Climate Change and Shenandoah Salamanders

Introduction

In many national parks, high elevation biota are severely threatened by climate change. Some of these biota are endangered species and, although park managers strive to reduce anthropogenic disturbance to these species, efforts are frequently targeted at mitigating disturbance from relatively small scale and limited management actions, such as trail maintenance, backcountry camping, etc. Limiting any anthropogenic disturbance on an endangered species is appropriate, but those limitations are somewhat arbitrary when much larger and more devastating disturbances (e.g. climate change) are either ignored or unaddressed. An assessment of the impacts of climate change on endangered species is required for efficient spending of current funds, proper management of rare species, and effective conservation of National Park Service biological resources. This project proposes to combine refined habitat and competition models for the Shenandoah salamander (Plethodon shenandoah) with downscaled projections of future climates to anticipate changes in the salamander's distribution under a variety of anticipated climate scenarios. We propose to use these modeling and experimental results to feed a structured decision making process that will develop an climate change adaptive management strategy for the Shenandoah salamander.

International Climate Change Symbol

Management Needs

Climate change predictions point to severe consequences for sensitive natural resources managed in many national parks. A variety of impacts are described and anticipated, often resulting in dramatic changes in national park ecosystems, where the most severe impacts are anticipated in high-elevation habitats (Saunders et al 2009). Many national parks were established to protect high elevation sites that maintain communities not found in the surrounding lowland areas – as is the case in Eastern mountain parks like Shenandoah National Park (SHEN).

In the Appalachians, many high elevation communities are often isolated from other high elevation habitats, frequently resulting in small, localized, and unique ecosystems that support rare endemic species on these mountaintop 'islands'. Protecting endemic species in the larger Eastern national parks is especially important because these parks are frequently not afforded the buffering protection of surrounding undeveloped public lands like many Western parks, and as such, migration or range shifts of species and biological communities are less likely to occur without substantial intervention. In addition, many Eastern parks, particularly those in the Central and Southern Appalachians, provide for tremendous biodiversity of national importance (Stein et al 2000). In some parks, much of this diversity is associated with isolated high elevation habitats (i.e. mountaintops) and the endemic flora and fauna that reside there. These biota are often described as Pleistocene relicts, because these species and communities have persisted since the Pleistocene era, becoming more isolated and restricted to cooler high elevation habitats as the climate warmed and the ranges of other species shifted north.

A perfect example of an isolated and range-restricted high elevation animal is the Shenandoah salamander. This federally endangered salamander is found nowhere else on earth except within the boundaries of Shenandoah National Park and its entire known range consists of approximately 6 square kilometers of high elevation (>900m) forested habitat. Shenandoah salamander was believed to be more widely distributed during the Pleistocene, but has become restricted by competition with another species (red backed salamander - Plethodon cinereus), which is believed to have expanded from the lowlands with a changing climate (Highton and Worthington, 1967; Highton, 1972). The Shenandoah salamander is characteristic of many other rare Appalachian salamander species (including the federally threatened Cheat Mountain salamander (Plethodon netting), Weller's salamander (Plethodon welleri), and the Peaks of Otter salamander (Plethodon hubrichi), in that its presence is strongly influenced by elevation and aspect, presumably in relation to temperature and moisture gradients and associated central and southern Appalachian high elevation forest types (e.g. Yellow Birch, Spruce/Fir, etc., species accounts in Lannoo, M. J. 2005).

Climate change is expected to result in dramatic alterations in temperature and moisture gradients in the Appalachians. New efforts at downscaling global climate models (GCM) are expected to provide high-resolution projections of these gradients under a variety of emission scenarios (Hay, personal communication). Rapid and significant changes in temperature and moisture may result in species extirpation in high elevation habitats, since many species have adapted to environmental conditions typical of high elevation sites (e.g., Jaeger., R. G. 1971b.). Compounding the threat is the fact that current ranges of many high elevation species are already extraordinarily small (such as the case with Shenandoah salamander), and because migration (and associated range shifts) might not be possible through lower elevation areas.

Climate Change and Shenandoah Salamanders (continued...)

High Elevation Communities in Shenandoah

Current Procedures

This project proposes to combine refined habitat and competition models for the Shenandoah salamander with projections of future climates to anticipate changes in the salamander's distribution under a variety of anticipated climate scenarios. This information is required to help managers set priorities in regards to management of Shenandoah salamander, to help assess other high elevation communities in SHEN (via providing a template for characterizing effects of climate change on other high elevation species/communities and by providing an assessment of a specific animal which is representative of high elevation organisms), and to further refine monitoring goals for the Shenandoah salamander. Ultimately, we propose to use structured decision making, a tool which combines data from monitoring and research programs with models linking objectives and management actions, to evaluate outcomes(including the concept of multiple thresholds in natural resource management (Martin et al, 2009) to develop preferred management strategies for the Shenandoah salamander. In addition to local benefits, this project would also provide a template for assessing climate change impacts and mitigating management actions on other high elevation biota, such as the federally threatened Cheat Mountain salamander, or the rare Weller's and Peaks of Otter salamander.

References

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