An Assessment of Vulnerability of Threatened, Endangered, and At-Risk Species to Climate Change at Fort Huachuca, Arizona (Legacy 09-433)

Abstract

Future climate change is anticipated to result in ecosystem changes and, consequently many species are expected to become increasingly vulnerable to extinction. This scenario is of particular concern for threatened, endangered, rare, and species at-risk (TER-S). A simple flexible strategy is needed to help integrate climate change into management planning and actions. This assessment uses basic ecological principals to rank individual TER species within the Fort Huachuca region according to predicted climate change responses and associated population declines balanced by those responses expected to incur resilience or population increases. Based solely on predicted response to climate change, northern Mexican garter snake and Southwestern willow flycatcher were identified as the most vulnerable to declines. Results also suggest that climate change will make management of some TER-S species more difficult. Several critical management areas were identified that can benefit multiple species including fire and fuels, invasive species, natural and artificial waters, and landscape-scale planning.

Project Specifics

Description of geographic setting: Fort Huachuca is in southeastern Arizona. The varied topography and climate in the region enhances diversity leading to a large number of species and vegetation types within a relatively small area. Desert grassland and scrub habitats dominate with important components of oak and mixed pine-oak woodland and riparian forest.

Principal investigators: Deborah M. Finch and Karen E. Bagne, USDA Forest Service, Rocky Mountain Research Station

Partners: Department of Defense Legacy Program (09-433); Sheridan Stone, Fort Huachuca; Megan Friggens and Sharon Coe, USDA Forest Service, Rocky Mountain Research Station; David Gori and Carolyn Enquist, The Nature Conservancy; Lisa Graumlich, University of Arizona

Service branch: Army

Project location: Fort Huachuca

Installation size: 73,300 acres

Installation primary mission: Research, development, testing, and training for Army's intelligence and communications systems.

Project dates: January 2009 to September 2010

Project point of contact: Deborah M. Finch, Supervisory Research Wildlife Biologist; USDA Forest Service, Rocky Mountain Research Station, 333 Broadway SE, Suite 115, Albuquerque, New Mexico 87102; dfinch@fs.fed.us.

Figure 1 Fort Huachuca provides habitat for a wide range of TER-S. Species (photo credit) from left to right are the lesser long-nosed bat (Courtesy of USFWS), tiger salamander (Gary Stolz, Courtesy of USFWS), willow flycatcher (Dave Menke, Courtesy of USFWS), black-tailed prairie dog (Gary Stolz, Courtesy of USFWS).

Purpose/Need

Species assessments of vulnerability or extinction risk are management tools used to help prioritize conservation needs so that actions can be directed in an effective and efficient manner. Anticipation of future impacts to TER-S species can help ameliorate those impacts through early intervention, a key factor for balancing ongoing and uninterrupted military operations with cost-effective natural resource management.

Approach

Of Federal landholdings, those managed by the Department of Defense (DoD) harbor the most endangered or threatened species. They also contain large numbers of species at-risk; those that are imperiled but not yet listed by the U.S. Fish and Wildlife Service (USFWS). These species, also known as TER-S (threatened, endangered, rare and species at-risk) are an important element of natural resources management. Proactive management of species at risk can prevent listing, reduce costs, and protect biodiversity while, at the same time, insuring that military training is not disrupted. There is a broad consensus future climate will be more extreme, which will have consequences for biodiversity. While the exact nature of these consequences is unknown, extinction is of increasing concern for species already at high extinction risk that will experience negative impacts from climate change.

Projected climate change temperatures are expected to rise and rainfall patterns expected to change. Although projections for quantity of future rainfall are variable, most modelers conclude that the region will be drier and subject to longer and more severe droughts. Drier conditions will reduce riparian and wetland habitats. Higher elevation forest and woodland vegetation are expected to shift upward in elevation leading to reduced area. Higher fire frequency and enhanced growth in grasses will encourage grassland species including non-natives.

Scoring vulnerability of species Vulnerability of species to climate change will depend on sensitivity, exposure, and adaptive capacity. We have developed a vulnerability scoring tool in an attempt to synthesize complex and uncertain climate projections into a simple and flexible set of predictions for the direction of population changes. The USDA Forest Service, Rocky Mountain Research Station has created a tool that scores terrestrial vertebrate species based on basic ecology and life history traits that are related to

climate. Although it is in an earlier phase of development, we have also designed a similar, but separate, tool predictive of individual plant species' vulnerability. Predictions and scores were made based on available projections of how climate and related phenomena are expected to change in the region of interest. For this assessment we focused on projections within the next 50 years or less. We assessed species with known or suspected occurrence at Fort Huachuca listed by USFWS as endangered or threatened. We also included additional species that are either proposed or under review for Federal listing or of high conservation priority for Arizona as identified by the State Wildlife Action Plan.

Results

Twenty-one vertebrate species were scored for Fort Huachuca, Arizona. The highest score, or the species most vulnerable to population decline, was the northern Mexican garter snake (Thamnophis eques megalops) followed by the Southwestern willow flycatcher (Empidonax trailii extimus). Species with the highest vulnerability tended to be vulnerable across multiple factors rather than have many predictors of vulnerability within a single factor. The lowest score was for the black-tailed prairie dog, the only species with a negative score, predictive of more favorable conditions and potentially increasing populations if other threats are not present. The aplomado falcon had the second lowest score, but a relative neutral response to climate change conditions was expected. Almost all species scored were vulnerable rather than resilient to climate change. It is likely that this result is partly due to climate change exacerbating some of the current impacts already responsible for declines in these species.

Not surprisingly given that grasslands are expected to expand in the region, grassland species tended to be assessed as the most resilient. Riparian and high mountain species had some of the highest vulnerability scores and their habitats are also vulnerable, particularly in the Southwest. It is clear that climate change exacerbates habitat threats that are already implicated in species declines such as the loss of habitats vulnerable to fire or subject to water withdrawals. Phenology was consistently an important factor in vulnerability for many species. The phenology factor score reflects the relative influence of climate on species' phenology, timing of resources, and the potential for timing flexibility.

Amphibians and reptiles had the highest vulnerability on average, while vulnerability of birds was lower. Mammals, on average, were the least vulnerable with the Arizona shrew (Sorex arizonae) being the most vulnerable mammal. The more striking pattern, however, is that related species did not group together in the assessment and taxonomic group members were scattered throughout the scores. The four endangered species, the southwestern willow flycatcher, the lesser long-nosed bat, the aplomado falcon (Falco femoralis septentrionalis), and the Sonoran tiger salamander (Ambystoma tigrinum stebbinsi), are the ones with the most legal protection, but were not all the most vulnerable. Several species designated as at-risk or currently in review by USFWS were also identified as vulnerable to declines associated with climate change including the top-listed northern Mexican garter snake.

Only two plant species were assessed, one endangered and the other a candidate for listing. Both received almost identical scores that indicated greater vulnerability with climate change. Although population responses may ultimately be similar, these species

were vulnerable for very different reasons. The Huachuca water umbel (Lilaeopsis schaffneriana var. recurva) will be exposed to greater drying of its required wetland and riparian habitats, but its ability to disperse via rhizomes and with floods may give it some advantage under projected changes. Assessing vulnerability for Lemmon Fleabane (Erigeron lemmonii) was limited by lack of information. Although conditions in Scheelite Canyon are expected to remain suitable into the near future, this species also seems to possess few attributes that could be considered resilient. Pollination and reproduction, as for many species, is vulnerable as insects will also be subject to changing conditions resulting in changes in timing and/or numbers.

Benefit

Ranking vulnerability scores do not directly translate to linear population projections, because we do not know the relative importance of each trait considered nor could every possible predictor of population response to climate change be included. However, the score is the balance of traits associated with vulnerability minus those associated with resilience, thus a group of species can be ranked based on the balance of the same set of vulnerable and resilient traits. Taken with other assessments related to current threats, ranks, along with other factors such as legal requirements or economics, can be used to inform the prioritization process. We encourage managers to apply tools to assess vulnerability of species of interest. Vulnerability tools applied in this assessment are available for use.

Targeting management actions: each question in the scoring system identifies a potential effect of climate change on a species' population. Those areas that are identified as vulnerable can potentially be used to target management actions that reduce expected negative impacts. For example, species like Sonoran tiger salamander need water for egg laying and larval development and are vulnerable to drying of water sources and shifts in timing of water availability. Thus, management that ensures continued water availability during the breeding season will be essential.

Recommendations/Lessons learned

1. Water sources, both natural and artificial, will be critical as temperatures rise.
2. Protect riparian habitats from water stress and fire.
3. Take actions to reduce threats, such as fire and exotic grasses that will encourage habitat conversion.
4. Consider timing changes in management plans.
5. Consider inclusion of locales or elements associated with cooler microclimates in habitat protection.
6. Expect species to shift and local populations to change.
7. Anticipate threats as well as opportunities.

Communications

A workshop outlining the assessment results and use of the vulnerability tools was presented to land managers in Tucson, Arizona on August 30, 2010.

Additional Information

This project includes a factsheet, a species assessment, and individual species accounts for the following species: Sonoran tiger salamander, Arizona treefrog, Western barking frog, Chiricahua leopard frog, northern Mexican garter snake, Arizona ridge-nosed rattlesnake, desert massasauga, bald eagle, aplomado falcon, northern goshawk, peregrine falcon, Mexican spotted owl, elegant trogon, western yellow-billed cuckoo, buff-breasted flycatcher, Southwestern willow flycatcher, Arizona shrew, Mexican long-tongued bat, lesser long-nosed bat, cave myotis, black-tailed prairie dog, Lemmon fleabane, and Huachuca water umbel. In addition, vulnerability assessment tools were provided for terrestrial vertebrates (v.2.0) and plants (v.1.0).