USING PHYLOGEOGRAPHY TO INFORM CONSERVATION OF DESERT SPRING INVERTEBRATES

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The use of molecular genetic tools has greatly improved our understanding of the biodiversity of organisms in threatened environments. A number of studies have identified desert springs as hotspots of aquatic biodiversity because of the presence of cryptic and microendemic species. We used a phylogeographic framework to quantify genetic variation in amphipods of the genus *Gammarus* that occupy 16 springs in the northern Chihuahuan Desert of west Texas and southeastern New Mexico. This approach allowed us to examine the evolutionary forces that promoted diversity, while also providing information that was critical to conservation agencies and NGOs. Sequencing of mitochondrial and nuclear genes revealed the presence of two evolutionarily independent lineages of *Gammarus* in this region that shared a most-recent-common-ancestor ~66 million years ago (MYA). One lineage consisted of a radiation from the Gulf of Mexico ~28-16 MYA, while the second lineage was a radiation from northerly freshwater ancestors ~5-2 MYA. Allopatric speciation in each lineage was driven by paleo-geological, hydrological, and climatic events followed by isolation, which promoted genetic drift and local adaptation. Each spring system contains an endemic *Gammarus*, suggesting a total of 8-10 species in the region. Three described species are currently federally listed as endangered, a fourth has just been described, and 4-6 additional species await description. Microsatellite and morphological analyses support the DNA sequencing data providing further evidence of geographically distinct species. These patterns of variation occur in other taxa as well. Using DNA barcoding approaches, we find undescribed and/or endemic species in a wide variety of spring

invertebrate taxa including amphipods in the genus *Hyalella,* several groups of snails, and flatworms. Our results provide information that is critical to managers of these unique aquatic habitats, many of which are threatened with destruction due to human demands for water and accelerating rates of climate change.