



An Assessment of Vulnerability of Threatened, Endangered, and At-Risk Species to Climate Change at the Barry M. Goldwater Range, Arizona

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) or other rare species. 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 species of interest within the eastern portion of the Barry M. Goldwater Range 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, Sonoran pronghorn and desert tortoise 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: The Barry M. Goldwater Range (BMGR) is in southern Arizona along the border with Mexico. In conjunction with adjacent protected lands, it is part of a vast unfragmented landscape covering approximately 6 million acres of Sonoran Desert. With less than 10% of the Range in intensive use, natural resource and cultural site protection are an important component of the DoD mission.

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Service branch: Air Force

Project location: Barry M. Goldwater Range-East

Installation size: ~850,000 acres (eastern half only)

Installation primary mission: The Barry M. Goldwater Range complex is used as pilot training grounds by the Army, Navy, Marine Corps, and Air Force including air-to-air and air-to-ground missions. The eastern portion of the Range, which was the focus of this project, is primarily overseen by the Luke Air Force Base.

Project dates: January 2009 to September 2010.

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The Barry M. Goldwater Range provides habitat for a range of TER-S. Species (photo credit) from left to right are Sonoran pronghorn (Courtesy of USFWS), Le Conte's thrasher (Jeff Bouton), ferruginous pygmy-owl (Courtesy of National Park Service), and desert tortoise (Courtesy of USGS).

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

Background

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 that 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 are expected to change. Although projections for quantity of future rainfall are variable, most modelers conclude that the region will become drier and subject to longer and more severe droughts. Monsoonal rainfall is regionally important, but not well projected. Although vegetation is expected to remain primarily Sonoran desert scrub, fires are expected to increase, which along with introduced plants, could lead to loss of native vegetation.

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 in the eastern portion of the Barry M. Goldwater Range listed by the USFWS as endangered or threatened. We also included additional species that are under review for Federal listing, of high conservation priority for Arizona, or are identified as a key conservation element for BMGR.

Results

Fifteen vertebrate species were scored for BMGR-East. The highest score, or the species most vulnerable to population decline, was the Sonoran pronghorn (*Antilocapra americana sonoriensis*) followed by the desert tortoise (*Gopherus agassizii*). The lowest score was for the California leaf-nosed bat (*Macrotus californicus*), although it had a score close to zero indicating a relatively neutral effect of climate change. Phenology or timing was consistently an important factor in species' vulnerability.

No species was scored as negative or expected to benefit overall from climate change effects, although many species possessed resilient traits. It is likely that this result is partly due to climate change exacerbating some of the current impacts, not directly part of scores, already responsible for declines in these species.

All taxonomic classes had similar vulnerability on average with the lowest for birds and the highest for reptiles. The most vulnerable species, the Sonoran pronghorn, is also an endangered species, although the other endangered species, the lesser long-nosed bat (*Leptonycteris yerbabuena*), was relatively less vulnerable than most other species in the assessment. Importantly, the two species under review by USFWS for listing, Sonoran populations of the desert tortoise (*Gopherus agassizii*) and Arizona populations of the cactus ferruginous pygmy-owl (*Glaucidium brasilianum cactorum*), were also the second and third most vulnerable in this assessment. Limitations to the scope of this assessment may be partly responsible for these patterns.

Only one plant species was assessed, the acuña cactus (*Echinomastus erectocentrus* var. *acunensis*). It is a USFWS candidate for listing. It received a vulnerability score indicating increased vulnerability to population declines with projected climate change. That a cactus species is also vulnerable to declines associated with climate change despite adaptations to hot climates is an important outcome for management. Interactions such as fire and invasive plants may threaten habitats and pollinators or seed dispersal may be reduced if associated species decline or shift timing out of sync with flowering phenology of the cactus.

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 the desert tortoise may have future populations with highly skewed sex ratios because sex in developing eggs is temperature dependent. Protected areas for the tortoise should consider microclimate of suitable burrowing areas and managers should expect large variability in sex ratios among cohorts.

Recommendations/Lessons learned

1. Water sources, both natural and artificial, will be critical as temperatures rise
2. Take actions to reduce threats, such as fire and exotic grasses, which will encourage habitat conversion
3. Consider timing changes in management plans
4. Consider inclusion of locales or elements associated with cooler microclimates in habitat protection
5. Expect species to shift and local populations to change
6. 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: Couch's spadefoot, desert tortoise, saddled leaf-nosed snake, red-backed whiptail, Yuman fringe-toed lizard, peregrine falcon, cactus ferruginous pygmy-owl, gilded flicker, Le Conte's thrasher, cave myotis, Mexican long-tongued bat, lesser long-nosed bat, California leaf-nosed bat, desert bighorn, Sonoran pronghorn, and acuña cactus. In addition, vulnerability assessment tools were provided for terrestrial vertebrates (v.2.0) and plants (v.1.0).