasticity mediate species divergence. Evolution 56:1217-1228.

Whitford, W.G. 2002. Ecology of desert systems. Academic press, San Diego.