

Managing for Threatened, Endangered, and Sensitive Species

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Few pieces of national legislation are as important to military land managers, and to the biodiversity they conserve, as the Endangered Species Act (ESA). Military lands may be scenes of recurring bombardment, fire, troop maneuvers, and assorted other disturbances, but they also are sanctuaries for species of plant and animal life whose very existence is threatened.

The Department of Defense (DOD) and other federal agencies estimate that the military's lands and waters harbor more than three hundred species classified as endangered or threatened. Why? For security and safety reasons, military installations are generally off limits to the sort of development pressures that produce habitat loss elsewhere. And the Endangered Species Act (ESA) has given this protection the force of law.

Congress enacted the ESA in 1973. It replaced two much weaker endangered species laws dating to 1966. (For the legislation's history, see <http://www.fws.gov/endangered/esasum.html>). The law charged the U.S. Fish and Wildlife Service (USFWS), part of the Department of the Interior, and the National Oceanic and Atmospheric Administration (NOAA), part of the Department of Commerce, with the job of administering the act and maintaining a record (commonly called the "Endangered Species List") of the flora and fauna it protects (known as "listed species"). The USFWS is responsible for terrestrial and freshwater species while NOAA is responsible for marine species. As a federal agency, the DOD is required to identify and protect the threatened or endangered species on its lands or in its waters, as well as listed species it may impact elsewhere.

More information on ESA can be found in chapter 3, "The Legal and Policy Context for Conserving Biodiversity on Military Lands," and on the Internet at <http://www.fws.gov/endangered/> or <http://www.nmfs.noaa.gov/pr/laws/esa/>. In this chapter, we discuss implementing an endangered species program on a military installation, Arnold Air Force Base in Tennessee.

Basic to the job of protecting endangered species is the idea of "critical habitat"—the place where the endangered species live. Here, military land managers have an important tool at their command: A thoughtfully-written and implemented Integrated Natural Resources Management Plan (INRMP), which installations are required to produce and keep up to date, can allow the USFWS to forgo designating critical habitat on a military installation, thus eliminating a significant administrative burden for the military natural resources manager. (For more on INRMPS, see chapter 11. For more on recent legislation affecting critical habitat see chapter 3.)²

Any installation with federally listed species must address their protection in the INRMP. But, if properly prepared the INRMP can substitute for critical habitat designation as long as the species of interest are addressed to the satisfaction of USFWS.

It is especially important for military land managers to work with their local USFWS ecological services field offices (<http://www.fws.gov/offices>) in the development of this section of the INRMP. Natural resources managers should clearly identify the status of any critical habitat designation, or exemption, in the endangered species section of the INRMP (see related box).

Inventories are Critical

A baseline species inventory is essential for the protection of listed species. Inventories form the foundation of any natural resources program, since such resources cannot be managed without clear knowledge of what and where they are. Sources of resources for developing baseline inventories are varied and numerous. Some examples include:

- universities
- state natural heritage programs and natural resources offices
- The Nature Conservancy (TNC) (<http://www.nature.org/>)
- NatureServe (<http://www.natureserve.org>)
- the Cooperative Ecosystem Studies Unit Network (<http://www.cesu.org>)
- the Long Term Ecological Research (LTER) network (<http://www.lternet.edu>)
- the U.S. Geological Survey (USGS) (<http://www.usgs.gov>)
- Audubon Society (<http://www.audubon.org/states/index.php>) and other bird clubs (e.g., *Partners in Flight* (<http://www.dodpif.org/>))
- state native plant societies (see e.g., Tennessee Native Plant Society, <http://www.tnps.org/>)
- private environmental consultants

Critical Habitat and the INRMP

What is "critical habitat?" Section 3 of the Endangered Species Act (ESA) defines the term this way:

... The term critical habitat, for a threatened or endangered species means ... the specific areas within the geographical area occupied by the species, at the time it is listed in accordance with the provisions of section 4 of this Act, on which are found those physical or biological features (I) essential to the conservation of the species and (II) which may require special management considerations or protection; and

- Specific areas outside the geographical area occupied by the species at the time it is listed in accordance with the provisions of section 4 of this Act, upon a determination by the Secretary [of the Interior] that such areas are essential for the conservation of the species.

- Critical habitat may be established for those species now listed as threatened or endangered species for which no critical habitat has heretofore been established as set forth in subparagraph (A) of this paragraph.

- Except in those circumstances determined by the Secretary, critical habitat shall not include the entire geographical area which can be occupied by the threatened or endangered species.

Section 4 of the ESA describes the relationship between critical habitat and the INRMP:

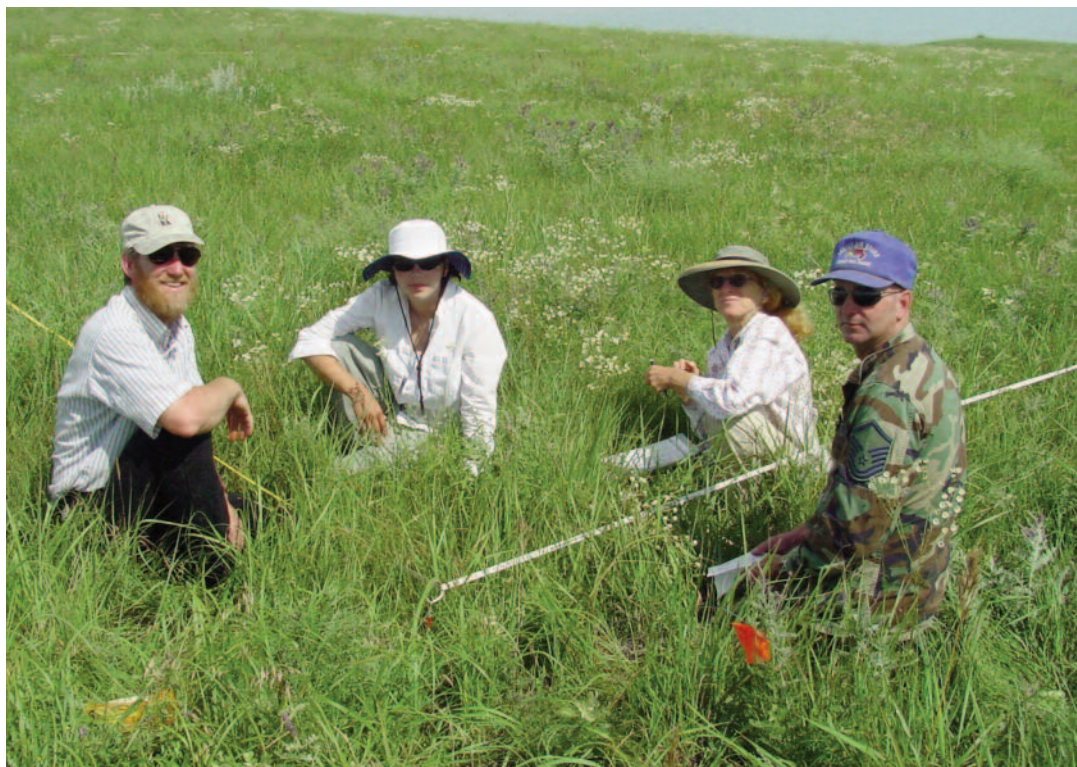
- The Secretary shall not designate as critical habitat any lands or other geographical areas owned or controlled by the Department of Defense, or designated for its use, that are subject to an integrated natural resources management plan prepared under section 101

of the Sikes Act (16 u.s.c. 670a), if the Secretary determines in writing that such plan provides a benefit to the species for which critical habitat is proposed for designation.

- Nothing in this paragraph affects the requirement to consult under section 7(a)(2) with respect to an agency action (as that term is defined in that section).

- Nothing in this paragraph affects the obligation of the Department of Defense to comply with section 9, including the prohibition preventing extinction and taking of endangered species and threatened species.

Members of the Kansas Biological Survey assist MSgt Kurt Keeler, range natural resources officer, in conducting a botanical survey of the Smoky Hill Air National Guard Range, Kansas. Careful biological surveys are the first step in establishing a successful endangered species management program. (Photo: Douglas Ripley)



Baseline inventories should be viewed as starting points, not ends unto themselves. Rare species or those that are secretive by their nature are less likely to be detected in a one-time inventory, so continued inventory and monitoring should be a cornerstone of any natural resources program. As an example, at Arnold Air Force Base (AAFB) extensive surveys were conducted for reptiles and amphibians as a part of the baseline inventory. However, one species, the barking tree frog (*Hyla gratiosa*), which is a state listed species in Tennessee, wasn't detected until two years after the baseline inventory. Researchers heard the frog calling from an isolated wetland while conducting monitoring for other species—whip-poor-wills and chuck-will's-widow. Similarly, the secretive scarlet snake was not detected until six years after the initial inventory.

Highly mobile species, such as migratory birds, must also be considered, as they might not have been present during the baseline inventory. At AAFB, the management regime for grasslands was changed from annual mowing to prescribed burning for the then threatened Eggert's sunflower. Following this change, Henslow's sparrow was detected breeding for the first time. The bird community at these sites was well documented prior to the management change as part of a Partners in Flight monitoring program, so it is highly unlikely that this species was there previously.²

The Five-S Framework

The 1994 Department of Defense memorandum, “Implementation of Ecosystem Management in the DoD,” issued by then Deputy Under Secretary of Defense (Environmental Security) Sherri W. Goodman, stated, in part, “I want to ensure that ecosystem management becomes the basis for future management of DoD lands and waters. Ecosystem management is not only a smart way of doing business; it will blend multiple-use needs and provide a consistent framework to managing DoD installations, ensuring the integrity of the system remains intact.” The memo further states that the DoD will use an ecological approach by continuing to “shift its focus from protection of individual species to management of ecosystems.” But individual listed species must be protected under the ESA. The full text of the document can be found at <http://www.denix.osd.mil>.³

An excellent device for implementing ecosystem management, and also protecting listed species, is the Site Conservation Planning (SCP) process. It is a tool for transferring the science-based, adaptive framework of ecosystem management into a clear set of goals and strategies for a base’s conservation program (TNC 2000). The process is outlined in detail in The Nature Conservancy’s publication, *The Five-S Framework for Site Conservation: A Practitioner’s Handbook for Site Conservation Planning and Measuring Conservation Success*, which can be downloaded at http://www.nature.org/summit/files/five_s_eng.pdf. Also included is a case study of the application of this process at AAFB. The “Five Ss” are Systems, Stresses, Sources, Strategies, and Success (TNC 2000).

The Nature Conservancy developed the planning framework as a means for:

- selecting conservation targets and determining the functional site or landscape they require,
- identifying the human context and the threats it poses to the conservation targets,
- outlining strategies to protect those targets and their functional landscape, and
- developing measures of success related to the conservation goals for the site.

At Arnold AFB this process is used as a planning tool to develop goals and objectives for the INRMP. The planning process involves stakeholders to insure that realistic conservation goals are developed, all threats are considered, and strategies for achieving goals are feasible (TNC 2000). At AAFB, stakeholders are involved in a series of meetings for which they are prepared ahead of time with the topics to be discussed. Among others, the local USFWS Ecological Services Field Office and state wildlife agency are included as stakeholders in the planning process, particularly when discussing threatened or endangered species. When these organizations receive draft copies of the INRMP for review, they are already familiar with the content, as they had assisted in its development. This made the required INRMP Sikes Act coordination a smoother process.

Central to the conservation planning process is the selection of focal targets (the ecological systems, species, or species groups to be managed) for the site of interest. Focal targets are best defined based on ecological systems (the first “S”), but can also include particular ecological communities or threatened or endangered species (TNC 2000). In many cases, managing for system focal conservation targets acts as a management “umbrella” for rare species and/or communities. Rare species and/or communities are grouped as nested conservation sub-targets



Jet overflights by the U.S. Air Force and the German Air Force stationed at Holloman AFB, New Mexico, have the potential to disturb the endangered Mexican Spotted Owl in the Gila National Forest, NM (top). German and U.S. Air Force officers and various scientists (above) have worked closely to monitor the effects of jet noise on the owl in accordance with a Biological Opinion rendered by the U.S. Fish and Wildlife Service. (Photos: top, Arlene Ripley; above, Douglas Ripley)

Important Cooperative Conservation Partners

Bat Conservation International (BCI) (<http://www.batcon.org/home/default.asp>)

Breeding Biology Research and Monitoring Database (BBIRD) (<http://www.umd.edu/bbird/>)

Breeding Bird Survey (BBS) (<http://www.pwrc.usgs.gov/BBS/>)

Monitoring Avian Productivity and Survivorship (MAPS) (<http://www.birdpop.org/maps.htm>)

North American Bird Conservation Initiative (NABCI) (<http://www.nabci-us.org/>)

North American Butterfly Association (NABA) (www.naba.org)

Partners in Amphibian and Reptile Conservation (PARC) (www.parcplace.org)

Partners in Flight (PIF) (<http://www.partnersinflight.org> and <http://www.dodpif.org>)

A listing of bird conservation regions can be found at <http://www.nabci-us.org/map.html>.

under the focal conservation targets and should be protected through the management of the broader focal conservation targets. This approach also benefits state listed or common species; thus it enhances biodiversity. For example, at AAFB, Eggert's sunflower was classified as a threatened species prior to its delisting; however, it was not identified as a focal target. It, along with high priority non-federally listed fauna and flora, are nested sub-targets in the grassland and woodland/savanna/shrubland focal targets. The USFWS was aware of this concept because they were involved in the planning process.⁴

Before proceeding further, it is important to assess the focal targets' current health. The assessment is based on three factors: size, condition, and landscape context (TNC 2000). Thus the first "S" is *systems*, which TNC defines as "the conservation targets occurring at a site, and the natural processes that maintain them, that will be the focus of site-based planning."

Threats to the conservation targets must be identified after assessing their viability. Threats are defined by the *stresses* (the second "S") affecting the targets and the active and/or historical *sources* (the third "S") of those stresses. The stresses and their sources are combined to define the threats to the conservation targets—e.g. mowing instead of burning lands where Eggert's sunflower grows.

Developing *strategies* (the fourth "S") for abating all the stresses affecting the focal targets may not be practical. It's best to review the sources, many of which are common to multiple stresses and targets. Next, rank the active threats (i.e., active sources of stress) for focal targets; next, determine how each active threat affects focal conservation targets, and then begin developing strategies for reducing primary threats. Developing strategies for the highest ranked threats should provide the greatest return on investment (TNC 2000). Strategies are implemented as goals, objectives, and projects in the INRMP.

Success (the fifth "S") is measured through monitoring (populations, acres burned, wetlands restored, etc.). Monitoring is a subject that can and has filled numerous volumes and is too broad a subject to cover here. However, the importance of this last step cannot be overemphasized. It serves as the primary feedback mechanism in an adaptive management program.

In the case of threatened or endangered species, monitoring is needed to justify the substitution of the INRMP for critical habitat designation and to show progress towards achieving delisting. These monitoring steps should be spelled out in an approved recovery plan for a specific listed species. Additionally, when or if a species is delisted; monitoring is a continuing requirement for five years. These requirements will be spelled out in a post-delisting monitoring plan. (Visit <http://www.fws.gov/endangered/recovery/index.html> for details regarding the delisting process.)

Cooperative Conservation

Cooperative conservation is defined in Executive Order 13352 (http://www.nepa.gov/nepa/regs/Executive_Order_13352.htm) as "actions that relate to use, enhancement, and enjoyment of natural resources, protection of the environment, or both, and that involve collaborative activity among federal, state, local, and tribal governments, private for-profit and nonprofit institutions, other nongovernmental entities, and individuals." This executive order gives DoD installations the ability to work with outside agencies and stakeholders in conserving natural resources. By working with other stakeholders, DoD installations can contribute to and use the resources of these organizations. Obviously, benefits of cooperative

conservation efforts to endangered species and natural resource programs are vast, from increased scale of projects to technical knowledge of resources. Many cooperative partnerships can help the DOD address endangered species issues with specific plant and animal groups and compliance with other federal wildlife protection laws, such as the Migratory Bird Treaty Act.

MIGRATORY BIRDS

A number of laws and treaties have been established for the protection of migratory birds in the United States (see <http://www.fws.gov/migratorybirds/intrnltr/treatlaw.html>). The Migratory Bird Treaty Act was formed out of treaties with Canada, Japan, Mexico, and Russia and protects migratory birds in those countries. From this and other laws and treaties, federal agencies are mandated to protect migratory birds. As discussed in chapter 3, this mandate was clarified and enhanced in January 2001 when Executive Order 13186, *Responsibilities of Federal Agencies to Protect Migratory Birds*, was published (see <http://www.fws.gov/migratorybirds/EO/migbrdeo.pdf>). In this order, federal agencies are directed to protect migratory birds and to participate in cooperative conservation efforts such as Partners in Flight, North American Waterfowl Management Plan, and others.

In compliance with Executive Order 13186, a memorandum of understanding between the USFWS and the DOD was signed in 2006. This agreement states that the DOD will cooperate, when possible, with many national organizations designed to coordinate bird monitoring projects both nationally and internationally, such as MAPS, PIF, BBS, BBIRD, and NABCI (see box on previous page.) As part of cooperation with NABCI, the USFWS and DOD have adopted the Bird Conservation Region (BCR), a geographical framework, as a basis for conservation efforts. (To find a specific region, visit <http://www.nabci-us.org/map.html>.) State ornithological societies can offer information on local species and habitats as well (for example, the New York State Ornithological Society, see <http://www.nybirds.org>). These are among the many programs that are invaluable sources for data and monitoring of listed species. More information on migratory bird conservation can be found at the USFWS migratory bird web page (<http://www.fws.gov/migratorybirds/>).

OTHER PLANT AND ANIMAL GROUPS

In addition to the information on birds provided by the groups and agencies mentioned above, other organizations provide conservation support for other major plant and animal groups. Partners in Amphibian and Reptile Conservation (PARC) is “an inclusive partnership dedicated to the conservation of the herpetofauna—reptiles and amphibians—and their habitats,” and is recognized by DOD. Regional chapters of PARC (see <http://www.parcplace.org>) are a great place to find information on the amphibians and reptiles of an area. State herpetological associations are another source for cooperative agreements (an example is the Kansas Herpetological Society at <http://www.cnah.org/khs>). Bat Conservation International (BCI) and the DOD enjoy a cooperative agreement for the conservation of bats in the U.S. BCI (see <http://www.batcon.org>) is a valuable source of technical information on all aspects of bat protection. State and regional bat groups are also available for information (for example, the Southeastern Bat Diversity Network at <http://www.sbdn.org>). Other organizations useful in cooperative conservation efforts include state native plant societies (such as the California Native Plant Society at <http://www.cnps.org>), the North American Butterfly Association

Camp Bullis, located in the Edwards Plateau of central Texas, provides some of the best remaining breeding habitat for the critically endangered Golden-cheeked Warbler (below). Careful management of the species' habitat in consultation with the U.S. Fish and Wildlife Service ensures that Army operations do not adversely affect the species (bottom). (Photos: warbler © Steve Maslowski; sign, Douglas Ripley)



(<http://www.naba.org>) and its associated local chapters, and many more.

Another especially important source of information and assistance is state natural resources offices. These offices have expertise and knowledge of most animals and plants in a state. Along with USFWS field offices and regional offices, state natural resources agencies—especially the state natural heritage programs—can provide important information on endangered species and the biodiversity of a specific area. NatureServe, which represents the network of state natural heritage programs, maintains the NatureServe Explorer website, a source for authoritative data on more than 70,000 plants, animals, and ecosystems in North America (see <http://www.natureserve.org/explorer/>.) Finally, the state wildlife action plans, now completed for every state, are excellent sources of information about threatened, endangered, and rare species (<http://www.wildlifeactionplans.org/>).

Cooperative conservation can benefit many agencies and groups, including—especially—military installations. By using these various agencies and groups, installations can achieve goals that would not be possible otherwise. For biodiversity and especially endangered species conservation, cooperation among groups is essential to the success of any natural resources program.

The NatureServe Explorer website is an outstanding source of information on threatened, endangered, and rare species in North America.

The screenshot shows the NatureServe Explorer website. The header includes the NatureServe Explorer logo and the tagline "An Online Encyclopedia of Life". Navigation links for Search, About Us, About the Data, Local Programs, and Help are visible. A welcome message states: "Welcome to NatureServe Explorer, an authoritative source for information on more than 70,000 plants, animals, and ecosystems of the United States and Canada. Explorer includes particularly in-depth coverage for rare and endangered species." A "Species Quick Search" box is present, with a search button and a "GO" button. Below the search box, it says "or search Species and/or Ecological Communities & Systems by Name, Taxonomy, Location, or Conservation Status." A map of North America is shown with a monarch butterfly overlaid. The text below the map reads: "NatureServe Explorer is a product of NatureServe and its natural heritage member programs. Use the database to easily find: scientific and common names, conservation status, distribution maps, images for thousands of species, life histories, conservation needs, and more." The footer includes "Copyright © 2007 NatureServe" and "NatureServe Website | Support Us | Feedback | Offices".

HOW IT WORKS: CONSERVATION PLANNING AT ARNOLD AIR FORCE BASE

The basic concepts of Site Conservation Planning are outlined above. What follows is an example of how such planning was applied at one military installation, Arnold Air Force Base in Tennessee, using the base's Integrated Natural Resources Management Plan. On the base's 40,000 acres is the vast Arnold Engineering Design Center, which operates 53 wind tunnels and other specialized units.

The first phase of conservation planning at AAFB was completed in 1999, with participation from invited stakeholders. The conservation planning effort was revisited in 2001 during an internal meeting of AAFB's conservation program, facilitated by The Nature Conservancy. The most recent revisions were developed during internal meetings in 2005 and were presented to the USFWS, Tennessee Wildlife Resources Agency, Tennessee Army National Guard, and Tennessee Department of Environment and Conservation for comment. During and following the 2001 and 2005 meetings, the conservation planning process for AAFB was documented in a spreadsheet application designed for that purpose by TNC. The following paragraphs describe the conservation planning process at Arnold and present the revised focal conservation targets for AAFB that resulted from the internal meetings during 2005.

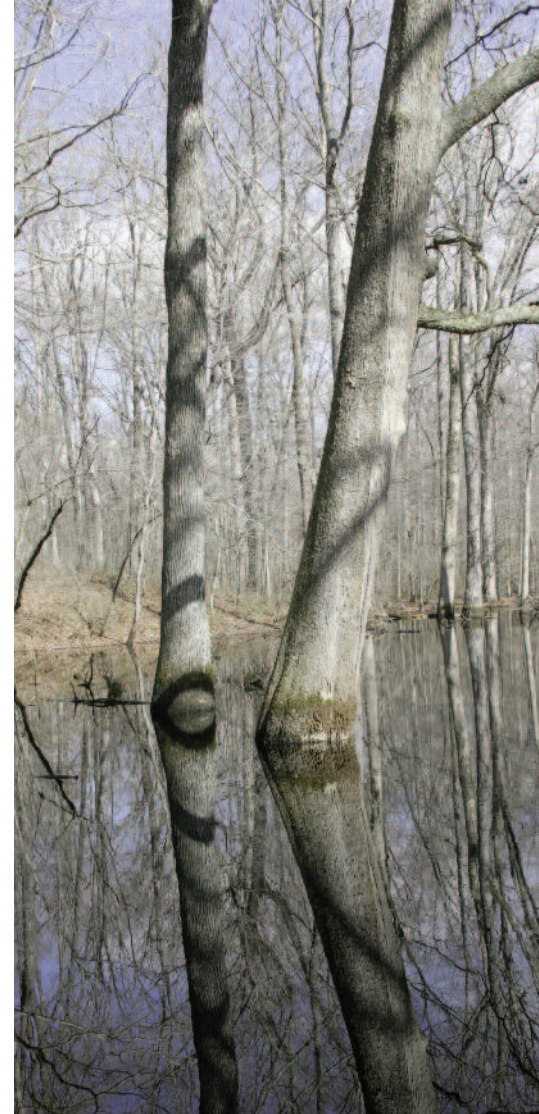
The planning process requires periodic reassessment of targets, threats, and strategies and incorporates new information and changing perceptions into the planning framework. This has proved to be an important concept for AAFB's conservation program, as focal conservation targets were realigned during an internal conservation planning meeting in 2005. The focal conservation targets identified for the five-year period, 2007–2011, are:

- amphibians
- gray bat
- karst wetlands
- streams, springs, riparian zones, and mesic slopes
- closed canopy hardwood forest
- woodland/savanna/shrubland
- grassland
- rare, threatened, or endangered flora not covered in system targets

The woodland/savanna/shrubland system target is a gradient of successional stages that may intermingle spatially. Included in this focal target are rare plants (i.e., Eggert's sunflower and others), two plant communities, and the faunal communities they support. Rare faunal communities include several high-priority bird species on the Partners in Flight lists and a highly diverse reptile community, which includes the state threatened pine snake. This target will be used as an example through the remainder of this case.

Target Viability

The first step toward identifying threats to the focal targets is to generally assess their viability. Viability is based on three factors: size, condition, and landscape context.



Sinking Pond, a National Natural Landmark, represents one element of the rich biological diversity found on Arnold AFB, in central Tennessee. (Photo: Douglas Ripley)

TABLE 6.1

Managing the conservation target Woodland/Savanna/Shrubland with prescribed fire will benefit the threatened and endangered species and communities that are listed here as sub-targets.

Source for Tables 6.1, 6.2, 6.3: Arnold Air Force Base. 2006. Arnold Air Force Base Integrated Natural Resources Management Plan. FY 2007–2011. Signed in December 2006.

CONSERVATION TARGET- WOODLAND/SAVANNA/SHRUBLAND			
Flora Sub-targets	G1 and G2 Plant Communities Sub-targets*	Fauna Sub-targets	USFWS Birds of Management Concern for Central Hardwoods Bird Conservation Region Sub-targets
Dwarf huckleberry	Post oak (Scarlet oak) Blackjacket oak /	Northern harrier	Red-headed woodpecker
Eggert's sunflower	Hillside blueberry (Deerberry) Woodland	Loggerhead shrike	Short-eared owl
Pale purple coneflower	(Southern Red Oak, Post Oak) /	Northern pine snake	Prairie warbler
Sand cherry	Blackjacket Oak / (Black Huckleberry,	Eastern slender glass lizard	Bachman's sparrow
Narrow-leaf bush-clover	Dwarf Huckleberry) Woodland	Meadow jumping mouse	Blue-winged warbler
Green milkweed			

* **Global ranks** are determined by the scientific staff of NatureServe and state natural heritage programs. Global ranks are the best available and objective assessment of the rarity of a species and the level of threat to its existence; communities are ranked similarly. For definitions of these ranks, see Table 1.1 in Chapter 1. A full discussion is provided on the NatureServe website at <http://www.natureserve.org/explorer/ranking.htm>.

TABLE 6.2

Viability rank for woodland/savanna/shrubland.

TARGETS	SIZE	CONDITION	LANDSCAPE CONTEXT	VIABILITY RANK
Woodland/savanna/shrubland	Fair	Fair	Poor	Fair

TABLE 6.3

Example of rank order of active threats to targets.

Active Threats Across Systems	Amphibians	Woodland/Savanna/Shrubland	Grassland	Overall Threat Rank
Lack of Target Redundancy	—	—	VERY HIGH	HIGH
Invasive/Alien Species	MEDIUM	MEDIUM	MEDIUM	HIGH
Limited Prescribed Fire	—	—	HIGH	MEDIUM
Lack of Connectivity	—	MEDIUM	MEDIUM	MEDIUM
Small Patch Size	—	—	MEDIUM	LOW
Threat Status for Targets and Site	MEDIUM	MEDIUM	VERY HIGH	HIGH



Wildlife biologists at the Barry M. Goldwater Range, Arizona, carefully monitor for the presence of the endangered Sonoran pronghorn antelope. Air Force and Marine Corps operations can proceed on individual bombing ranges only if no antelope are detected within 15 kilometers. (Photo: Douglas Ripley)

The viability ranking process provokes thought and discussion that become the basis for assessing factors that threaten the status of the focal targets, and overall biodiversity in the planning area. Planners generally define those threats in terms of human behaviors and land uses that, if left unchanged, would adversely affect the targets in the conservation area.

Justification must be documented for each the rankings. For example, as shown in Table 6.2, the size of the woodland/savanna/shrubland target was ranked as fair because, although landscape patch size, or management unit size, is variable, some large units are under management. The condition for this target is rated as fair because, while highly diverse plant communities do exist in barrens restoration sites, the majority of this habitat type is the result of other management goals (i.e. silvicultural practices). Bird species diversity, however, remains high in most of these patches. The landscape context is ranked as poor because it occurs in a fragmented state, scattered across the base. Small patch size leads to increased nest parasitism and predation of breeding birds. In addition, lack of landscape connectivity prevents colonization by low mobility species (e.g., pine snake).

Threats: Stresses and Sources of Stress

During this step, the stresses should be ranked in terms of their severity and scope. Severity is the level of damage to the conservation target that would result from the stress during the planning timeframe. Scope is the geographic extent of the damage to the target that the stress would be expected to cause at the site. Each of these factors is ranked qualitatively as very high, high, medium, or low. The two factors are combined to derive a single rank for each stress in relation to each target.

It would not be practical to develop strategies for abating all stresses affecting the focal targets on AAFB. A more reasonable approach is to review and prioritize the sources, many of which are common to multiple stresses and targets. The Site Conservation Planning software application developed by TNC performs this analysis and produces a ranking of active threats (i.e., active sources of stress) for focal targets (Table 6.3). This permits managers to determine how each active threat affects focal conservation targets and to begin developing strategies for abating primary threats to biodiversity on AAFB.

Strategies for Threat Abatement

Planners at a 2005 conservation meeting identified strategies that could be implemented to reduce conservation threats. These strategies were translated into goals with supporting objectives and associated projects which will work toward achieving objectives over the lifetime of the INRMP (see box below). Monitoring and research projects are also in place to track management effectiveness and to develop information that will increase knowledge of ecological patterns and processes. Such knowledge will be essential for adapting management strategies in the future and ensuring that monitoring programs track relevant indicators and changes in key ecosystem patterns and processes.

Eggert's Sunflower: an Endangered Species Act Success Story

Eggert's sunflower (*Helianthus eggertii*), a rare plant of the Highland Rim region of Tennessee, Alabama, and Kentucky, was removed from the federal list of endangered and threatened plants on August 18, 2005. During the eight years it was

Reducing threats: An example

The following sample, taken from the AAFB experience, depicts a process for reducing threats to the woodland/savanna/shrubland target:

Goal 6: Maintain and expand woodland/savanna/shrubland by reintroducing fire as an ecological process.

OBJECTIVE 6.1: Continue maintenance of current woodland/savanna/shrubland (2,400 acres) that have been shown through projects associated with objective 6.3 to exhibit the structural characteristics described in the definitions for this target.

Project 6.1.1: Apply prescribed fire to 800 acres annually and monitor burn severity.

OBJECTIVE 6.2: Expand and create 2,703 acres of woodland/savanna/shrubland.

Project 6.2.1: Apply prescribed fire to 1,500 acres annually and monitor burn severity.

Project 6.2.2: Apply ecological thinning to 100 acres annually.

OBJECTIVE 6.3: Adaptively manage woodland/savanna/shrubland using integrated monitoring data (satellite imagery, vegetation and bird community monitoring) to indicate the current successional stage of management units.

Project 6.3.1: Develop an integrated monitoring program for vegetation structure, invasive pest plants, and bird communities.

Project 6.3.2: Use results of project 6.3.1 to develop a monitoring program using indicator species if determined to be appropriate.

Project 6.3.3: Survey all new woodland/savanna/shrubland and grassland restoration sites for Eggert's sunflower prior to and following treatment.

OBJECTIVE 6.4: Prevent invasive pest plant species from compromising the quality of AAFB's woodland/savanna/shrubland.

Project 6.4.1: Conduct invasive pest plant surveys on 600 acres of woodland/savanna/shrubland per year.

Project 6.4.2: Apply herbicides or implement other appropriate action to control or eliminate invasive pest plants documented in project 6.4.1 within 2 years of the surveys.

listed as a threatened species, monitoring and exploration showed evidence that populations were increasing in size and sustainability. Recovery of a federally listed species is a first for the Air Force, and conservation work at Arnold Engineering Development Center is responsible for this milestone. The base is home to the largest known occurrence of Eggert's sunflower. Efforts here have been of primary importance in the recovery of the species and the delisting process. Active management, research and monitoring, and cooperative agreements have contributed to the sunflower's success at Arnold AFB.

Helianthus eggertii, a showy sunflower that often reaches eight feet in height, was listed as threatened by the U.S. Fish and Wildlife Service in May 1997. Only 34 sites were originally found, in Alabama, Kentucky, and Tennessee. Twenty sites were observed in Tennessee; half of these sites supported less than 20 stems each. At that time, it was believed that the plant was restricted to a few remaining natural Barrens areas, and that it was opportunistically inhabiting low-quality sites in a desperate attempt to persevere.

The Barrens habitats of central Tennessee do, in fact, correlate strongly with the geographic range of Eggert's sunflower. Here, the term "Barrens" refers to the unique grass-, shrub-, and woodland complex that once characterized the High-



The U.S. Fish and Wildlife Service removed (delisted) the Eggert's sunflower from the Endangered Species List in April 2005, thanks in large measure to the exceptional conservation measures taken for the species at Arnold AFB. (Photo: U.S. Air Force)

land Rim physiographic region. The gently rolling uplands, interspersed with wet flats and depressions, appear much like the familiar Midwestern tallgrass prairie-savanna-woodland environment. Prior to European settlement, the health of these systems was dependent on fire and grazing. A history of fire suppression and agriculture, however, has drastically reduced the extent of the Barrens. As a key member of the declining Barrens biological community, Eggert's sunflower has been a species of special concern.

We have learned a great deal about the sunflower's ecology. The USFWS Recovery Plan for the flower called for the documentation and protection of at least twenty self-sustaining populations. At the time of listing, little was known about the plant's population ecology, and what genetic relationship each observed site had to other sites. Nor was it understood that the disturbed manmade sites where it was found represented not marginal, but thriving, sunflower populations.

Genetic studies in 2002 and 2004 helped define what "self-sustaining" means for sunflower populations. Using that information, and exploring a wider variety of habitats, the original number of sites (34) has exploded to 287, providing home to 73 distinct genetic populations. Twenty-seven of these populations occur on public lands, or land owned by The Nature Conservancy, and are now protected by management plans. The plans were developed through the cooperative efforts of the USFWS and partnering organizations, including The Nature Conservancy, Kentucky Transportation Cabinet, Kentucky State Nature Preserves Commission, City of Nashville, Mammoth Cave National Park, Tennessee Wildlife Resources Agency, and Arnold AFB. Each cooperative management agreement provides for continued activity that maintains or expands Eggert's sunflower occurrences.

THE IMPORTANCE OF FIRE

Foremost among techniques for managing this sunflower, and a common element in all the management plans, is the restoration of fire as an ecological process. Arnold AFB practices an unusually aggressive prescribed burning program. Base land managers also utilize mowing (which mimics grazing pressure), and are currently experimenting with various combinations of burning and mowing to determine the most effective method for maintaining the open Barrens environs favored by Eggert's sunflower. Additional treatments include silvicultural practices such as thinning and clearcutting, and invasive pest plant removal.

Of the 27 total protected populations, Arnold AFB is home to 11. Eggert's sunflower is managed here according to several binding plan documents. In the past, the Eggert's Sunflower Management Plan and Barrens Management Plan have directed activities. In support of the delisting process, AAFB and USFWS signed a cooperative management agreement in 2004, guaranteeing continued protection and monitoring of Eggert's sunflower on the base. The agreement provides for the inclusion of sunflower management in the base's new, comprehensive Integrated Natural Resources Management Plan (INRMP). Mandated by the DoD, the INRMP is an authoritative guide for all natural resources activities on base. AAFB conservation staff are also consulting with regional USFWS staff to complete the post-delisting monitoring plan. This plan is federally required to ensure species' stability for the five years following delisting. The ongoing cooperation will address Eggert's sunflower protection and monitoring both on base and across the region.

The Eggert's sunflower case is a good example of ways in which endangered



Restoration burn in wetlands at Goose Pond National Natural Landmark, Arnold AFB. Prescribed burning plays a major role in Arnold's natural resources management program, including endangered species conservation efforts. (Photo: Kevin Fitch)

species on a military installation—or anywhere, for that matter—can be found, studied, inventoried, nurtured, included in an area-wide conservation plan, protected, and, finally, moved to a more exalted status (or “delisted,” as the bureaucratic term would have it). The Eggert’s success story need not be an unusual example. Endangered species of all sorts, be they plants or animals, birds or aquatic creatures, can be conserved once similar attention is focused on them. In fact, it could be argued that the military installation, with its strict attention to rules and regulations and its promise to “get the job done,” is the ideal place to save endangered and threatened species.

NOTES

1. The act sets forth what’s required in designating an area as “critical habitat,” but it also specifies possible exclusions. The Secretary of the Interior, says the act, “shall designate critical habitat, and make revisions thereto, . . . on the basis of the best scientific data available and after taking into consideration the economic impact, the impact on national security, and any other relevant impact, of specifying any particular area as critical habitat. The Secretary may exclude any area from critical habitat if he determines that the benefits of such exclusion outweigh the benefits of specifying such area as part of the critical habitat, unless he determines, based on the best scientific and commercial data available, that the failure to designate such area as critical habitat will result in the extinction of the species concerned.”

Furthermore, the Secretary of the Interior “shall develop and implement plans (hereinafter in this subsection referred to as ‘recovery plan’) for the conservation and survival of endangered species and threatened species listed pursuant to this section, unless he finds that such a plan will not promote the conservation of the species. The Secretary, in developing and implementing recovery plans, shall, to the maximum extent practicable . . . give priority to those endangered species or threatened species, without regard to taxonomic classification, that are most likely to benefit from such plans, particularly those species that are, or may be, in conflict with construction or other development projects or other forms of economic activity; The full text of the act may be found at <http://www.fws.gov/Endangered/esa.html>.

2. Partners in Flight (PIF) was begun in 1990 as a result of concerns about declines in land bird populations. Because many birds migrate across national and geographical borders, the program is international in scope. According to Partners in Flight’s website, “The central premise . . . has been that the resources of public and private organizations in North and South America must be combined, coordinated, and increased in order to achieve success in conserving bird populations in this hemisphere.” To this end, PIF has become “a cooperative effort involving partnerships among federal, state and local government agencies, philanthropic foundations, professional organizations, conservation groups, industry, the academic community, and private individuals.” The Department of Defense is one of PIF’s more active collaborators. For more information, see <http://www.partnersinflight.org/description.cfm> and, for DoD’s participation, see <https://www.dodpif.org>.

3. “Ecosystem management” is akin to another popular term, “sustainable development.” One website has collected definitions of the term at <http://silvae.cfr.washington.edu/ecosystem-management/EcoManFrame.html>. The site, which is maintained by the University of Washington’s College of Forest Resources, says the two themes common to most such definitions are “(1) management should maintain or improve ecosystems; and (2) ecosystems should provide a range of goods and services to current and future generations.”

4. Terms such as “Focal conservation targets” and “Nested targets” are defined by a Nature Conservancy paper by Rebecca Esselman at http://conserveonline.org/workspaces/cbdgateway/cap/practices/bp_2. “Focal conservation targets” are “A limited suite of species, communities and ecological systems that are chosen to represent and encompass the full array of biodiversity found in a project area. They are the basis for setting goals, carrying out conservation actions, and measuring conservation effectiveness.”

The Nature Conservancy. 2000. The five-s framework for site conservation: a practitioner’s handbook for site conservation planning and measuring conservation success. Volume I, Second Edition, June 2000.



In some cases, such as on the plays of the Idaho Army National Guard’s Orchard Training Area in southwestern Idaho (above), species new to science, such as a giant fairy shrimp (top) are discovered as a result of biological inventories. (Photos: Dana Quinney)

Literature Cited