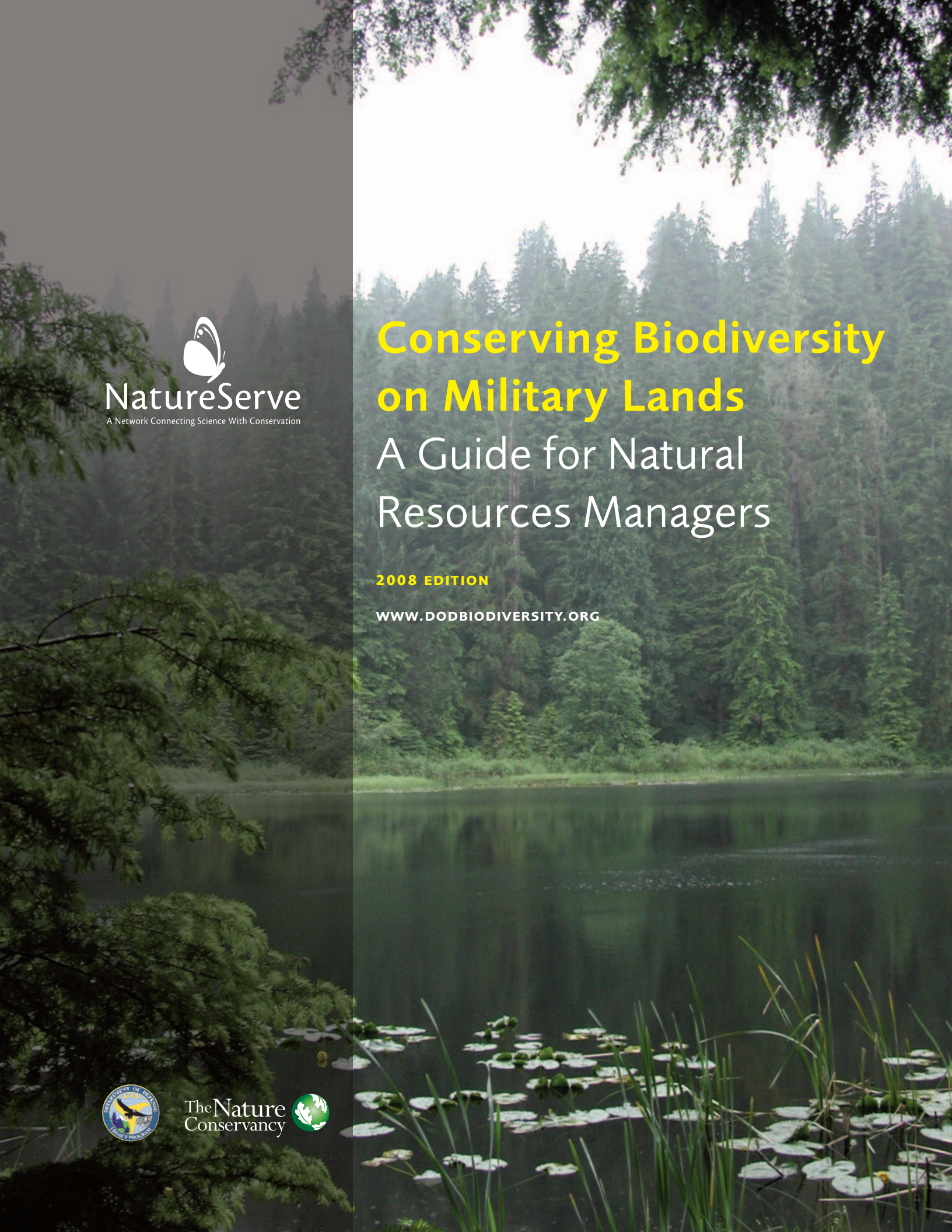

NatureServe
A Network Connecting Science With Conservation

# Conserving Biodiversity on Military Lands

## A Guide for Natural Resources Managers

2008 EDITION

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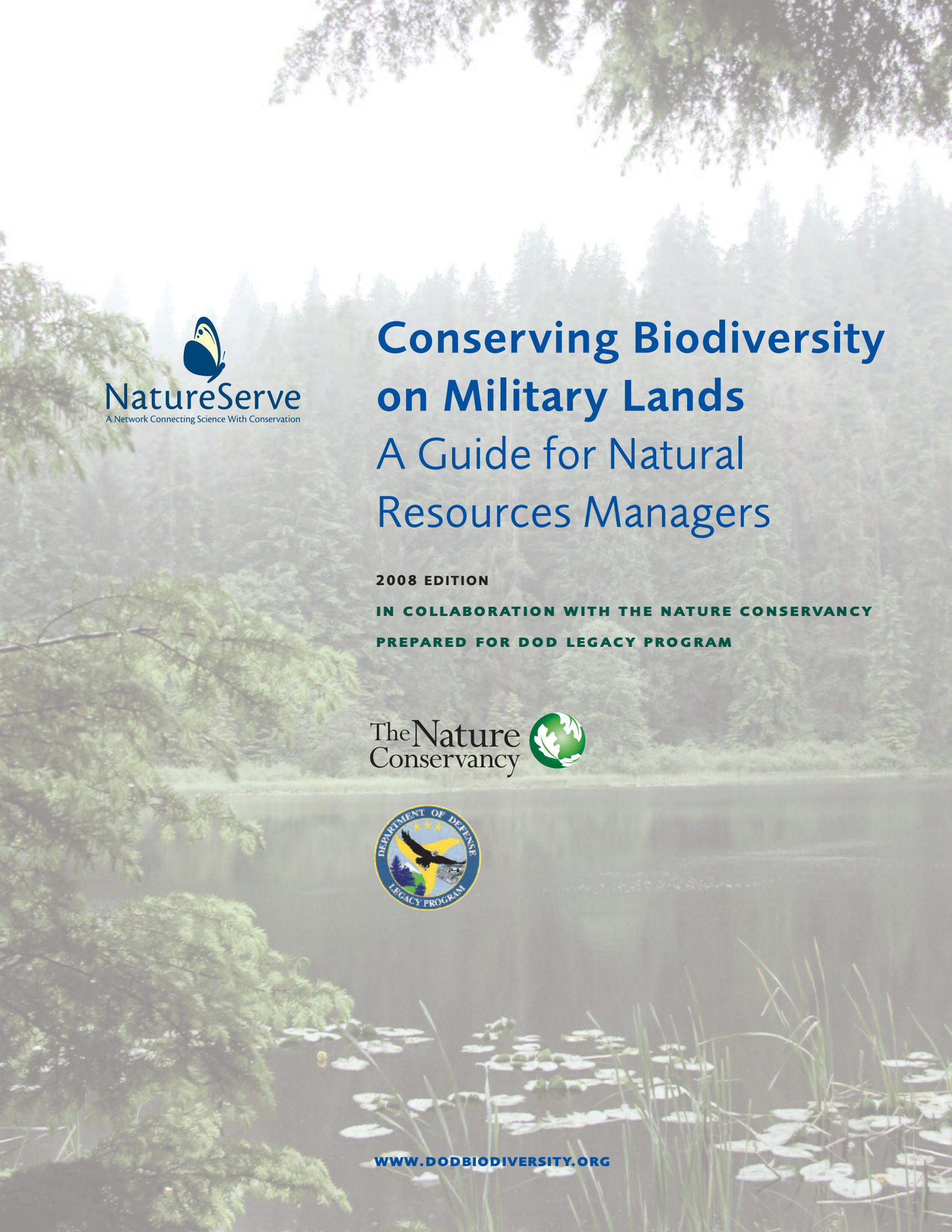
The Nature Conservancy



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## A Guide for Natural Resources Managers

**2008 EDITION**

**IN COLLABORATION WITH THE NATURE CONSERVANCY**

**PREPARED FOR DOD LEGACY PROGRAM**

The Nature Conservancy

DEPARTMENT OF DEFENSE LEGACY PROGRAM

**WWW.DODBIODIVERSITY.ORG**

NatureServe is a non-profit organization dedicated to providing the scientific basis for effective conservation.

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LIMITED PRINT EDITION. This guide was produced as an electronic publication to facilitate future updates and additions. For updated information, see WWW.DOD BIODIVERSITY.ORG.

**IN MEMORY OF MICHELE LESLIE**

**1952–2006**

This publication is dedicated to the memory of Michele Leslie. As The Nature Conservancy's senior policy advisor on the Department of Defense, Michele was the inspiration and principal author of the original *Conserving Biodiversity on Military Lands* handbook. We hope that this new version honors Michele's dedication to understanding and protecting biological diversity and her commitment to conserving the natural resources on our nation's military lands.

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Nancy Benton is a project manager with NatureServe who has managed biodiversity information projects with partners such as the forest sector, the U.S. Bureau of Land Management, and the U.S. Department of Defense. She is trained as a conservation biologist and previously worked as a botanist for NatureServe focusing on conservation of rare plant species and management of invasive species.

J. Douglas Ripley is an environmental consultant who retired from the U.S. Air Force in 2004 after 35 years of service. He has served as natural and cultural resources manager for the Department of the Air Force, and was the DOD project manager for the original 1996 DOD Biodiversity Handbook. He taught biology for ten years at the U.S. Air Force Academy.

Fred Powledge is a freelance writer who specializes in biodiversity and related environmental subjects. He is the author of 17 books and scores of articles in publications as diverse as *The New Yorker*, *Esquire*, *New York*, *BioScience*, and *Audubon*. He is the consulting science writer for the Bay and Paul Foundations' Biodiversity Leadership Awards.

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# Contents

# Foreword

In an era of increasingly demanding and ever-changing requirements for our nation's military forces, the conservation of biological diversity on the lands used to train those forces, and to test the weapons they will need in battle, may strike some as a curious, and even unnecessary, priority. But long experience by the Department of Defense (DoD) with the management of the natural resources on its nearly 30 million acres of land has shown that the environmental health of these lands is absolutely essential for realistic and sustainable military testing and training.

Biological diversity refers to the variety of life and the ecological processes that sustain it. It plays an essential role in the sustainability of the many diverse and complex ecosystems upon which the military relies. Thanks to over two decades of comprehensive inventorying of the plants and animals on military lands, we know now that many of those lands possess a remarkably high level of biological diversity. In many cases, military lands are more biologically diverse and provide more habitats to more threatened, endangered, or sensitive species than public lands specifically managed for their biological values. Maintaining that level of biological diversity, which contributes to the ability of the land to withstand both natural and man-made disturbances, is critical to our national military preparedness.

The DoD has long recognized and complied with the requirements of a wide array of national environmental laws to protect its land, water and air resources and the organisms they support. Indeed, the department has become a leader in compliance with major natural resources laws such as the Endangered Species Act, the Clean Water Act, the Migratory Bird Treaty Act, and many others. Thanks to conducting extensive biological inventories of its lands, the DoD knows that its lands support the highest density of federally threatened, endangered, and sensitive species of any federal land management agency. Likewise, other analyses of DoD lands, typically performed by respected independent environmental groups such as The Nature Conservancy and NatureServe, have revealed that many of those lands represent some of the best-preserved natural landscapes in the country.

The outstanding condition of most DoD lands can be attributed to a number of factors, some more obvious than others. Among the most important is the comprehensive management approach the DoD has employed known as Integrated Natural Resources Management. This approach considers and coordinates all significant natural resources issues in a comprehensive planning document. Those issues range from considerations of the effects of military operations on soils, vegetation, wetlands, and species at risk, to strategies for the management of forestry, agricultural, and hunting and fishing programs. Key to the implementation of the DoD's integrated natural resources program is the dedicated cadre of civilian and military natural resources managers whose job it is to ensure the accomplishment of the military mission in a way that sustains and enhances the natural resources on their installations. But their job can only be accomplished effectively by working in close cooperation with military operators whose support and understanding are critical to success.

It is primarily for the DoD natural resources manager and the military operators who use the land for testing and training that this guide has been prepared. But, as was shown to be the case with the earlier edition of this guide, we hope that the information it contains may prove useful to land managers in

other government agencies, environmental organizations, and interested private individuals.

Building on the success of the 1996 DoD *Biodiversity Handbook,* this updated version, which is also available in an electronic, interactive format, is intended to provide an overview of major DoD natural resources issues with a specific emphasis on biodiversity conservation. As well, much of the original handbook will still be of use to natural resources managers as a supplement to the updated revision. The major subject areas of the revised guide include:

- Biodiversity and the military mission
- Conservation science
- Legal and policy context
- Encroachment issues
- Balancing biodiversity among multiple uses
- Endangered species
- Invasive species
- Landscape disturbance
- Funding for natural resources programs
- Partnerships and issues beyond boundaries
- Building a strong Integrated Natural Resources Management Plan (INRMP)

I hope that all military and civilian DoD natural resources managers and operations personnel will refer to this revised DoD biodiversity conservation guide often. Its new interactive format allows frequent updating and the opportunity for readers to contribute to its improvement by providing comments, feedback, and other suggestions. It is my sincere wish that this new tool for DoD natural resources managers and operators will play an important role in helping the DoD maintain the long-term sustainability of the many complex ecosystems on which the military and our nation rely.

*—Alex A. Beehler*
*Assistant Deputy Under Secretary of Defense*
*Environment, Safety and Occupational Health*

# Preface

This new edition of the Department of Defense (DOD) biodiversity conservation guide has two principal aims. First, it endeavors to present an updated overview of the subject of biological diversity on DOD lands, one that includes discussions of current scientific thought and that reflects the many new issues confronting the DOD natural resources manager. Second, via a supporting website, **www.dodbiodiversity.org,** it aims to provide a forum for military natural resources managers to discuss biodiversity conservation and offer suggestions and ideas for biodiversity enhancement programs.

This 2008 edition is a fully revised and updated successor to the original publication, *Conserving Biodiversity on Military Lands: A Handbook for Natural Resources Managers,* which was prepared by The Nature Conservancy for the DOD in 1996 based on the results of a yearlong dialogue conducted by the Keystone Center. In that effort, experts from the military, academia, private environmental organizations, and other federal and state land management agencies were brought together in a series of workshops to discuss strategies for enhancing biological diversity on military lands. The resulting handbook proved to be an unprecedented success. Over five thousand copies were distributed, and it was adopted as a textbook in three major universities. It has served as a useful reference for many DOD conservation undertakings and remains the only document of its kind prepared by a federal land management agency.

The DOD Legacy Resource Management Program supported the development of this new edition through funding provided to NatureServe. To assess the needs of military natural resources managers, in February 2006 NatureServe conducted a two-day workshop at Arnold Air Force Base, Tennessee, in which key managers from across the country met with scientific and management experts from NatureServe and The Nature Conservancy to develop a detailed outline for the new guide. Other DOD staff were either interviewed personally or asked to participate in an online survey. Military natural resources managers, both at the installation and headquarters levels, prepared many of the chapters. Others, including Chapter 1 (Biodiversity and the Military Mission) and Chapter 2 (Understanding Conservation Science) were authored by respected scientists with long associations with DOD environmental programs. A highly experienced science writer authored the remaining chapters.

One of the main requests from workshop participants and the interviewees was the need for the guide content to be concise, interactive, and updatable. We have responded to this need in two ways. First, the guide is available as an interactive PDF file, rather than merely in print. Second, all content is available through the dedicated website, **www.dodbiodiversity.org.**

A new feature is the inclusion of numerous case studies prepared by military natural resources managers that highlight the successful accomplishments of specific biodiversity conservation projects on their installations. The website allows us to add new case studies periodically, as well as to make additions or changes to the basic text material as needed.

This edition retains and expands the "Toolbox" section of the original handbook, but transfers it to the website, where the ability to update sources should make the Toolbox much more useful than in the original. Finally, the website's interactive "Forum" section in which readers may post questions, comments, or other observations on biodiversity conservation will hopefully prove to be a valuable new addition.

We are confident that this guide will support DoD natural resources managers by providing guidance for implementing biodiversity conservation strategies at the installation level. In addition, it will serve as a valuable tool to inform DoD stakeholders and leadership about the critical need to maintain natural resources in order to successfully meet the military function of DoD lands.

## ACKNOWLEDGEMENTS

This 2008 edition of *Conserving Biodiversity on Military Lands* has benefited from the contributions of numerous people with expertise related to biodiversity conservation and the military. Foremost among them is J. Douglas Ripley, who helped conceive and lead this follow-up effort to the 1996 edition. Over the past two years, Doug conducted dozens of interviews, helped to coordinate an experts' workshop, organized the case studies included in this edition, provided many of the photos, wrote the chapter on policy issues, and provided a constant source of expertise and advice as part of our project team.

We thank science writer Fred Powledge, who was the principal liaison with the chapter authors and also researched and wrote three chapters, for his keen editorial eye, superb writing skills, and sharp sense of humor. Fred brought focus and stylistic consistency to the contributions of multiple authors.

Nancy Benton, NatureServe's project manager, managed all aspects of the project from inception to completion and coordinated the involvement of the many persons who are recognized here. Rob Riordan of NatureServe assisted with editorial and production issues for the guide and the accompanying website. The guide was designed by Marc Meadows of Meadows Design Office, Inc., Washington, D.C.

Funding for this guide was provided by the Department of Defense Legacy Resource Management Program. In particular, we would like to thank Peter Boice and Jane Mallory for all of their support and guidance throughout the project. Joe Hautzenroder of the U.S. Navy was our project sponsor.

We thank all of our chapter authors for sharing their experience and expertise, including: Bruce Stein, Bob Unnasch, Doug Ripley, John Elwood, Dorothy Gibb, Joe Ferris, John Lamb, Troy Weldy, Steve Orzell, William Platt, and Fred Powledge. In addition, thanks to the following people for reviewing chapter drafts: Mary Anderson, Tim Beaty, Scott Belfit, Peter Boice, Pete Egan, Don Faber-Langendoen, Scott Farley, Jim McDermott, Jay Rubinoff, and Marty Skoglund.

In the summer and fall of 2005, we conducted numerous interviews to help inform the direction of the revised edition of this guide, to maximize its usefulness for military and other natural resources managers. We thank everyone who participated in these interviews, including: Bob Anderson, Michael J. Bean, Tim Beaty, David Beckmann, Scott Belfit, Walter Bien, Stuart Cannon, Jamie Rappaport Clark, Richard Clewell, Tammy Conkle, Diane Drigot, Christopher W. Eberly, Paul Ebersbach, Tom Egeland, Daniel Friese, Dorothy Gibb, Lewis Gorman, Jeff Hardesty, Joe Hautzenroder, Steve Helfert, Laura Henze, Tom Lillie, Tad McCall, Rick McWhite, Valerie Morrill, Jim Omans, Charles Pekins, Kevin Porteck, Rick Spaulding, James Van Ness, Sara Vickerman, Tom Warren, and Bill Woodson.

In February 2006 we presented a draft outline of this publication to a group of leading military natural resources managers and other experts. This publication has benefited enormously from the input of these workshop attendees, including: Bob Barnes, Timothy A. Beaty, Scott Belfit, John Elwood, Kevin C. Fitch, Daniel Friese, James McDermott, Richard McWhite, Kim Mello, Valerie Morrill, Charles Pekins, Kyle Rambo, Doug Ripley, Marty Skoglund, Bruce Stein, and Bob Unnasch. Will Murray, formerly with Conservation Impact, facilitated the workshop.

One of the key recommendations of experts we interviewed, and of our workshop attendees, was to include numerous case studies of successful biodiversity conservation on military lands in this current guide, from a variety of military installations, and to showcase not only successes, but also some of the challenges and how military natural resources staffs were able to overcome them. We are grateful to all of the people who volunteered their time to write and/or contribute to the case studies, including: Hannah Andersen, David Beckmann, Scott Belfit, Walter Bien, Pete Campbell, Kirsten Christopherson, Steve Covell, Diane Drigot, Scott Farley, Peter Frank, Brent Friedl, Don George, Janet Bracey Gray, Mary Hassell, Thomas H. Hilliard, Matthew Hohmann, Michael L. Kennedy, James Kerkman, Gerald T. Johnson, Jana Johnson, Will Murray, Jim Omans, Albert Owen, Charles Pekins, Luis Perez, Kyle Rambo, William Rogers, and Stephen Stephenson.

# **Conserving Biodiversity on Military Lands**

A Guide for Natural Resources Managers

CHAPTER ONE

# Biodiversity and the Military Mission

By Bruce A. Stein Ph.D.
Vice President and
Chief Scientist, NatureServe

Set amidst the sandhills of North Carolina, Fort Bragg is one of the largest and busiest military installations in the world. The base, which is the home of the Army's airborne and special operations forces, trains more soldiers each year than any other military installation. The base plays a crucial role in enabling rapid deployments around the world, and soldiers from its 82nd Airborne Division must be ready to fight anyplace on the globe within eighteen hours. Military readiness is dependent on training, and training is a perishable commodity. As a result, Fort Bragg hosts extensive ground and aerial training exercises, and up to one hundred thousand parachutes a year blossom in the skies above the base. The success of these training maneuvers in meeting the military mission depends on the availability of adequate land and realistic fighting conditions.

Sharing the base's airspace and terrain with these parachutists are some of the last remaining red-cockaded woodpeckers (*Picoides borealis*), a federally protected endangered species. Efforts to protect this eight-inch tall, black and white-striped woodpecker had the potential for dramatically restricting the training opportunities at the base with consequences for the installation's capacity for maintaining military readiness. Instead, by taking an innovative approach to managing the base's natural ecosystems and to working across boundaries—geographic and institutional—Fort Bragg not only is helping ensure the survival of this endangered bird, but also is enhancing the availability of realistic training for the nation's troops. And in doing so, those involved have helped forge a new generation of approaches for conserving biodiversity on military lands.

## Biodiversity: What is It?

Biodiversity, most simply put, is the variety of life—everything from genes, to species, to entire ecosystems. Shorthand for "biological diversity," the concept is most frequently applied to the array of plant and animal species that occur in a particular place, or region. The notion, however, captures not only the diversity of species in an area, but also the genetic variation within those species, as well as the organization of these species into biological communities and the variety of ecosystems across a landscape. Biodiversity conservation must take each of these levels into consideration.

As might be expected of a term that attempts to address the dazzling variation in life forms inhabiting the Earth, numerous definitions for biodiversity have been proffered, with each emphasizing one aspect or another of the concept. Perhaps the most widely used definition is contained in the international Convention on Biological Diversity, the international undertaking that grew out of the 1992 "Earth Summit" in Rio de Janeiro. The convention defines biological diversity as:

> . . . the variability among living organisms from all sources including, among other things, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems. (CBD 1992).

Other definitions include a focus on the processes necessary for sustaining this diversity. For instance, a report on biodiversity policy on U.S. federal lands (Keystone Center 1991), defined biodiversity as: "the variety of life and its processes; and it includes the variety of living organisms, the genetic differences among them, and the communities and ecosystems in which they occur."

Looking across the various definitions that have been offered, four key concepts emerge that address different aspects of biodiversity: variety, variability, multiple biological levels, and sustaining processes.

Wetlands such as Alligator Lake at Marine Corps Base Camp Lejeune, North Carolina, are areas of high biological diversity protected on military lands. (Photo: DoD Legacy Program)

**VARIETY.** The number of different biological units of interest--for example, the number of distinct plants, animals, and microorganisms occurring within the bounds of Fort Bragg, or the number of different ecosystems found across the southeastern United States.

**VARIABILITY.** The differences both within and among those biological units--for example, the genetic variation within an individual colony of red-cockaded woodpeckers, or the distinctions found across populations of this woodpecker over its entire range.

**MULTIPLE BIOLOGICAL LEVELS.** The different levels of biological organization, including genetic, species, and ecosystem levels. (Some would add landscape levels to this list.) The levels of this hierarchy are occasionally more finely subdivided.

**SUSTAINING PROCESSES.** The processes that sustain the variety and variability of life forms at these different biological levels. This can include ecological processes, such as the role of fire in maintaining longleaf pine ecosystems, and evolutionary processes, such as the gene flow that results from the dispersal of young woodpeckers.

For purposes of this handbook, the following definition serves to encompass all four of these key concepts: *Biodiversity is the variety and variability of life on Earth, from genes to ecosystems, together with the ecological and evolutionary processes that sustain it.*

Military lands often exhibit high levels of biodiversity, sometimes in surprising places, such as at the Brandywine Radio Site of Andrews AFB, Maryland, located in a highly urbanized area near Washington D.C. (Photo: Douglas Ripley)

## WHY SHOULD I CARE? THE VALUE OF BIODIVERSITY

Constituting the overall fabric of life on Earth, biodiversity naturally provides people with many benefits, direct and indirect. While some of these can be represented in dollars and cents, others cannot—at least not yet. Nonetheless, there is an increasing realization that biodiversity benefits not only our material well-being and livelihoods, but also contributes to our security, health, and freedom of choices and actions. It is no coincidence that many of the regions around the world experiencing the greatest political and social unrest—and requiring the attention or intervention of U.S. military forces—are those where biodiversity and natural resources have been most severely depleted.

The value of biodiversity can be expressed from a variety of perspectives ranging from scientific and economic to ethical and aesthetic. One framework for understanding the value of biodiversity that has been gaining currency over the past few years is termed *ecosystem services* (Millennium Ecosystem Assessment 2005). Under this framework, biodiversity can be viewed as providing benefits in several areas:

**PROVISIONING SERVICES** include the role biodiversity plays in providing food, medicine, fiber, and fuel. Most of the world's food supply, for example, derives from just 20 species of plants, such as corn, rice, wheat, and potatoes. Our ability to ensure the continued production of these crops, and to provide food to a growing world population, depends largely on the periodic infusion of genetic material from wild relatives or locally adapted strains. Similarly, about a quarter of all prescription drugs are taken directly from plants or are chemically synthesized versions of plant substances (Eisner and Beiring 1994). Fungi and microorganisms have proven to be particularly potent sources for new drugs, and more than half of prescription drugs are modeled on natural compounds. Indeed, most breakthrough compounds, such as penicillin, originate from natural products. Our ability to continue developing lifesaving drugs is closely tied to the existence of a robust array of species.

**REGULATING SERVICES** include the role biodiversity plays in the modulation of diseases, climate, floods, and water purification. We now understand that the outbreak and regulation of many diseases is closely tied to changes in biodiversity and integrity of ecosystems. As an example, the spread of Lyme disease, a bacterial infection carried by ticks that, when untreated, causes a debilitating chronic condition, has been linked to changes in wildlife populations in the eastern United States. A combination of burgeoning deer populations and increasingly fragmented forests have combined to increase the risk of Lyme infection in many areas (LoGiudice et al. 2003). Disruption of such disease regulatory mechanisms is a particular concern given the potential risk posed to troops deployed in regions with deteriorating ecological conditions.

**CULTURAL SERVICES** include spiritual, aesthetic, recreation, and education values. Biological heritage is embedded deeply in the social fabric of our society, and communities historically have had close connections with the surrounding natural landscape. A personal relationship with biodiversity often takes place through outdoor recreation such as hunting, fishing, bird watching, or hiking. Many people value the mere existence of species, for instance free-ranging grizzly bears or great whales, even though they may never have the opportunity to see them in person. Religious communities of different faiths view biodiversity as a reflection of the hand of God, and many have embraced conservation as an expression of reverence for the works of creation. The disappearance of natural habitats and decreasing opportunities for outdoor recreation, however, is severing connections between people and the natural world. Together with other cultural shifts, the resulting phenomenon has been termed "nature-deficit disorder" and linked to a variety of social problems (Louv 2005).

The value of biodiversity is also enshrined within the U.S. legal system. The Endangered Species Act of 1973 constitutes the strongest expression of this respect and value for biodiversity, noting that "…species of fish, wildlife, and plants are of esthetic, ecological, educational, historical, recreational, and scientific value to the Nation and its People." While the focus of the act is on preventing the loss of species, the emphasis on ecosystems contained in the act's purpose statement makes clear the connection to the broader concept of biodiversity:

> to provide a means whereby the ecosystems upon which endangered species and threatened species depend may be conserved, to provide a program for the conservation of such endangered species and threatened species…

The Pacific yew at Naval Air Station Jim Creek, Washington. Its wood contains a chemical from which the potent cancer treatment drug known as paclitaxel is derived. (Photo: Douglas Ripley)

Fort Bragg is home to a remarkable array of rare plants and animals, including carnivorous pitcher plants (top) and the tiger salamander (above). (Photos courtesy of Fort Bragg)

## Fort Bragg and the Vanishing Longleaf Pine Ecosystem

In the spring of 1773 William Bartram, a naturalist from Philadelphia, traveled across the Southeast and described "...a vast forest of the most stately pine trees that can be imagined . . . " At that time longleaf pine (*Pinus palustris*) was the dominant tree across much of the Southeast, and the ecosystem that bears its name covered on the order of ninety million acres. Over time, logging, land development, and other factors destroyed most of these old growth pine forests. Currently, less than two million acres of this unique habitat still exist, representing a 97 percent decline, and one of the most drastic reductions of any major natural ecosystem across the United States.

As the longleaf pine forests declined, so too did many of the species dependent on these habitats. Although some species are quite adaptable and able to survive equally well in one type of forest over another, others have highly specific requirements that tie them tightly to a particular habitat. Such is the case with the red-cockaded woodpecker. This species is the only woodpecker that creates cavities in live rather than dead trees, and these roosting and nesting cavities are located primarily in longleaf pines at least eighty years old. The bird's popular name refers to the ribbon-like patch sometimes visible on the heads of males, along with a white cheek patch and black and white barred back. The woodpecker is territorial and non-migratory; birds have an unusual social structure, commonly living in groups that include a breeding pair and as many as four "helpers," offspring from earlier years, who assist in incubating, brooding, and feeding. The woodpeckers live for more than 20 years in cavities they excavate in mature trees; the collection of cavity trees used by a group of woodpeckers is known as a "cluster."[1]

In 1918, when Fort Bragg was created, longleaf pine was still widespread across the Southeast, and the area of North Carolina where the base was established was considered a remote and desolate region. Much has changed since that time, and as longleaf pine forests disappeared across most of their former range, the relative importance of remaining reservoirs of this habitat, such as Fort Bragg, increased. Of Fort Bragg's 161,000 acres, more than half—about 89,000 acres—are covered with longleaf pine, representing one of the last strongholds for this disappearing ecosystem. The base's old-growth longleaf pine forests are rich in biodiversity, harboring a fairly large number of other rare or endangered species beyond the red-cockaded woodpecker. But while the woodpecker, like the pines themselves, formerly occupied a vast area, many of these other rare species are highly localized and were never found outside of the Sandhills region.

### JEOPARDY AND BEYOND

Natural forests on the installation are important for providing a realistic training environment, and by maintaining the forest base managers felt they were doing a good job of sustaining the red-cockaded woodpeckers. The U.S. Fish and Wildlife Service (USFWS), which co-administers the Endangered Species Act, felt otherwise and in 1990 issued a "jeopardy opinion."[2] That regulatory opinion maintained that training activities on the base were having a detrimental impact on the long-term survival of the woodpeckers. As a result of this Fish and Wildlife Service order, a number of training restrictions were required to buffer the woodpeckers from training activities thought to be harmful to them. This resulted in the closure of some shooting ranges, and redesign of other training sites. These restrictions were codified in management guidelines adopted in 1994.

An open stand of majestic longleaf pine forest with wiregrass understory at Fort Bragg, North Carolina. Less than three percent of this forest type still exists across the Southeast. (Photo courtesy of Fort Bragg)

Such extensive restrictions on training activities at Fort Bragg and other Southeastern military installations provoked high-level consternation, including calls from some for congressional action. In an effort to defuse the situation, the Secretary of the Army and the Secretary of the Interior directed their respective staffs to work together and devise a strategy that would both support recovery of the woodpecker consistent with the Endangered Species Act and enable the Army to continue training its troops. A joint Department of Defense/Fish and Wildlife Service team was assembled under the leadership of an experienced infantry officer and charged with tackling the issue.

What is needed to sustain and increase red-cockaded woodpecker numbers was already fairly well known to wildlife biologists, and includes a combination of proactive habitat management and creation of artificial nesting cavities. While a principle focus of the response to the jeopardy opinion was restrictions on training activities, the team recognized that a lack of proactive habitat management


Top: A young red-cockaded woodpecker peers out of an artificial nest cavity at Avon Park Air Force Range, Florida. Innovative management strategies, such as installing these cavities in young pine trees, are aiding the recovery of this endangered species. (Photo: Arlene Ripley).

Bottom: A sign designating red-cockaded woodpecker habitat zone, Camp Blanding, Florida. (Photo: Douglas Ripley)

was probably the greatest factor limiting the bird's survival and recovery. By its regulatory nature, however, the Endangered Species Act is better suited to limiting potentially harmful activities than promoting beneficial ones, and the team was challenged to create a strategy that balanced these approaches.

Fortunately, the type of open understory forest habitat best suited for the woodpecker was also considered by military trainers to be an ideal cover type for providing realistic training experiences. This concordance in habitat preferences opened up a host of opportunities for meeting mutual goals. And fire was key to maintaining suitable conditions for both.

Healthy longleaf pine forests depend on frequent but low-intensity fires. Under natural conditions these forests experienced lightning fires every two to five years. These fires were essential for maintaining the pine forest's characteristic wiregrass groundcover and for preventing scrub oaks and other hardwoods from replacing the pines. The many unusual plants and animals restricted to the Sandhills region evolved with these frequent fires, and most depend on them for their long-term health. As a result, prescribed burns are one of the key management tools for maintaining and restoring Fort Bragg's natural ecosystems, benefiting not only the woodpecker, but also a host of other rare species.

### MISSION-CRITICAL THINKING

The DoD/USFWS team worked together to devise a novel strategy for ways in which Fort Bragg and other Southeastern military bases could contribute to regional recovery goals for the red-cockaded woodpecker. This approach started with understanding the amount of suitable or potentially suitable habitat on the installation, together with an identification of areas considered mission critical from a military training perspective. A specific and quantifiable "Mission Compatible Goal" would then be derived from these acreages, along with a more ambitious "Regional Recovery Goal," which could take into account woodpecker clusters on adjacent lands. Proactive habitat management such as prescribed burns would be applied to all suitable or potentially suitable habitat, and artificial cavities created to help expand the number of woodpecker clusters that existed, and increase the bird's population numbers.

A novel aspect of this strategy was its distinction between two types of new recruitment clusters resulting from the artificial cavities.[3] One cluster type (termed "Primary") would contribute to a base's "Mission Compatible Goal" and be subject to the same restrictions on military training as naturally occurring woodpeckers. The second type (termed "Supplemental") would contribute towards the more expansive regional recovery goal, but would not be subject to training restrictions. The team felt that this approach would encourage a base to produce more than the minimum number of woodpeckers, without being penalized for doing so in terms of training restrictions. Secondly, the approach provided an ideal opportunity for comparing the impact training activities actually have on the bird's reproductive success as a means for evaluating the efficacy of training restrictions in place. Rigorously testing the woodpecker's response to different training-related activities would enable managers to institute a strong adaptive management approach to the plan's implementation.

New management guidelines based on this approach were adopted by the Army in 1996, and Fort Bragg was the first installation to implement an Endangered Species Management Plan (ESMP) under those guidelines. This set the stage for a relaxation in training restrictions at the base.

With a growing number of red-cockaded woodpeckers using the base, the new management approach has proven to be quite successful. In recent years the population of woodpeckers at Fort Bragg has been growing, and in 2006 the population had topped 350 clusters, a recovery goal that had not been expected for another five years. Production of woodpeckers on the base has even been sufficient to enable export of birds to other properties to help in the overall recovery effort.

### PRESSURES FROM OUTSIDE THE GATE

Even as Fort Bragg worked to reconcile red-cockaded woodpecker conservation and military training needs, it became apparent that a major threat to both loomed on the other side of the base fence. Rapid development of lands adjacent to the base was eliminating wildlife habitat and putting pressures on the base's lands. And the human occupants of the new developments increasingly were complaining about the noise and smoke associated with military training exercises. These encroachment pressures demanded "outside the gate" thinking. [4]

Historically, most military posts were established in remote areas where potential conflicts between local communities and military activities would be minimized. As many of these areas have become more densely populated, many active bases are in danger of becoming islands in an ocean of private development, with consequences that can jeopardize the installation's primary missions. By the mid-1990s rapid urban development outside Fort Bragg was becoming increasingly worrisome to installation officials. Although housing and other developments being approved could have major impacts on the Army's ability to carry out maneuvers and other training activities, the Fort had no jurisdiction over land use planning adjacent to the base. And as these adjacent lands were developed, the relative importance of Fort Bragg's lands for sustaining the red-cockaded woodpecker only increased.

Military planners recognized that a buffer of undeveloped land was needed surrounding the base both to meet red-cockaded woodpecker recovery goals, and for the training mission to be sustainable over the long term. At the time, however, there were few options available for the creation of such a protected buffer, and the Army had neither the authority nor the funds to purchase adjacent private lands for this purpose. Against this backdrop, officials at Fort Bragg began working with The Nature Conservancy (TNC), a non-profit organization specializing in private land protection that had a history of working with the Department of Defense, to accomplish broader biodiversity conservation goals. Using Sikes Act[5] authority, in 1995 the Army entered into a cooperative agreement with The Nature Conservancy and the U.S. Fish and Wildlife Service to create the Fort Bragg Private Lands Initiative (PLI). This cooperative agreement and the resulting private lands initiative marked a major innovation, and represented the first of their type within the military.

Under the Private Lands Initiative, The Nature Conservancy was empowered to negotiate the purchase of land or interest in the land (e.g., development rights or conservation easements) from willing sellers. The Army provides funding for the acquisitions, usually matched by the Conservancy, which holds title to the property or easements, and provides for the long-term management and restoration of the habitat. In turn, the Army has negotiated access for compatible training exercises. Acquisition priorities are set by a broad set of stakeholders constituted as the North Carolina Sandhills Conservation Partnership (**http://www.**

Prescribed burning is an effective management tool for restoring pine habitats in southeastern states. (Photo courtesy of Fort Bragg)

New housing encroaching on the boundaries of Fort Bragg, North Carolina, creating potential conflicts for wildlife management and military training. (Photo courtesy of Fort Bragg)

ncscp.org/), and take into account a broader regional perspective. Because of the buy-in of this broader partnership, the initiative has also been successful at attracting funding investments from other agencies, such as the North Carolina Department of Transportation.

The encroachment issues being experienced at Fort Bragg are being felt at installations across the country. As a result, this innovative Private Lands Initiative has served as the model for a nationwide implementation, known as Army Compatible Use Buffers (ACUB). While authority for the Fort Bragg PLI was under the wildlife-oriented Sikes Act, the 2003 Defense Authorization Act reaffirmed and expanded this authority to include constraints on military training, testing, and operations.[6]

### LESSONS LEARNED AT FORT BRAGG

Although Fort Bragg has been a leader in developing new approaches for balancing military training and biodiversity conservation, it is not unique. Creative and successful approaches to managing ecological resources on military lands are taking place across the country, and across the services. This guide relies extensively on the experience and expertise of military conservation practitioners involved in these efforts. Common to many of these efforts are several success factors, which the Fort Bragg example highlights.

Military training and biodiversity conservation are in a balancing act at Fort Bragg: 82nd Airborne Division personnel practice jumps (left); and a biologist drills an artificial nest cavity for red-cockaded woodpeckers (right). (Photos courtesy of Fort Bragg)

- *Focus on the military mission*. The underlying goal from the DOD perspective was to ensure the sustainability of Fort Bragg for carrying out critical training activities and maintaining military readiness. Placing the conservation work in the context of military readiness enabled the Army to tackle these problems with characteristic intensity and efficiency.

- *Think regionally and work across boundaries*. Taking the broader landscape into account was important for understanding the role that the base's lands play in regional conservation issues, and conversely, the impact that off-base land uses have on the base's ability to meet both mission and conservation goals.

- *Rely on the best available science*. A deeper understanding of the needs of the woodpecker, its response to different training regimes, and the processes required to maintain its habitat improved the effectiveness of management actions and allowed more flexibility in crafting approaches.

- *Form partnerships and establish trust*. Success required that individuals and organizations with different values and cultures establish working relationships based on trust. Establishing trust takes time and comes through each party gaining a better understanding for the goals of the others, leading to mutual respect. Partnerships allowed diverse expertise to be brought to bear on the problem.

## State of the Nation: The Condition of Biodiversity Across the United States

Stretching from the arctic of Alaska to the Florida Keys, and the coast of Maine to Hawai'i's volcanic islands, the United States supports an extraordinary diversity of life. Encompassing more than 3.5 million square miles of land and with 12,000 miles of coastline, the nation spans 120 degrees of longitude—nearly a third of the globe. This expanse includes an exceptional variety of terrains, from Death Valley at 282 feet below sea level to Mt. McKinley at 20,320 feet above. The resulting range of climates has given rise to a wide array of ecosystems, from tundra and subarctic taiga to deserts, prairie, boreal forest, deciduous forests, temperate rain forests, and even tropical rain forests. Military installations are widely represented among these ecosystems.

This tapestry sustains a remarkable array of species. Although the total number of species inhabiting our lands and waters is far from fully known, a recent tally puts the number of U.S. species that have been formally described and named by science at approximately two hundred thousand (Stein et al. 2000). Additional species continue to come to light as new areas are explored, and new and increasingly powerful techniques for documenting diversity are developed. While many of these discoveries are among poorly known groups of organisms, such as insects and fungi, even among such relatively well known groups such as the flowering plants up to thirty new North American species are described every year.

The U.S. military has played an important role in helping to discover and understand the nation's biological wealth. When Captain Meriwether Lewis of the First Infantry and Lieutenant William Clark set out in 1803 to cross the continent with their Corps of Discovery, they were under orders from President Jefferson to record everything they could about the countryside, including "the soils and face of the country, its growth and vegetation productions . . . the animals of the country . . . the remains and any which may be deemed rare or extinct." Many

Intrepid explorer and plant collector Major General John Charles Fremont (top) was one of many 19th-century Army officers who contributed to the early understanding of the natural history of the western United States. The beautiful California flannelbush (*Fremontodendron californicum*) is one of many plants named in his honor. (Top photo: University of Utah. Bottom photo: Douglas Ripley)

of western North America's most characteristic, and charismatic, wildlife species were first scientifically documented by the Corps of Discovery, including grizzly bear, pronghorn antelope, and mule deer.

Lewis and Clark's journey was followed by many other military expeditions exploring different routes across the continent, many of which included accomplished naturalists. The expeditions fueled the dramatic expansion in scientific knowledge about our flora and fauna that took place in the mid-1800s. A multitude of western plants and animals enshrine in their names the contributions of military men, such as Captain John C. Frémont (*Fremontodendron californicum*, the California flannelbush), Captain Howard Stansbury (*Uta stansburiana*, the western side-blotch lizard), and Captain John W. Gunnison (*Cynomys gunnisoni*, Gunnison prairie dog).

As exploration of the American continent brought the nation into better focus, it became clear that the lands and waters harbored a spectacular assemblage of plants and animals. And while most people think of tropical rainforests as the region on Earth teeming with the greatest diversity of life, for certain groups of organisms the United States turns out to be a global leader. For example, more salamander species are found in the United States than any other country on Earth, with the greatest concentrations of diversity in the Southeast. A number of other freshwater groups exhibit similar patterns, including freshwater mussels and crayfishes. For gymnosperms, a plant group that includes conifers like pines and spruces, the United States is second only to China in its variety of species.

Hawai'i's inclusion in the United States, first as a territory in 1898 and later as a state in 1959, added tremendously to the richness of the nation's biological fabric. This set of mid-oceanic volcanic islands has never been connected to the mainland, and all life forms naturally occurring in the archipelago either arrived from elsewhere or evolved in place from earlier arrivals. The combination of isolation from other land masses, multiple islands within the archipelago, and the island's dramatic contrasts in terrain and climate—from tropical beaches to icy volcanic peaks—has led to perhaps the most distinctive and unique flora and fauna in the world. A species that is restricted to a specific area is referred to as *endemic* to that area, and Hawai'i has some of the highest levels of endemism in the world. More than two-fifths (43%) of Hawai'i's vertebrate animals are endemic, as are 87% of its vascular plants, and 97% of its insects (Stein et al. 2000). Not only are these species found only in Hawai'i, but many are extremely localized, a factor greatly contributing to the high levels of endangerment found in the Hawaiian flora and fauna that will be discussed in a later section.

### HOW IS OUR BIODIVERSITY FARING?

Broad concern about the decline of wildlife species began in the late 19th century, instigated in part by massive commercial slaughter of such species as the passenger pigeon, and the decimation of many waterbird colonies for plumes to adorn women's hats. These early concerns led to such things as the passage of the Lacey Act[7] in 1900 and establishment of the National Wildlife Refuge System in 1903. By mid-century it was apparent that many species were in decline from a variety of causes. This included the bald eagle, the nation's symbol, whose reproduction was plummeting due to pesticide-related thinning of its eggshells. As awareness of environmental problems increased, a host of seminal federal legislation was passed in the late 1960s and early 1970s, including the Clean Water Act, Clean Air Act, and National Environmental Policy Act (NEPA). The first endangered

Wiregrass and other plants in the understory of a longleaf pine forest recover quickly after a prescribed burn conducted at Fort Bragg, North Carolina. (Photo courtesy of Fort Bragg)

species protection act was adopted by Congress in 1966, and replaced by the more expansive Endangered Species Act of 1973.[8]

Ensuring the continued survival of the nation's species requires that we have a sound understanding of how they are faring. That is, which species are widespread, abundant, and secure, and which are rare or declining, and at increased risk of extinction? Assessing a plant or animal's conservation status—or extinction risk—requires accurate information about the species' distribution, its population numbers, trends in those numbers, and any threats placing stress on those populations. The U.S. Fish and Wildlife Service, which with the National Oceanic and Atmospheric Administration has primary responsibility for administration

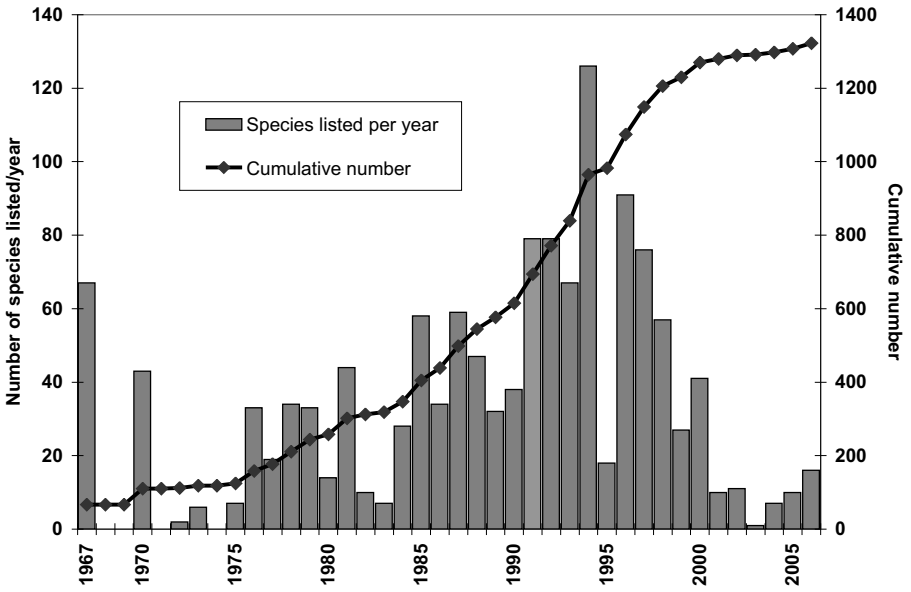
of the ESA, is charged with assessing the condition of plants and animals for the purpose of determining which warrant protection under that Act. For this purpose, the service seeks to identify those species considered endangered, defined as "an animal or plant species in danger of extinction throughout all or a significant portion of its range," and those considered threatened, defined as "an animal or plant species likely to become endangered within the foreseeable future throughout all or a significant portion of its range."[9]

Overall, 1,312 U.S. species were listed under the Endangered Species Act as of June 2007, of which 1,009 were endangered, and another 303 threatened. The number of listed species is dynamic, as additional species are considered for possible listing, and other species considered for delisting due either to recovery, extinction, or reassessment of condition. For example, thanks to the elimination of the pesticide DDT and other conservation practices, bald eagle numbers in the lower 48 states have climbed from a low in 1963 of 417 nesting pairs to nearly 10,000 pairs at present. Based on this strong recovery, the species has now been removed ("delisted") from the federal endangered species list.[10] The federal endangered species list, however, is not a sufficient gauge of the overall condition of the U.S. biota. As Figure 1.1 shows, the rate of listings under the ESA varies dramatically, reflecting not only the biological condition of plants and animals, but also the availability of funds and shifts in policy. As described in more detail later, these federally listed species occur on both public and private lands, and are particularly well represented on military properties.

A better overview of the broad condition of U.S. species is contained in the conservation status assessments carried out by NatureServe and its network of state natural heritage programs. This public-private partnership serves as a clearinghouse for scientific information about the condition and location of the nation's species and ecosystems, with a particular focus on those that are rare or otherwise of conservation concern. Based on about a dozen factors that relate to increases in risk of extinction, these assessments are designed to categorize species into one of five "conservation status ranks," ranging from critically imperiled (G1) to secure (G5) (Table 1.1).[11] Because the status of species may vary from place to place, assessments are carried out at a rangewide scale (where "G" indicates

**FIGURE 1.1.**
**Listings under the U.S. Endangered Species Act**

The rate at which species have been listed as threatened or endangered under the U.S. Endangered Species Act has varied considerably over time. Currently more than 1,310 plant and animal species are afforded protection under the Act (Adapted from Stein et al. 2008)



| STATUS | RANK | DEFINITION |
|---|---|---|
| Presumed Extinct | GX | Not located despite intensive searches and virtually no likelihood of rediscovery. |
| Possibly Extinct | GH | Missing; known from only historical occurrences but still some hope of rediscovery. |
| Critically Imperiled | G1 | At very high risk of extinction due to extreme rarity (often 5 or fewer populations), very steep declines, or other factors. |
| Imperiled | G2 | At high risk of extinction due to very restricted range, very few populations (often 20 or fewer), steep declines, or other factors. |
| Vulnerable | G3 | At moderate risk of extinction due to a restricted range, relatively few populations (often 80 or fewer), recent and widespread declines, or other factors. |
| Apparently Secure | G4 | Uncommon but not rare; some cause for long-term concern due to declines or other factors. |
| Secure | G5 | Common; widespread and abundant. |

**TABLE 1.1.**
**NatureServe Conservation Status Categories**

NatureServe assesses status on three geographic scales: "G" indicates global; "N" means national, and "S" means subnational (state or province). Global categories depicted here. For additional information on the system, see **http://www.natureserve.org/explorer/ranking.htm.**

global), as well as at the state level (where "S" indicates state or subnational). As an example, the red-cockaded woodpecker is categorized as vulnerable (G3) across its entire range, which stretches from Texas to Maryland. Its status in any particular state, however, may differ from that rangewide status. In North Carolina, for instance, the woodpecker is considered to be imperiled (S2), while in Virginia it is regarded as critically imperiled (S1), and in Maryland as possibly extirpated (SH). Combining rangewide and state-level conservation status ranks offers a powerful tool for placing local conservation priorities into a broader context.

By assessing the conservation status of each and every species in the best known groups of plants and animals, NatureServe and its state natural heritage program partners have been able to create a comprehensive view of the overall condition of the U.S. flora and fauna. Summarizing status information across 23 plant and animal groups, representing 22,500 individual species, indicates that approximately one-third (33.6%) of U.S. species display some level of increased risk of extinction (Figure 1.2). Of particular concern are the approximately 8% regarded as critically imperiled (G1) and 9% categorized as imperiled (G2). Looking at risk patterns across the various groups of plants and animals reveals some striking patterns (Figure 1.3). While considerable conservation attention is focused on the plight of rare birds and mammals, these groups actually have relatively modest levels of imperilment when compared with several of the groups dependent on freshwater habitats. Freshwater mussels, for which the United States is the global leader in number of species, emerge as the group of organisms with the highest levels of imperilment, with 69% of mussel species categorized as vulnerable, imperiled, or already extinct. Flowering plants, however, contain by far the largest number of at-risk species, due both to the large number of species in this group overall (more than 15,500), and the many rare and highly localized plants that occur in different regions.

More than one hundred U.S. species are already known to have been lost to extinction, and are categorized by NatureServe as "presumed extinct" (GX). This includes species that were once extremely abundant, such as the passenger pigeon and Carolina parakeet, along with more obscure organisms, like Whipple's mon-

**FIGURE 1.2.**
**Proportion of U.S. species at risk**
About one-third of U.S. species exhibit elevated levels of extinction risk based on conservation status assessments carried out by NatureServe and its state natural heritage program partners (Adapted from Master et al. 2000).

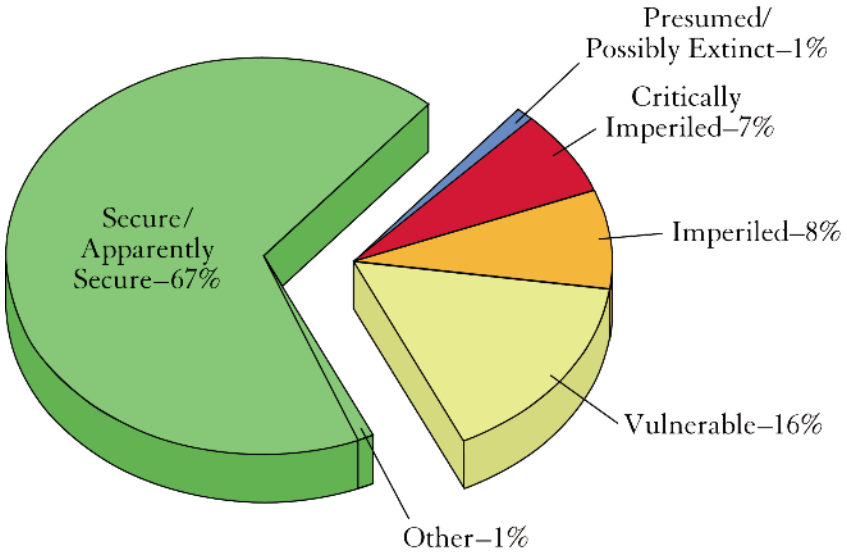
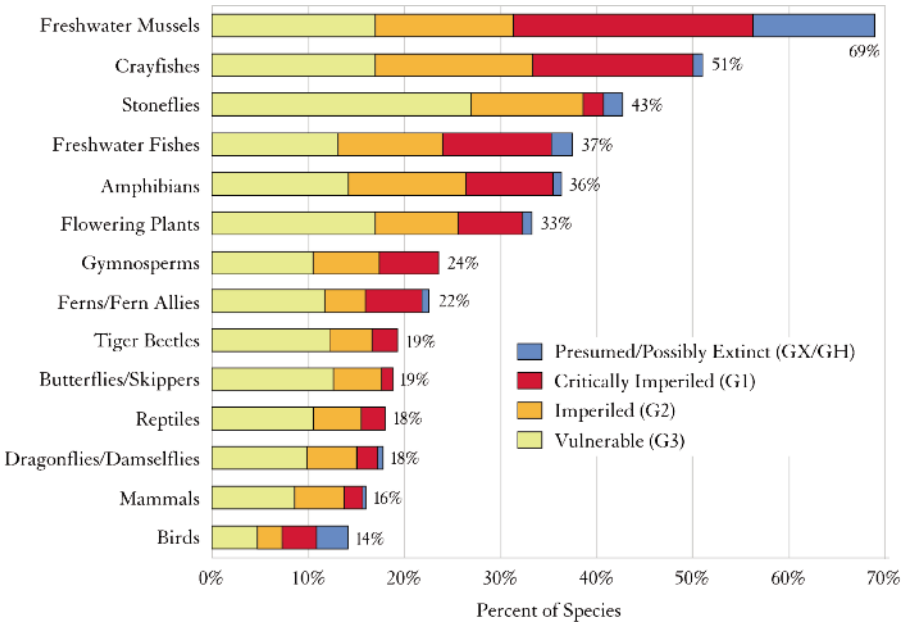



**FIGURE 1.3.**
**Proportion of species at risk by plant and animal group**
Levels of extinction risk vary dramatically among different groups of plants and animals. In general, species groups that depend on aquatic habitats—such as freshwater mussels, crayfishes, freshwater fishes, and amphibians—are faring the worst (Adapted from Master et al. 2000).




keyflower (*Mimulus whipplei*) (yet another species named in honor of a military man, Lt. Amiel Whipple). Definitively establishing that a species has gone extinct is a difficult proposition since one must of necessity rely on the absence of evidence—which is not the same thing as evidence of absence. As a result, another 400 U.S. species are categorized by NatureServe as possibly extinct (GH); most of these species have not been seen in many years and are regarded as missing in action.[12]

### A GEOGRAPHY OF IMPERILMENT

As any outdoors lover knows, wildlife is not distributed uniformly across the landscape, but individual species have very particular habitat preferences. Climate is the principle determinant of a region's flora and fauna: palm trees don't grow outdoors in Alaska, nor do caribou wander around Florida. Although the diversity of

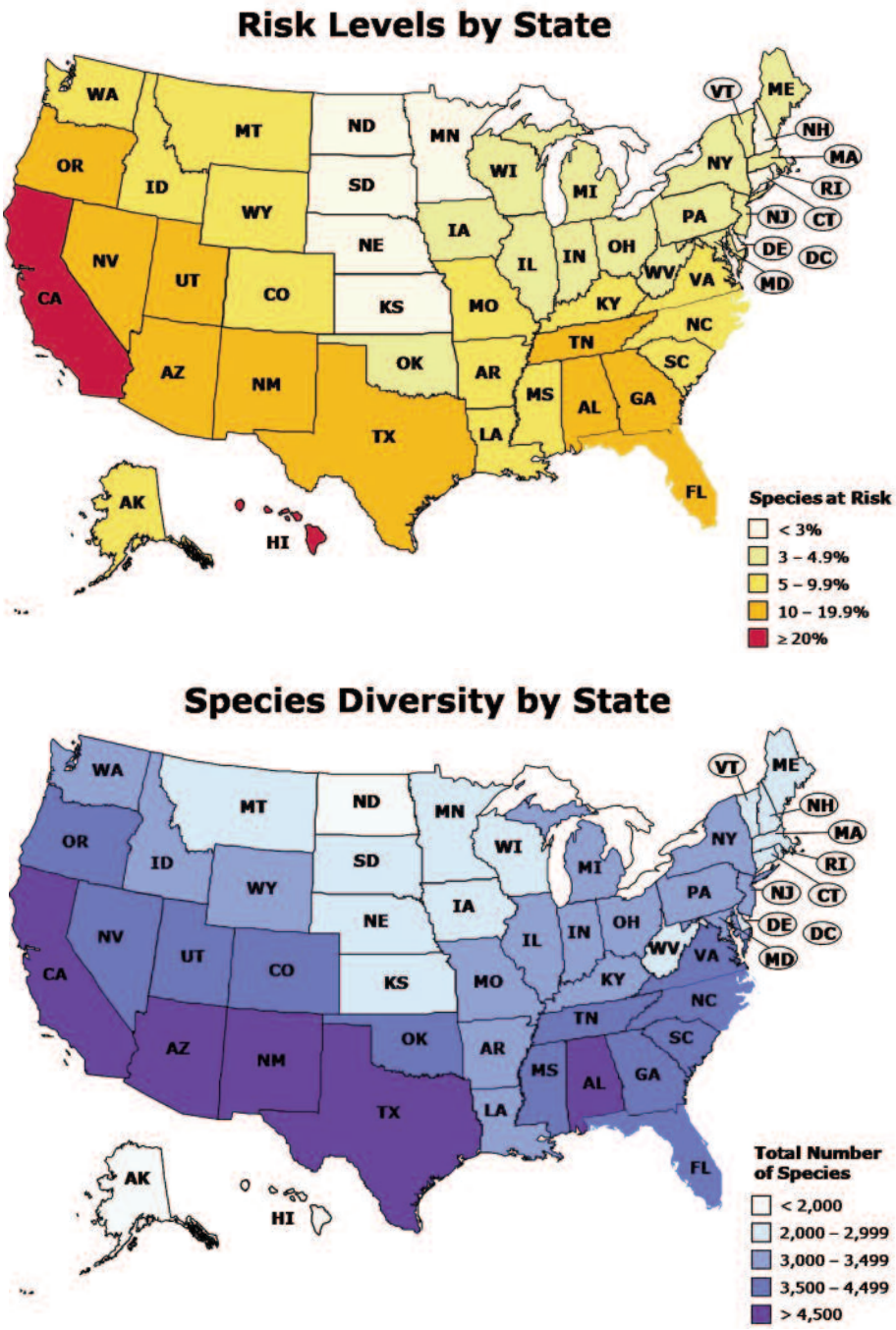



**FIGURE 1.4.**
**Overall state patterns of diversity and risk**
The diversity, or number, of plant and animal species is highest along the Pacific Coast, and more generally along the nation's southern border. Hawai'i displays by far the highest levels of extinction risk among its species, followed by California (Adapted from Stein 2002).

species generally increases as one moves south towards the equator, the natural diversity of species in any given region is dependent on a host of factors. These include the complexity of terrain, type of soils, interconnections with other regions, and even the lingering effects of Pleistocene glaciers. The states with the greatest number of species are for the most part clustered along the nation's southern edge (Figure 1.4). The top-ranking states for total number of species are California, Texas, Arizona, New Mexico, and Alabama (Stein 2002). Looking instead at the levels of risk (that is, the proportion of a state's species that are vulnerable, imperiled, or extinct), Hawai'i and California dominate all others. Indeed, an extraordinary 63 percent of Hawai'i's native species are at increased risk of extinction.

State natural heritage programs maintain databases of precise locational data for most rare and endangered species, representing a valuable resource for military planners and resources managers. Because these state-managed data are

developed and maintained according to nationally consistent standards, they can be pulled together to provide a far more fine-grained view of the geography of imperilment across America. Figures 1.5 and 1.6 represent two perspectives on the distribution of imperiled species across the United States. Mapping the number of imperiled species (G1 and G2) against an equal-area grid (Figure 1.5) provides a striking depiction of where these very rare and often localized plants and animals are concentrated. Of particular note are the concentrations apparent throughout Hawai'i, in many parts of California, in the central Appalachians, across the panhandle of Florida, and along the central ridge of Florida. Through use of an innovative "rarity-weighted richness" analysis (Figure 1.6), hot spots of rare and restricted range species stand out even more sharply, emphasizing the significance of the regions mentioned above. Even a casual perusal of these two maps suggests a considerable overlap between the geography of imperilment and the location of many of the military's landholdings, a topic that will be more fully explored in a later section.

Much of the coastal sage scrub habitat that once covered millions of acres of southern California coast is now fragmented or lost. Marine Corps Base Camp Pendleton serves as a refuge for this rich ecosystem. (Photo: Douglas Ripley)

### CAUSES OF DECLINES

Although there are many causes for the declines of species, two in particular stand out. These are the loss or degradation of natural habitats and the introduction and spread of non-native species. Poised to eclipse even these is the prospect of significant climate change, which has the potential to fundamentally disrupt natural ecosystems and their component species.

The natural complexion of the American continent has changed dramatically in the time since European colonization. Although scholars now recognize that Native Americans extensively managed and manipulated their environment, the extent and condition of major habitats at the time of European settlement serves as a useful baseline for measuring change. The production of food, fuel, and fiber, and the construction of housing and other infrastructure has consumed vast areas of natural habitat. While much of this conversion is old news, the loss of natural habitat and other types of open space continue. Currently, about two million acres of open space are being lost to development a year, amounting to roughly six thousand acres each day (NRCS 2003).

Some natural ecosystems have been affected particularly dramatically. Taking advantage of the rich soils of the Midwest, agriculture has replaced more than 98 percent of the original tallgrass prairie, matching the level of loss to the longleaf pine forests of the Southeast. Wetlands play a particularly important role in providing fish and wildlife habitat and maintaining clean water, yet more than half (53 percent) of wetlands across the lower 48 states have been destroyed (Dahl 1990).

Loss of habitat, and its implication for military operations, is perhaps most vividly illustrated along the rugged coast of southern California. Coastal sage scrub is an aromatic habitat that covered many of the seaside hills stretching south from Los Angeles to San Diego. As one housing development after another has been built in the hills overlooking the Pacific Ocean, much of this unique habitat has been lost one piece at a time. Over the years, the cumulative effect of these piecemeal land use decisions resulted in the loss of much of the original coastal sage scrub, with the result that a variety of species dependent on this habitat type have declined significantly. Among these is the California gnatcatcher *(Polioptila californica)*, a diminutive bird whose plight landed it on the federal list of endangered species. With metropolitan Los Angeles sprawling towards the south,

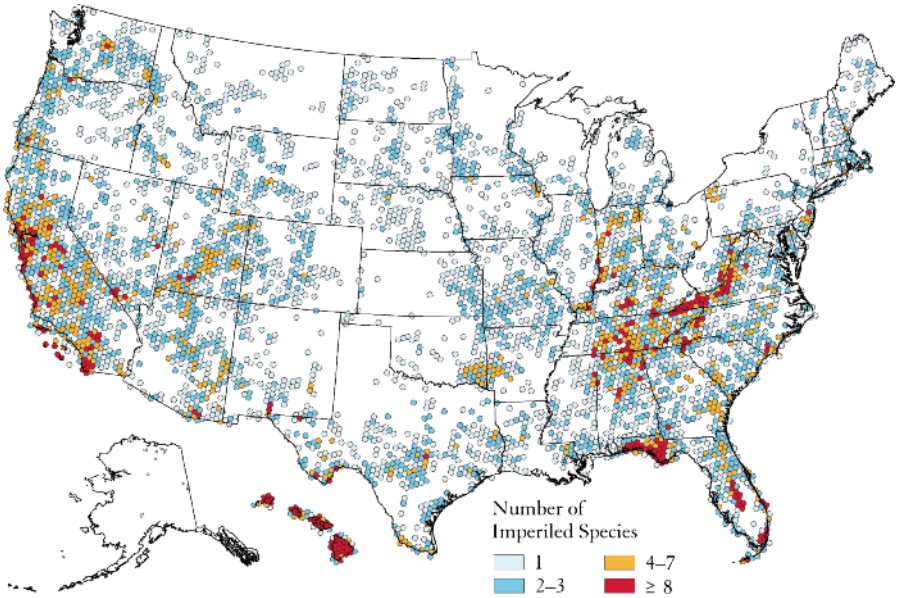



**FIGURE 1.5.**
**Distribution of imperiled species**
Mapping the number of imperiled species across the nation using an equal-area grid highlights the biological importance of regions such as Hawai'i, coastal California, and the Appalachian region (Adapted from Chaplin et al. 2000).

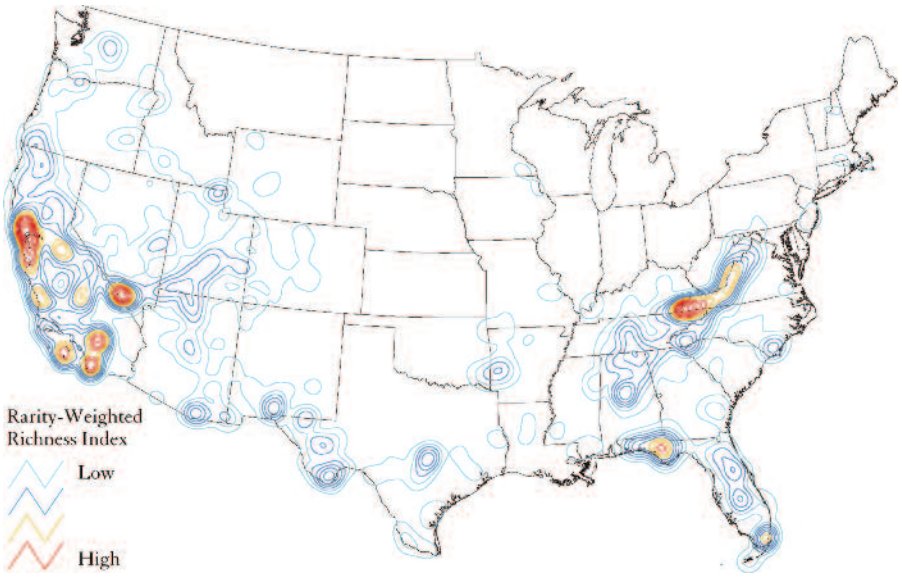



**FIGURE 1.6.**
**Hot spots of rarity and richness**
Using a computer mapping technique designed to accentuate concentrations of rare and locally restricted species provides a topographic-map style depiction of species rarity across the United States. This "rarity-weighted richness" analysis reveals little-known hotspots of biodiversity, such as in the Florida panhandle including and surrounding Eglin Air Force Base (Adapted from Chaplin et al. 2000).

and San Diego spreading north, a single large undeveloped tract of land stands in the way of these two major metropolitan areas' merging—Marine Corps Base Camp Pendleton. Home to the First Marine Expeditionary Force, Camp Pendleton is the only west coast amphibious assault training center. Stretching along 17 miles of coastline, the installation is something of an island of natural habitat in a sea of urbanization, and now harbors the largest contiguous stands of coastal sage scrub in the San Diego region.

## The Role of Military Lands in Maintaining Biodiversity

Camp Pendleton is situated in the midst of one of the nation's most intense biodiversity hot spots (Figure 1.6). Not surprisingly, then, a considerable number of rare and endangered species live here, including at least 17 federally listed species. And as natural lands disappear elsewhere in coastal California, the importance of the base's habitats for sustaining the region's rich and threatened biodiversity increases. But Camp Pendleton is just one of many Department of Defense installations that play an important role in maintaining biodiversity.[13]

In the early 1990s the Navy used DoD Legacy Program funds to acquire timber rights on over 200 acres of old growth forest at the Naval Radio Station Jim Creek in Washington, one of the best remaining low-elevation old growth forests in the Cascade Range. It is managed by the Navy as a watershed, a buffer zone for radio antenna facilities, and a superb recreation area for military personnel and their families. (Photo: Douglas Ripley)

Lands managed by the Department of Defense in the United States cover almost thirty million acres, and span a wide array of different ecosystems, representing many of the major land and climate types in which soldiers may be expected to fight wars. This includes harsh desert terrains like the Yuma Proving Ground in Arizona, mountainous regions like Colorado's Fort Carson, and balmy coastal areas as at Florida's Eglin Air Force Base. Many of these lands were designated for military use long ago, and are situated in some of the premier wildlands across the country. And because a primary mission for most of these bases is training troops in realistic outdoor settings, they often contain excellent examples of their region's wildlife habitat. Over the past twenty years in particular, the military has made a serious commitment to understanding and documenting the wildlife, including rare and endangered species, found on its lands, as a means both to comply with environmental regulations and to work proactively to sustain its resource base.

One way to consider the role of military lands for maintaining biodiversity is to compare the number of species found on defense lands with those of other federal agencies. Several past studies have come to the conclusion that military lands harbor a disproportionate number of at-risk and endangered species. An analysis conducted by NatureServe and The Nature Conservancy (Groves et al. 2000), and based on inventory data from state natural heritage programs, found that Department of Defense lands contained a greater number of species with status under the Endangered Species Act than those of any other federal agency. Because that study was based on data current as of 1996, NatureServe recently has carried out an updated analysis, taking into account changes in the species added to and removed from the federal endangered species list, and additional distribution data from inventories conducted over the past decade.

Based on current information, lands managed by the Department of Defense now appear to harbor about the same number of species with status[14] under the ESA (about 355) as lands managed by the U.S. Department of Agriculture's Forest Service (USFS) (Figure 1.7) (Stein et al. 2008). The DoD, however, manages just one-eighth of the land area managed by the Forest Service (193 million acres). The significance of military lands for biodiversity is particularly striking when viewed from the perspective of number of ESA status species per million acres (Figure 1.8). Species with status under the Endangered Species Act are only a portion of the total number of plants and animals that are at increased risk of extinction and of conservation concern. Considering instead the number of NatureServe-defined critically imperiled (G1) and imperiled (G2) species, military lands appear to harbor at least 458 such species,[15] ranking third in number of imperiled species behind the Forest Service and the Bureau of Land Management (BLM). Looking

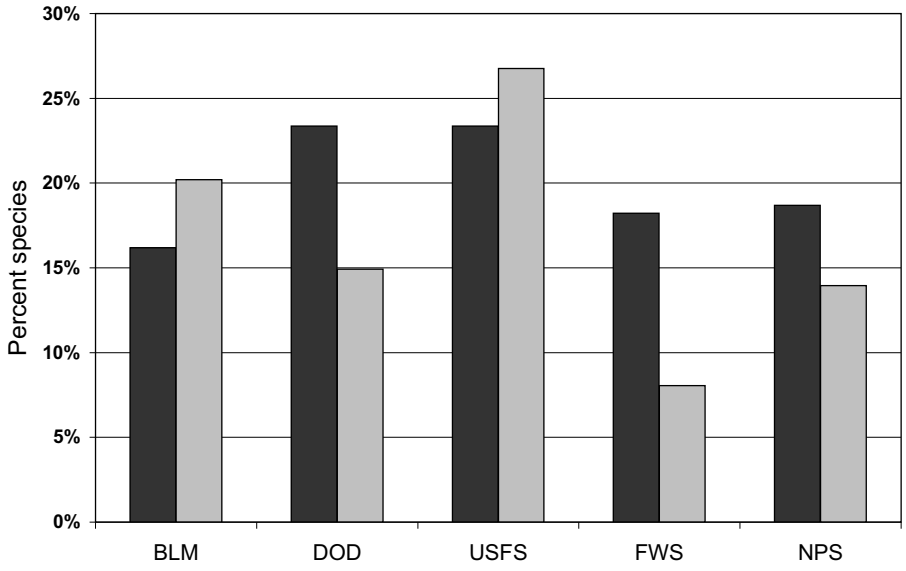



**FIGURE 1.7.**
**Endangered and imperiled species on federal agency lands**
Lands of the Department of Defense and USDA Forest Service harbor the greatest number of species with formal status under the U.S. Endangered Species Act. Approximately 23% of such species are found on DOD lands, representing at least 355 species (Adapted from Stein et al. 2008).

ESA STATUS SPECIES
IMPERILED SPECIES

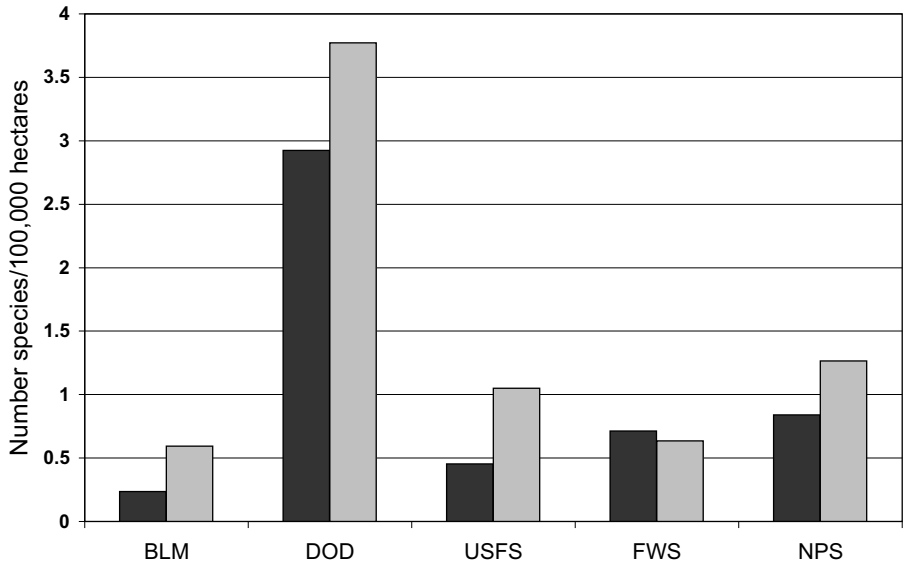



**FIGURE 1.8.**
**Density of endangered and imperiled species on agency lands**
Military lands have the greatest density of both ESA status species and imperiled species of any federal land management agency. DOD lands have at least three times the density of such species as the National Park Service (Adapted from Stein et al. 2008)

ESA STATUS SPECIES
IMPERILED SPECIES

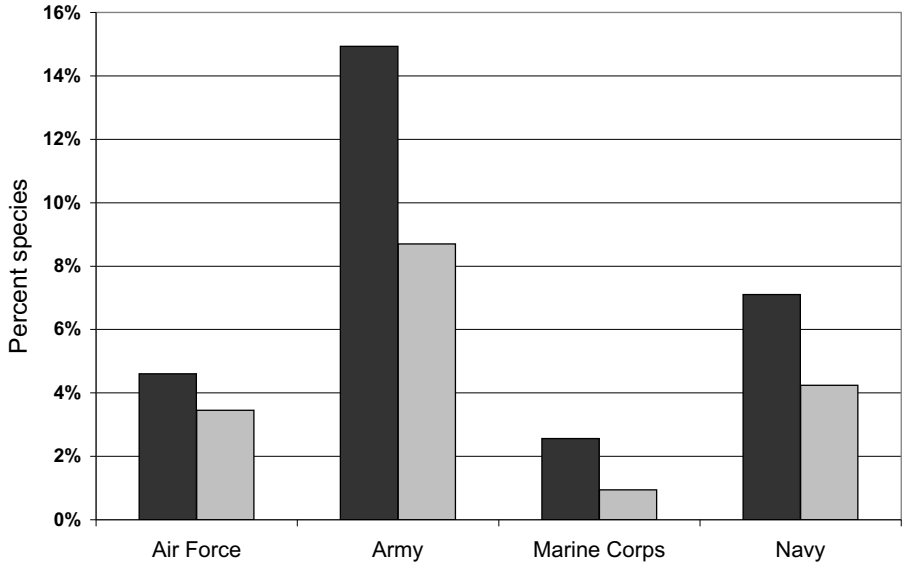



**FIGURE 1.9.**
**Distributions of endangered and imperiled species by military service**
Army lands support about twice the number of both ESA status and imperiled species as those of the Navy (Adapted from Stein et al. 2008)

ESA STATUS SPECIES
IMPERILED SPECIES

**TABLE 1.2.**

**Top Ten Military Installations for ESA Status Species**

| RANK | SERVICE | INSTALLATION | STATE | NUMBER OF LISTED SPECIES |
|---|---|---|---|---|
| 1 | Army | Schofield Barracks Military Reservation | HI | 47 |
| 2 | Army | Makua Military Reservation | HI | 39 |
| 3 | Navy | Lualualei Naval Reservation | HI | 38 |
| 4 | Army | Pohakuloa Training Area | HI | 17 |
| 5 | Marine Corps | Marine Corps Base Camp Pendleton | CA | 17 |
| 6 | Navy | San Clemente Island Range Complex | CA | 10 |
| 7 | Air Force | Eglin Air Force Base | FL | 10 |
| 8 | Air Force | Vandenberg Air Force Base | CA | 10 |
| 9 | Army | Fort Lewis Military Reservation | WA | 10 |
| 10 | Air Force | Avon Park Air Force Range | FL | 10 |

**TABLE 1.3.**

**Top Ten Military Installations for Imperiled Species**

| RANK | SERVICE | INSTALLATION | STATE | NUMBER OF IMPERILED SPECIES |
|---|---|---|---|---|
| 1 | Army | Schofield Barracks Military Reservation | HI | 53 |
| 2 | Army | Makua Military Reservation | HI | 46 |
| 3 | Navy | Lualualei Naval Reservation | HI | 44 |
| 4 | Army | White Sands Missile Range | NM | 33 |
| 5 | Army | Pohakuloa Training Area | HI | 24 |
| 6 | Navy | San Clemente Island Range Complex | CA | 24 |
| 7 | Army | Fort Hunter-Liggett | CA | 18 |
| 8 | Air Force | Eglin Air Force Base | FL | 15 |
| 9 | Air Force | Vandenberg Air Force Base | CA | 13 |
| 10 | Marine Corps | Marine Corps Base Camp Pendleton | CA | 13 |

Source for tables 1.2 and 1.3: Stein et al. 2008.
Note: Figures represent minimum number of species based on documented occurrences in natural heritage databases.

across the services (Figure 1.9), Army bases have more than twice the number of both ESA status (227) and imperiled (267) species than do Navy installations (108 and 130 respectively).

The top ten military installations for ESA status and imperiled species reflect the overall patterns of biodiversity described earlier, with bases in areas such as Hawai'i, California, and Florida well represented (Tables 1.2, 1.3). Four of the top five bases are in Hawai'i—Schofield Barracks Military Reservation, Makua Military Reservation, Lualualei Naval Reservation, and Pohakuloa Training Area—highlighting the extreme levels of endemism and risk associated with the native Hawaiian biota. The military's Hawaiian holdings clearly are a major factor in defining the overall number of ESA status species on DoD lands. The Department of Defense has more discrete land holdings in Hawai'i than any other federal agency, and although many are fairly small in size, as a whole they touch upon a wide variety of biologically distinctive zones, each of which has its own distinct assemblage of rare species. Indeed, more than one-third (34.5%) of all ESA status species on DOD lands are from Hawai'i.

Proactive conservation of imperiled species and their habitats on and around DOD installations can help preclude the need for federal listing as well as reduce

recovery costs. For this reason, a previous NatureServe study focused on identifying species at risk occurring on or adjacent to military lands that could benefit from proactive conservation efforts to avoid the need for possible federal listings (Benton et al. 2004). For purposes of that study, "species at risk" were defined as plant and animal species not yet federally listed as threatened or endangered under the Endangered Species Act, but that are either designated as candidates for listing or are regarded by NatureServe as critically imperiled or imperiled. A total of 523 at-risk species were found to occur on or near DoD installations, of which 47 were federal candidates, 136 were critically imperiled, and 340 imperiled. Interestingly, 24 of these at-risk species appear to be restricted to individual DoD installations, and 82 have at least half of their known occurrences on individual installations. Overall, nearly one-third (30 percent) of military installations had at least one species at risk.

## Evolving Approaches to Military Natural Resources Management

The military is justifiably proud of its natural resources heritage and its tradition of stewardship. The armed forces have been called upon to oversee or manage public lands and natural resources since 1823, when timber and forest products used in shipbuilding were strategic resources (Siehl 1991).[16] Before there was a U.S. Forest Service or a National Park Service, the cavalry and engineers of the U.S. Army managed the lands set aside as national parks. Over the past several decades the military has strengthened its commitment to natural resources management, responding to new challenges and incorporating new scientific and technological advances. This has led to the adoption of ecosystem-based approaches to management, and use of the principles of adaptive management.

With the outbreak of World War II, millions of acres were acquired by the military to house, train, and prepare troops for combat. Construction practices, training exercises, and tank traffic lead to serious environmental problems at many sites, including dust, mud, and erosion. In those years the military largely attempted to address these issues through cooperative agreements with the Agriculture Department's Soil Conservation Service and transfers of agronomists and foresters to military installations. Following the war, natural resources management progressed to include planting of ground cover crops and trees, while timber production, agricultural leasing, and hunting programs were put in place at many installations.

By the 1960s, there was a general shift in public policy toward "multiple use" of public lands and management for "sustained yield." This trend, in conjunction with declining military funding and increasing public pressure for access to military lands for recreation and commercial purposes, shaped natural resources management on military lands. Passage of the Sikes Act in 1960 provided the legal basis for wildlife conservation and public access for recreation on military land, and authorized the collection of fees and the development of cooperative plans by the military, the U.S. Fish and Wildlife Service, and state fish and game agencies. During this period, however, policies generally encouraged consumptive uses of natural resources, and the revenues generated from forestry and fish and wildlife programs became the major source of funding for installation natural resources management programs (Lillie and Ripley 1998).[17]

With the establishment of Yellowstone as the nation's first national park in 1872, the United States Army was charged with providing its protection and management. The Army continued to manage the early national parks until the establishment of the National Park Service in 1916. (Photo: Douglas Ripley)

The 1970s and 1980s were decades of increasing pressure on natural resources management programs. The National Environmental Policy Act, the Endangered Species Act, and a host of other environmental protection statutes added demanding new requirements. The development of new weapons systems, which involved heavier vehicles and longer-range weapons, intensified damage and increased the military's need for additional and diversified training lands. With federal and state regulatory agencies emphasizing environmental cleanup and waste management, there was little institutional incentive to increase either staffing or funding for natural and cultural resources programs (Lang and Lillie 1995). Natural resources management programs continued to focus on game and revenue generating programs, such as agriculture, grazing, timber, and recreational hunting and fishing. It became increasingly clear, though, that the military was facing natural resources management challenges it was not well equipped to address. Poor management was leading to the loss of training lands, while compliance with environmental statutes such as the Endangered Species Act and Marine Mammal Act was becoming an increasing burden on military operations.

This bat box at Naval Air Station Key West, Florida, is just one of many examples of wildlife habitat enhancements carried out on military bases across America. (Photo: Douglas Ripley)

As a way of better addressing these problems, in 1989 a directive was issued calling for the development of Integrated Natural Resources Management Plans (INRMPs) on all installations with significant natural resources.[18] These plans, which are intended to help balance competing interests, began to set the stage for a new approach to resources management. This trend continued in the 1990s, with the military taking stock of its natural resources management responsibilities and considering new approaches for improving performance. Military departments completed audits of their programs and made commitments to complete biological (and cultural) resources inventories, and to improve training for natural resources managers.

Integrating land management with operational and training objectives was identified as key to ensuring the support of the military mission while managing natural resources. Geographic Information System (GIS) technology greatly facilitated analyses of land condition and training requirements and became a useful and widespread tool. The military also began reaching out to others in the government and the private sectors to provide additional expertise and to help develop solutions to common problems. The U.S. Fish and Wildlife Service, state fish and game agencies, USDA Forest Service, and The Nature Conservancy were among the many organizations invited to serve as partners in developing new strategies for natural resources management on military lands.

### ECOSYSTEM APPROACHES AND BIODIVERSITY CONSERVATION GUIDANCE

The emergence of a new philosophy and ethic was evident in DOD's 1994 policy, "Implementation of Ecosystem Management in the DOD" (**https://www.denix.osd.mil**). The goal of that policy was to maintain and improve the sustainability and native biological diversity of terrestrial and aquatic, including marine, ecosystems while supporting human needs, including the DOD mission. The policy goes on to state that military installations will use ecosystem management to: (1) restore and maintain ecological associations that are of local and regional importance and compatible with existing geophysical components (e.g., soil, water); (2) restore and maintain biological diversity; (3) restore and maintain ecological processes, structures, and functions; (4) adapt to changing conditions; (5) manage for viable populations, and (6) maintain ecologically appropriate perspectives of time and space.

Various definitions for ecosystem management have been proposed, but fundamentally this approach focuses on management of complex systems by addressing underlying processes while taking into consideration not only ecological, but also economic and social concerns. It is often contrasted with single-resource management approaches, and a comparison with more traditional natural resources management is a helpful way to understand the essence of the ecosystem approach to management (Table 1.4).

The year 1995 marked a milestone in the military's efforts to develop an overall strategy for managing biodiversity on military lands. At the direction of the Deputy Under Secretary of Defense (Environmental Security), a national dialogue was held under the auspices of the non-profit Keystone Center, which brought together DoD representatives with representatives of other government agencies and nongovernmental interests. The purpose of this dialogue was to develop policy guidance for enhancing and protecting DoD lands in a way that is integrated with the military mission.

**TABLE 1.4.**

**Comparison of Traditional Natural Resources Management and Ecosystem-Based Approaches**

Adapted from Hardesty and Murin 1994

| PARAMETER | TRADITIONAL MANAGEMENT | ECOSYSTEM MANAGEMENT |
|---|---|---|
| Ecosystem Integrity | Minimal concern; focus is on specific components of the ecosystem. | Overriding concern; properly functioning ecosystem is central to stewardship. |
| Knowledge of the System | Data may be lacking, but system can be understood and predicted. | Data critical to experimental management, but complexity of system and influence of stochastic events means much is unpredictable. |
| Spatial/Temporal Scale | Focus on localized and near term; natural resource properties and responses can be generalized over region and longer time periods. | Focus at multiple levels of spatial and temporal scales. Local actions have regional consequences. Effects of management accrue over time, often with time lags. |
| Social Values | Focus on goods and services for humans; sustained yield and revenue generation. | Focus on sustainable use and intergenerational equity. |
| Participation in Management Decisions | Natural resources managers dominate; involvement of others mainly where there are potential conflicts. | Participation by military operators/trainers, local scientists and other important stakeholders. |
| Ecological Perspective | Equilibrium, stability, climax. | Non-equilibrium, dynamics, resiliency, shifting mosaic. |
| Problem-Solving Approach | Solutions developed by resources management agencies through optimization and searches for single right answers. | Solutions developed through discussions among all stakeholders, with the possibility of multiple solutions. |
| Social Context | Confrontation; single issue polarization; public as adversary. | Consensus; multiple issues societal learning; partnerships. |

### BOX 1.1. Importance of Biodiversity Conservation for the Military Mission

The Keystone Dialogue on Department of Defense Biodiversity Management summarized key reasons why biodiversity conservation is important for meeting the military mission (Keystone Center 1996). These include:

- Biodiversity conservation is essential in sustaining the natural landscapes required for the training and testing necessary to maintain military readiness. Managing for biodiversity can help ensure that lands and waters are maintained in a "healthy condition" and thereby facilitate greater flexibility in land use for military operations.
- Biodiversity conservation is a central component of ecosystem management, which has been embraced as the DoD's natural resources management strategy. Given the DoD's significant investment in conserving and protecting the environment, this strategy promises the greatest return on investment--it is simply the right thing to do and the smart way of doing business.
- Biodiversity conservation can expedite the compliance process and help avoid conflicts. Proactive management for biodiversity can provide greater certainty in mitigation for environmental impact assessment processes under the National Environmental Policy Act as well as consultation processes under the Endangered Species Act.
- U.S. citizens demand that federal land managers demonstrate responsible stewardship of public lands. The practice of biodiversity conservation fosters good will within the communities surrounding military installations, which in turn engenders public support for the military mission.
- By helping to maintain aesthetically pleasing surroundings and expanding opportunities for outdoor recreation, managing for biodiversity can improve the quality of life of our nation's military personnel and their families.

The Keystone dialogue revealed strong support by the Department of Defense for biodiversity conservation on military lands and affirmed that the conservation of the department's exceptional natural heritage is important to the military for a number of reasons (Box 1.1). The report that emerged from that dialogue contained a number of suggestions for clarifying and improving military policies and programs, and for integrating mission planning and biodiversity conservation (Keystone Center 1996). One specific recommendation was for the development of a handbook outlining a "model process" for biodiversity conservation at the installation level that would be useful for installation natural resources management staff and mission leaders. In response to that suggestion, The Nature Conservancy developed for DoD the first edition of this guide: *Conserving Biodiversity on Military Lands: A Handbook for Natural Resources Managers* (Leslie et al. 1996) (available online at **https://www.denix.osd.mil**).

Also in 1996, the military issued an explicit Instruction for its Environmental Conservation Program (DODI 4715.3). This instruction recognized the close interrelationship between ecosystem management and accomplishing biodiversity conservation. Consistent with maintaining the military mission, that program adopted the following biodiversity-related goals: (1) maintain or restore remaining native ecosystem types across their natural range of variation; (2) maintain or reestablish viable populations of all native species in an installation's areas of natural habitat, when practical; (3) maintain evolutionary and ecological processes, such as disturbance regimes, hydrological processes, and nutrient cycles; (4) manage over sufficiently long time periods for changing system dynamics; and (5) accommodate human use in those guidelines.

### KEY DEVELOPMENTS IN THE PAST TEN YEARS

Perhaps the most significant development for military natural resources management since publication of the first edition of the biodiversity handbook was the 1997 amendment of the Sikes Act. As chapter 3 discusses in more detail, the Sikes Act Improvement Act requires that INRMPs be prepared and implemented on all installations with natural resources, and that they be prepared in cooperation with state and federal wildlife authorities and available for public review and comment. This legislation provided added impetus for installations to not only develop these plans, but to allocate the resources needed to put critical actions in place.

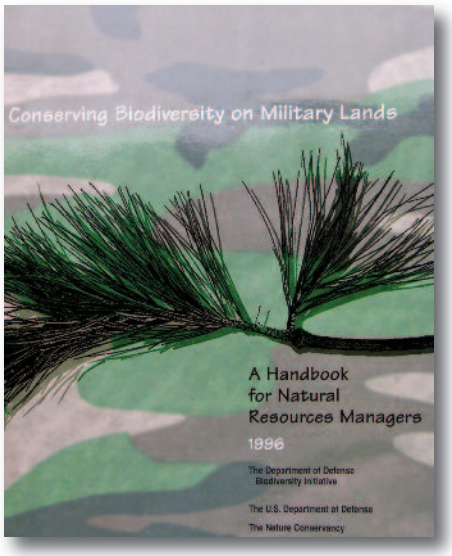
Another key shift has been the increasing recognition of the threat of encroachment on the ability of the military to continue making use of military lands, marine areas, and airspace for training. This recognition has given rise to the Sustainable Range Initiative (SRI), which is designed to ensure that DOD can preserve military readiness while protecting the environment and improving compatibility with local communities. The overarching policy for this program, Sustainment of Ranges and Operating Areas (DOD Directive 3200.15) was implemented in 2003 (see **http://www.dtic.mil/whs/directives/search.html**).

The need to work cooperatively with a wide array of public and private partners is particularly apparent when dealing with range sustainability and encroachment issues. This collaborative approach was the focus of a 2005 White House Conference on Cooperative Conservation, which featured a number of successful examples involving military bases. The Executive Order on Cooperative Conservation (13352) designates DOD as one of the lead agencies, and the military has adopted cooperative conservation as a key strategy. While cooperative conservation is as much a philosophy as a specific approach, one mechanism that DOD has adopted for promoting cross-organizational collaboration is the Readiness and Environmental Protection Initiative (REPI). This initiative—a part of the broader Sustainable Range Initiative—enables the military to partner with outside stakeholders to promote land conservation that supports the military mission and natural habitat, much in the way that Fort Bragg has successfully worked with the Sandhills Conservation Partnership.[19]

## The 1996 Biodiversity Handbook "Model Process"

In applying an ecosystem approach to biodiversity conservation, process is key. As recommended by the 1995 Keystone Dialogue, the first edition of this handbook was structured around a "model process," which was used as the primary means for putting the theory of ecosystem management into a practical framework for use at the installation level (Box 1.2, Figure 1.10). This model process was developed based on experience gained in applying an ecosystems approach at several installations, such as Eglin Air Force Base. It was intended to serve not as a cookbook approach to planning and management, but rather as a starting point or general blueprint, which could be customized according to the specific conditions and needs of an individual installation. Although this model process is not used as the central organizing structure of the current handbook edition, this framework still has great value, and is summarized here. For a more in-depth treatment of this planning approach, the reader should consult Leslie et al. (1996).

The primary objective of the model process was to ensure that the best information is applied to management decision-making, and secondarily, to allow managers to learn as they manage. Because no planning process is guaranteed to




The 1996 DOD biodiversity handbook.

## Box 1.2. Model Process for Ecosystem Management on Military Installations

A key recommendation of the 1995 Keystone Dialogue was the development of a model process for assisting military installation managers to better conserve biodiversity through use of an ecosystem-based approach (Figure 1.10). The process was designed to capture the best available information and to apply that information in a rational, stepwise decision-making process that takes into consideration the inherently political and non-rational nature of organizations and the unpredictable behavior of natural systems.

Initial steps in the process include developing a concept of what planners are trying to achieve, obtaining approval from management to begin, and developing a core team and a general plan of action. In addition, it is important to take stock of existing information relevant to biodiversity management on the installation. With that in hand, one would proceed through the following components:

**Present Context.** This step involves analyzing biodiversity characteristics on the installation and understanding what is important from various perspectives (i.e., military mission, ecological, socioeconomic, andinstitutional). For example, planned tank maneuvers might require a realistic mix of forested and open landscape. While the species on the landscape may be unimportant in terms of the military mission, structural attributes may be very important.

**Mission Statement.** This step involves developing a written statement of core organizational values, directions, and general goals, as they relate to ecosystem and biodiversity management.

**Conservation Priorities.** This involves establishing some basic parameters for managing for biodiversity. The management team targets those species and/or native communities that are of highest priority, develops basic models that help explain how natural systems work on the installation, identifies threats and opportunities, starts to map out desired futures, addresses conflicts among priorities, and identifies gaps in the information needed to manage effectively

**Objectives and Strategies.** This step involves developing concise management objectives and measures (or metrics) of success, and developing and implementing management strategies within an experimental framework. The team also must develop a strategy for pre-management and post-management monitoring to determine the results of management actions.

**Pre-Management Monitoring.** This involves establishing baseline conditions that will allow planners to determine the results of management actions.

**Management Actions.** This step includes routine management activities as well as management activities that are designed as experiments. A biodiversity management strategy will be integrated within the context of natural resources management activities already established at most installations.

**Products and Services.** Management actions will result in a range of products and services, which may include improvement of conditions for training, harvest of timber, and uses for grazing and agriculture. In addition, management can increase values for hunting and fishing, and other forms of recreation by military personnel and non-military users.

**Analysis, Model Validation, Adaptation.** As the results of management activities are known, their implications are analyzed, models are validated and adjusted, and management strategies are revisited. This is a cycle of learning, where future context becomes the present and a new future context is envisioned.

**Measuring and Reporting Results.** This step ensures accountability, which is important in the stewardship of public lands. Documenting the results of management also strengthens institutional memory, preserving lessons for future management and future managers. Finally, documentation helps communicate management strategies to others on the installation and within the outside community.

produce results, the following assumptions are prerequisites for success in use of this model process: (1) Compliance with the letter and spirit of federal, state, and local laws is paramount; (2) developing a working understanding of the structure, composition, and function of the regional and installation ecosystems is essential; (3) maintaining the integrity and resiliency of natural systems (that is, maintaining representative and functional ecosystems) is in the best interest of the military mission; (4) no one manager or set of resources managers has all of the information and training necessary to make the correct decisions all of the time; (5) thus, involvement of outside scientists and managers is necessary and essential to suc-

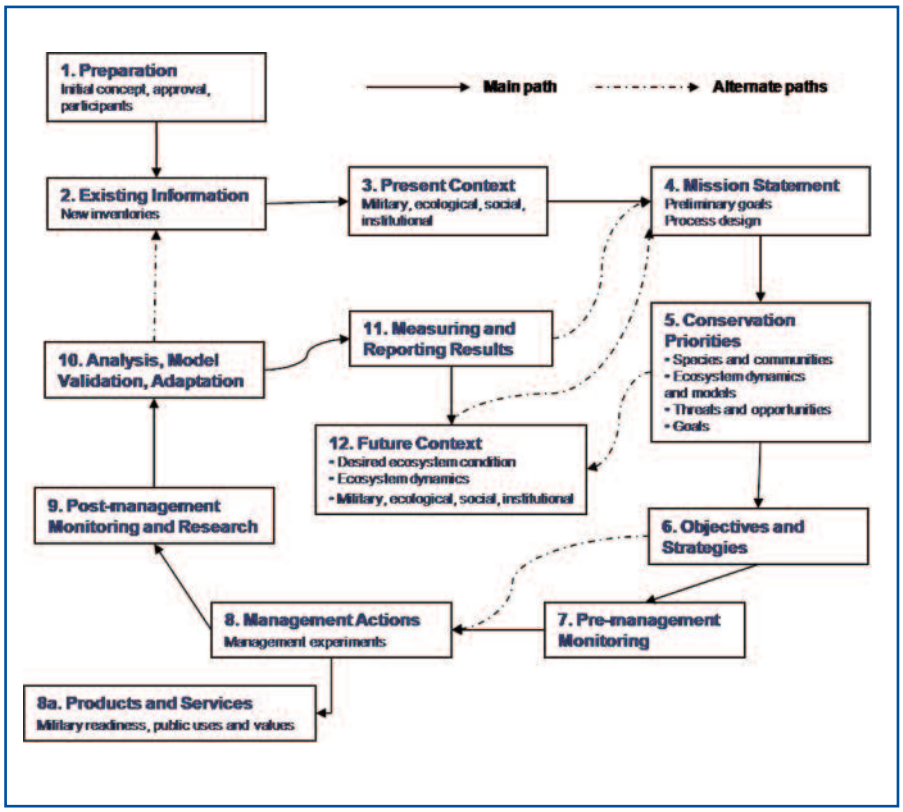



**FIGURE 1.10.**
**1996 "Model Process"**
Model process for incorporating ecosystem approaches into installation resources management.

(Adapted from Leslie et al. 1996)

cess and acceptance; (6) stakeholder values and needs are important and help drive the process; (7) being proactive is preferable to being reactive; and lastly, (8) decision-makers must be willing to make fundamental changes when necessary.

## How to Use This Guide

This guide provides background information, examples, and tools to help natural resources managers develop ecosystem-based biodiversity conservation strategies in the context of the military mission and Integrated Natural Resources Management Plans. The problems and opportunities that natural resources managers face vary from installation to installation. Some installations comprise many thousands of acres, support populations of rare species or sensitive natural communities, and have substantial staff and funding allocated to natural resources management. Other installations are biologically more modest, or have relatively few staff and little funding available for natural resources management. This guide is designed to offer assistance and guidance for managers of both types of installations. Other important factors include the level of support from installation commanders and other senior managers, the degrees of receptivity of operations/training personnel, and the nature and intensity of the military mission on the installation. Still, no matter what conditions exist on the installation, it is always possible to improve management practices in some way, and the principles and examples provided here will be applicable. With commitment and creativity—and often patience and willingness to compromise—you can promote stewardship and make a contribution to the military mission through biodiversity conservation.

Over the past decade a great deal of innovation and experience has been gained across the Department of Defense in supporting the military mission through bio-

diversity conservation. The first edition of this guide was largely organized around the model process for ecosystem management described in box 1.2. This new handbook edition takes advantage of the many successful applications of these principles that have been carried out over the past ten years, and is organized around best practices and lessons learned by many of the military's leading natural resources practitioners. We also focus on practical applications of many of the principles and underlying theories summarized in the handbook's first edition. The guide can be read sequentially, or the reader is invited to delve into specific topics and chapters that may be of interest, or relate to current issues or problems that they are confronting.

## Maintaining Readiness, Sustaining Biodiversity

The primary mission of the U.S. Department of Defense is to fight and win wars. To that end, military lands are important national assets for training military forces and testing and deploying new weapon systems. Training provides troops with the combat skills they require to be successful and to ensure their safety, and realistic training increases their success and survivability in combat. Similarly, realistic testing enhances the reliability and effectiveness of weapons systems to be used in combat. Realistic training and testing requires the availability of natural environments that reflect the conditions under which troops may expect to face combat operations. As a result, maintaining healthy and functioning ecosystems on the nation's military lands is not a luxury, but rather an essential component of maintaining military readiness.

Biodiversity is the overarching concept used to refer to the variety of species and ecosystems that make up the natural world, and maintenance of realistic training conditions depends on conservation of these biological and ecological resources. Many defense installations are found in some of the nation's most biologically rich regions, and accordingly, military lands harbor a particularly rich array of wildlife, including a significant number of the nation's federally listed endangered species. As a result, the Department of Defense's land management responsibilities include stewardship for hundreds of our nation's rarest species and most characteristic habitats. And while these stewardship obligations can create conflicts with operational needs, a growing body of experience—such as the successful recovery of red-cockaded woodpeckers at Fort Bragg—indicates that when these issues are approached creatively and with a solution-oriented spirit, biodiversity conservation and maintaining military readiness can go hand-in-hand.

Facing page: Largely undisturbed natural habitat in buffer areas surrounding impact zones, such as these at Avon Park Air Force Range, represents some of the best-preserved natural habitat in central Florida's Lake Wales Ridge. (Photo: Douglas Ripley)

**NOTES**

1. For more on the life and times of red-cockaded woodpeckers, see the Fish and Wildlife Service document at http://library.fws.gov/Pubs4/redcockadedwp02.pdf

2. When a federal agency seeks to take an action that might affect a listed species, it must send a "biological assessment" to one of the two Endangered Species Act administrator bodies. If the administrators feel the proposed action could put a listed species at risk of extinction, they can issue a "jeopardy opinion," which carries the force of a decision. For more on this, see http://www.nwr.noaa.gov/Salmon-Habitat/ESA-Consultations/.

3. A "recruitment cluster," in conservation terms, includes four artificial cavities installed in four different pine trees on about one acre. See http://www.fws.gov/endangered/bulletin/2001/09/30-31.pdf

4. For more on encroachment pressures, see chapter 4. And for more discussion of "outside the fence" thinking, including partnerships with the local community and others, see chapter 10.

5. For details on the all-important Sikes Act, see chapters 3 and 11.

6. Section 2811 of the 2003 Defense Authorization Act, codified at 10 USC 2684a.

7. The Lacey Act of 1900 provided a variety of protections for flora and fauna. It prohibited game taken illegally in one state to be shipped across state boundaries contrary to the laws of the state where it was taken.

8. For more information on rules and regulations that affect biodiversity on and off military lands, see chapter 3.

9. For more on endangered species and the Endangered Species Act, see chapter 6.

10. Bald eagle safeguards remain in place under the Bald and Golden Eagle Protection Act.

11. For a full explanation of NatureServe's conservation status ranking system, see http://www.nature serve.org/ explorer/ranking.htm.

12. NatureServe's global status ranking system is detailed at http://www.natureserve.org/explorer/ ranking.htm.

13. For a graphic view of development pressures around Camp Pendleton over time, see chapter 4.

14. This includes species that are either listed as threatened or endangered under the Act, or that are formally proposed for listing, or are candidates for listing.

15. Because there is overlap between the list of federally listed species and NatureServe defined imperiled species, these two figures (355 and 458) should not be summed.

16. For more on the military's management and use of its forested lands and multiple use in general, see chapter 5.

17. For more on the military's management and multiple use of its forested and other lands, see chapter 5.

18. For more information on the INRMPS, see chapter 11.

19. For more on the Sustainable Range Initiative, see chapter 3. For more on partnerships, see chapter 10.

## Literature Cited


Benton, N. 2004. Species at Risk on Department of Defense Installations. Arlington, VA: NatureServe.

Chaplin, S.J., R.A. Gerrard, H.M. Watson, L.L. Master and S.R. Flack. 2000. The geography of imperilment: Targeting conservation toward critical biodiversity areas. Pp. 159–199 in B.A. Stein, L.S. Kutner and J.S. Adams eds. *Precious Heritage: The Status of Biodiversity in the United States.* New York: Oxford University Press.

Convention on Biological Diversity. 1992. www.biodiv.org/.

Dahl, T.E. 1990. Wetland losses in the United States 1780's to 1980's. Washington, D.C: U.S. Department of the Interior, Fish and Wildlife Service.

Delaney, D. K., L. L. Pater, L. Swindell, T. Beaty, L. Carlile, and E. Spadgenske. 2000. Assessment of training noise impacts on the red-cockaded woodpecker: 2000 results. U.S. Army Corps of Engineers, SERDP 2000 Annual Report.

Eisner, T. and E. A. Beiring. 1994. Biotic exploration fund: Protecting biodiversity through chemical prospecting. *BioScience* 44: 95–98.

Groves, C.R., L.S. Kutner, D.M. Stoms, M.P. Murray, J.M. Scott, M. Schafale, A.S. Weakley, and R.L. Pressey. 2000. Owning up to our responsibilities: Who owns lands important for biodiversity? Pp. 275–300 in B.A. Stein, L.S. Kutner and J.S. Adams eds. *Precious Heritage: The Status of Biodiversity in the United States.* New York: Oxford University Press.

Hardesty, J.L. and S.L. Murin. 1994. Science in support of ecosystem management: summary of the first annual scientific meeting. Eglin Air Force Base, Florida. The Nature Conservancy and Department of Wildlife Ecology and Conservation, University of Florida, Gainesville, Florida.

Hayden, T. J. 1999. Training effects assessment and reporting for installations implementing the 1996 Management Guidelines for the Red-cockaded Woodpecker (RCW) on Army Installations. U.S. Army Corps of Engineers, CERL Technical Report 99/107.

Spring wildflowers, Edwards Air Force Base, California. In years of abundant rainfall, Edwards AFB is ablaze with Mojave Desert wildflowers. (Photo: Douglas Ripley)


Keystone Center. 1991. Final Consensus Report of the Keystone policy dialogue on biological diversity on federal lands. Keystone, Colorado: The Keystone Center.

Keystone Center. 1996. Keystone Center Policy Dialogue on a Department of Defense (DOD) Biodiversity Management Strategy. Keystone, Colorado: The Keystone Center.

Lang, J.T. and T.H. Lillie. 1995. Integrated natural resources management on U.S. Air Force installations. In *Proceedings of the American Defense Preparedness Association 21st Environmental Symposium and Exhibition*. San Diego, California.

Leslie, M., G.K. Meffe, J.L. Hardesty, and D.L. Adams. 1996. *Conserving Biodiversity on Military Lands: A Handbook for Natural Resources Managers*. Arlington, Virginia: The Nature Conservancy.

Lillie, T.H. and J.D. Ripley. 1998. A strategy for implementing ecosystem management in the United States Air Force. *Natural Areas Journal* 18: 73–80.

LoGiudice K, Ostfeld RS, Schmidt KA, Keesing F. 2003. The ecology of infectious disease: effects of host diversity and community composition on Lyme disease risk. *Proc Natl Acad Sci.* 100: 567–71

Louv, R. 2005. *Last Child in the Woods*. Chapel Hill, N.C.: Algonquin Books

Master, L.L., B.A. Stein, L.S. Kutner and G.A. Hammerson. 2000. Vanishing assets: Conservation status of U.S. species. Pp. 93–118 in B.A. Stein, L.S. Kutner and J.S. Adams eds. *Precious Heritage: The Status of Biodiversity in the United States*. New York: Oxford University Press.

Millennium Ecosystem Assessment, 2005. *Ecosystems and Human Well-being: Biodiversity Synthesis*. Washington, D.C.: Island Press.

Siehl, G.H. 1991. Natural resource issues in national defense programs. CRS Report for Congress. Washington D.C.: Library of Congress, Congressional Research Service.

Stein, B.A., L.S. Kutner and J.S. Adams eds. 2000. *Precious heritage: the status of biodiversity in the United States*. (New York: Oxford University Press, 2000).

Stein, B.A. 2002. States of the Union: Ranking America's Biodiversity. Arlington, Virginia: NatureServe.

Stein, B.A., C. Scott, and N. Benton. 2008. Federal lands and endangered species: The role of military lands for sustaining biodiversity. *BioScience*, in press.

U.S. Department of Agriculture, Natural Resources Conservation Service (USDA NRCS). 2003. Urbanization and Development of Rural Land. 2001 Annual National Resource Inventory. Available at **http://www.nrcs.usda.gov/technical/land/nri01/nri01dev.html.**

CHAPTER TWO

# Understanding Conservation Science

By Bob Unnasch
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*The last word in ignorance is the man who says of an animal or plant: 'what good is it?' If the land mechanism as a whole is good then every part is good whether we understand it or not. If the biota in the course of eons has built something we like but do not understand then who but a fool would discard seemingly useless parts. To keep every cog and wheel is the first precaution of intelligent tinkering.*

—Aldo Leopold, *Round River*

## PRINCIPLES OF CONSERVATION SCIENCE

The word "biodiversity," a merger of *biological* and *diversity*, is one of those terms that has been used in so many situations that its true meaning is difficult to pin down. There are many definitions, both explicit and implied. The term was probably first coined by W.G. Rosen in 1985. Rosen's original intent was to propose a word that encompassed all components of life, as a way to explicitly capture the idea that "everything is linked to everything else." Historically, geneticists communicated with geneticists, game managers communicated among themselves, and ecologists talked with their ilk. Coining the term "biodiversity" was an attempt to pull them all together, making explicit the need to consider all biological scales when undertaking conservation planning. It was, in essence, an early declaration that ecosystems are important.

The most straightforward definition is "the sum total of all living things—the immense richness and variation of the living world"(Orians and Groom 2006). While both simple and elegant, this definition is not very informative, and really makes little sense to non-biologists. A second, and probably the most commonly understood definition, holds that biodiversity is a measure of the relative diversity among organisms present in different areas, ecosystems, or regions. This definition, by focusing on species richness—that is, simply the number of species—ignores biological levels both above species (i.e. communities, ecosystems, landscapes) and below (i.e. genetic diversity).

Herein, biodiversity will be defined by a third definition that is often used by ecologists: Biodiversity refers to the totality of genes, species, ecosystems and natural landscapes of a region (Some would add "And the relationships among these components."). An advantage of this definition is that it describes most circumstances and presents a unified view of the levels at which biodiversity is commonly identified. Figure 2.1 (Noss 1990) exhibits some common attributes in terms of composition, structure, and function of each of these levels.

## Components of Biodiversity of Concern to Land Managers

For one tasked with the conservation of biodiversity, the idea of planning to preserve the "totality of genes, species, and ecosystems of a region" is daunting—as exhibited by the complexity of Figure 2.1. Attempting to implement the conservation of biodiversity, as defined, is an overwhelming challenge. It is far too easy to become stuck in the weeds of the details and to try to manage everything individually. A land manager will justifiably ask, "How can I hope to manage for

The bogs and other freshwater wetlands on the Warren Grove Air National Guard Range, located in the Pinelands of southern New Jersey, are areas of exceptional biological diversity. (Photos: Douglas Ripley)

all species on my installation? How in the world do I manage for landscape function? Where do I start?"

While it is important to keep all biological levels of organization in mind, one does not need to plan, or manage, for each. In reality, planning for conservation action leans most heavily on what is commonly called the coarse filter/fine filter approach (Noss 1987). The coarse filter approach focuses on ecological systems—ecosystem management—whereas the fine filter approach emphasizes individual species management. Successful biodiversity management relies on both. In brief, the reasoning supporting this paired approach is that most species are "captured" by the coarse filter because of their association with specific ecosystem types. Those species that are not captured in the coarse filter (e.g. wide ranging species) need then be caught by the fine filter (Groves 2003).

While the concept of the coarse and fine filters was initially conceived to be independent of spatial scale, in reality those species not captured by the coarse filter tend to be intermediate, coarse, or regional scale species as defined by Figure 2.2 (Poiani et al. 2000). These tend to be larger, wide-ranging species that are often dependent on a diversity of ecosystems during their lives.

**FIGURE 2.1**

**Identifying common levels of biodiversity.**

Compositional, structural, and functional biodiversity, shown as interconnected spheres, each encompassing multiple levels of organization. This conceptual framework may facilitate selection of indicators that represent the many aspects of biodiversity that warrant attention in environmental monitoring and assessment programs.

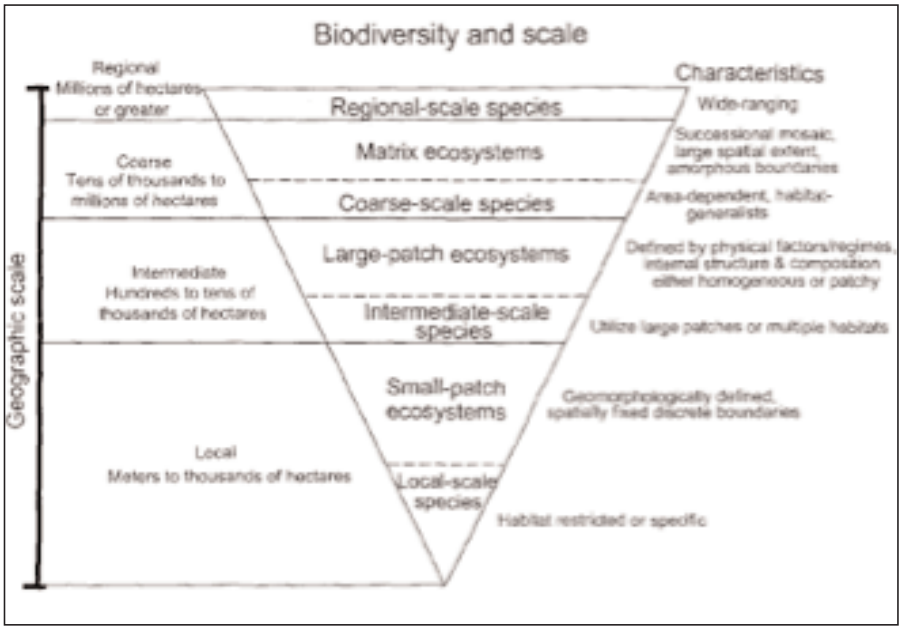
From Noss (1990).


**FIGURE 2.2**

**Biodiversity at various spatial scales.**

Levels of biological organization include ecosystems and species. Ecosystems and species are defined at four geographical scales, including local, intermediate, coarse, and regional.

From Poiani et al. (2000).




While most resources managers, and many non-biologists, have an intrinsic understanding of these levels of biological organization, it is always a good idea to review these terms and concepts as their precise meanings are often different from the perceived gestalt.

## POPULATIONS

A population is typically defined as a group of interbreeding individuals of the same species living within a defined area. The key to this definition is that individuals within a population must, at the very least, have the potential to interbreed. Thus, dispersal potential can drive the size of a population. Many wide-ranging species, for example migratory birds, have huge populations that can span thousands of square kilometers. More stationary species, for example, bog lemmings, will have more restricted population sizes where the entire population exists within a small peat bog.

**META-POPULATIONS, NATURAL AND DERIVED.** Between these two extremes, most species exist as constellations of sub-populations where most individuals inter-

act within their small group, with the rare individual dispersing over greater distances. So, these species are structured as a meta-population, or a population of sub-populations. These sub-populations are distributed across a landscape (or a military installation) as many "occurrences." Each occurrence has a low probability of persisting over the long term, in isolation from other occurrences. Most sub-populations are simply too small to be resilient to environmental variation, or demographic or genetic bottlenecks. Neighboring occurrences are constantly providing, at some low but critical rate, "new blood" into a given sub-population. These neighboring occurrences also provide sets of "founder" genes that will re-colonize a vacant area.

Meta-populations can be envisioned, then, as a galaxy where each "star" is a sub-population. These "stars" are winking off and on as sub-populations disappear, and then reappear as the vacant areas are re-colonized. The space between these stars—the voids—is not suitable habitat for these creatures, and so is simply not available for colonization by this species.

**SOURCES AND SINKS AND THEIR IMPORTANCE.** Upon reflection, it becomes obvious that all sub-populations are not the same. Some occur on tiny patches of acceptable habitat, and never grow to more than a small number of individuals. These, of course, never really escape the consequences of being in a "population bottleneck," and many have a low probability of persisting in isolation. Others occur on large areas of acceptable habitat and, thus, tend to exist as large healthy populations. These have greater demographic and genetic resilience, and hence a greater probability of persistence. Simply because of their large size, these populations tend to be the source of most of the dispersers that colonize vacant patches, and reinvigorate the small sub-populations both by their numbers and by their genetic diversity. These are thought of as "source" sub-populations, whereas the smaller occurrences which tend to absorb migrants, but do not provide dispersers, are considered "sinks."

The generalization that small populations tend to be sinks, and large populations sources, is, like all generalizations, only true to a point. The key, which is often difficult to measure, is whether the population produces significant numbers of emigrants or not. Source populations do, sinks do not. In general, "sink" sub-populations will not persist without continual immigration from "sources." Thus, the destruction of a single "source" sub-population can result in the extirpation of many surrounding "sinks" even if they are not directly impacted.

The Sikes Act and the Endangered Species Act require military installations to prevent the loss of threatened and endangered species found within their boundaries. Understanding the ecology of those species, and how their populations and sub-populations are distributed, is key to meeting this requirement. Conserving a wide-ranging species like the bald eagle might be accomplished simply by protecting a limited number of nesting sites—as only a small piece of a much larger population exists on site. The Karner Blue butterfly, in contrast, exists as a meta-population where sub-populations exist in ephemeral patches of host plants. Conserving this species requires an understanding of the disturbance dynamics creating these patches of host plants, and the dispersal capabilities of the butterfly, so as to manage the entire meta-population and not just a few occurrences, each with a low probability of persistence in isolation. Understanding and managing a meta-population often requires looking beyond an installation's borders to sub-populations on neighboring lands.

### Bottlenecks

**A "bottleneck" occurs when a population is dramatically reduced in size, often by 90 percent or more. Bottlenecks can result from any number of impacts: droughts or other climatic changes; epidemic disease; appearance of an exotic competitor, or human impacts. The consequences of this decline are manifested both in demographic and genetic realms. The most severe demographic consequence is, of course, extirpation. The remaining individuals are too dispersed to find each other, and hence the reproductive rate drops below replacement, and the population slowly "winks out."**

**The genetic consequences of a bottleneck event can be equally dramatic. As the population size shrinks, the genetic diversity also declines. This lack of genetic diversity can result in the expression of deleterious genes that reduce the vigor of the offspring of the remaining individuals—potentially leading to extirpation.**

## COMMUNITIES AND ECOSYSTEMS

How are communities and ecosystems different than "habitat"? Managing for species invariably means managing habitat. Habitat (which is Latin for "it inhabits") is the place where a particular species lives and grows. It is essentially the environment—at least the physical environment—that surrounds (influences and is utilized by) the species population. The term was originally defined as the physical conditions that surround a species population, or an assemblage of species (Clements and Shelford 1939). Wildlife managers, in particular, tend to focus on habitat management—identifying and manipulating those environmental factors limiting a targeted population's size (Leopold 1933, Yoakum and Dasmann 1971). Scientists often expand the concept of habitat to include an assemblage of many species, living together in the same place. Thus, for example, wildlife managers often work to improve shorebird habitat. The U.S. Fish and Wildlife Service (USFWS) has spent many millions of dollars managing for breeding habitat for migratory waterfowl in the prairie pothole region of North America. Ecologists regard the habitat shared by many species to be a biotope—a place where a community of species lives.

The concept of habitat is not synonymous with that of the natural community or ecosystem. A natural community is the assemblage of plants and animals sharing the same habitat and interacting with each other. When one speaks of a natural community, the focus is on the species and their interactions. The habitat, or biotope, is the biophysical stage on which these species and their interactions occur. Communities typically reoccur across a landscape as they track habitat conditions. As such, communities do not occur at a single, specific spatial scale. Vegetation communities are often perceived as the classic community, but one can also describe the smaller community existing within a fallen log, or ephemeral community within a vernal pool.

An ecosystem, then, can be thought of as the whole picture; the combination of a natural community and its habitat (or biotope). As such, an ecosystem can extend far beyond even a large military installation. But ecosystems are more than just a community in its habitat. The concept of the ecosystem includes dynamic ecological processes (see below) and the recognition that species composition (i.e. the community) will change over time as well as over space. Every species within a community responds to the environment differently from the others. Similarly, each species interacts with different suites of other species. As conditions change, as they certainly do within military installations as in other environmental settings, some species become more abundant, while others become rarer.

Natural disturbances, ranging in size from gaps caused by fallen trees to massive wildfires, all affect species abundance and distribution differently (Picket and White 1986). Thus, ecosystems are neither static nor homogeneous. Rather, they are composed of "patches" of various sizes and ages, and the relative abundance and distribution of these patches is crucial to maintain the full suite of biodiversity within an area. Maintaining ecological processes, such as fires, floods, and periodic disease epidemics, is the keystone of successful ecosystem conservation. Indeed, the core of the ecosystem-based management approach is the understanding that the persistence of all biodiversity within an area is contingent on the persistence of this crazy-quilt pattern of disturbed and recovering patches. Management, then, needs to focus on the dynamic processes creating this pattern and not on maintaining a static structure and condition. Military activities can mimic some natural disturbances, and thus can often be integrated into a biodiversity management plan.

## ECOLOGICAL PROCESSES

In most human-dominated landscapes, including most military installations, native ecosystems have been fragmented and now occur as islands in seas of intensively impacted and managed lands. As mentioned above, this fragmentation harms species populations by restricting the movement of those pioneering individuals necessary to found new sub-populations and reinvigorate population sinks. Similarly, fragmentation changes how natural disturbance plays out on the landscape. Fires, for example, may be prevented from running across the landscape by the cutting of firebreaks. Thus, vegetation patches may persist for greater periods of time between fires, resulting in greater fuel accumulation, and subsequently more severe fires when they do occur.

The intensity and impact of any ecosystem process varies over time. Species and ecosystems respond to, and are organized around, these natural ranges of variation within these ecological processes. Thus, fires returning every five years will result in a very different community than when they return every hundred years. This is exemplified by both the longleaf pine forests of the southeast and

Dr. Walter Bien, Professor of Biology at Drexel University, Philadelphia, explaining his field work to graduate students and the natural resources staff at the Warren Grove Air National Guard Range, New Jersey. Research by university and environmental organization scientists has contributed significantly to the DoD's understanding of ecological processes on its lands. (Photo: Douglas Ripley)

ponderosa pine forests of the Rocky Mountain west. While there was, of course, variation in the frequency of naturally-ignited fires, typically any given patch would burn every ten years or so. This resulted in open forests, with relatively few large trees in a matrix of grasses and forbs. Both long-leaf and ponderosa pines have thick, fire-resistant bark and so the adult trees are not damaged by low-intensity ground fires. Active fire suppression over the past several decades has decreased the fire frequency and allowed other, less fire tolerant, species to get toeholds. Now, when fires do occur, the fire climbs into the canopy and the results are conflagrations that consume everything rather then the historically less intense ground fires that did not impact the trees.

Ecological processes that are impacted by military land uses include:

- fire, both in terms of frequency, seasonality, and intensity
- flooding, including frequency, sediment movement
- disturbance of turf in prairie systems
- sheet flow, and other water movement patterns in desert systems

Active ecosystem management by humans can mimic historic ecological processes and their effects; conservation managers can achieve both their conservation goals and meet the needs of the military. However, management with an eye toward variation is more challenging than managing for consistency. A large forest ecosystem will be very different if every management unit is burned on a 10-year cycle than if units were burned randomly on a 5- to 30-year pattern. The former is easier to plan and to implement, as managers can anticipate needs many years in advance. The latter is more complex structurally, and hence, harbors greater biological diversity.

### NATURAL LANDSCAPES

From a biological perspective, a military installation is not an island, existing in isolation. It lives within a larger landscape comprising both natural and anthropogenic systems. A natural landscape can be thought of as the spatial scale at which ecosystems reoccur (Forman 1995). Meta-populations often function at this scale, with sub-populations occurring in ecosystem patches scattered throughout the landscape. Many wide-ranging species are very sensitive to the landscape pattern. These species often use, and require, two or more ecosystems for survival. These ecosystems may often not be congruent, and the species must travel through the landscape. Smaller installations may encompass only a small portion of the landscape mosaic and, as a result, critical habitats and ecosystems may only occur off-site. In these circumstances, it is very important to look beyond the installations boundaries.

Alternatively, a large military installation can often be fruitfully managed as a landscape unto itself—or sometimes as a microcosm of a much larger landscape. Natural buffer zones, impact areas, training areas, and other developed lands together join to form a landscape mosaic. There is great opportunity to build upon this existing mosaic, creating missing patches or systems, and enhancing others to effect significant conservation results.

*The cowman, who cleans his range of wolves, does not realize that he is taking over the wolf's job of trimming the herd to fit the range. He has not learned to think like a mountain. Hence we have dustbowls, and rivers washing the future into the sea.*

—Aldo Leopold, *A Sand County Almanac*

CONSERVATION IN PRACTICE

## Learning to Think Like a Mountain: Tools for Conservation Practitioners

Biodiversity conservation on military lands does not equate with outright preservation or the exclusion of military uses. Creatively using an ecosystem management approach, and working with the military community, have produced impressive results at many installations, several of which are chronicled in this manual. One key component is to use an adaptive approach to conservation planning and implementation.

Definitions of adaptive management vary by context, but the commonalities include the appreciation that "Ecosystems are not more complex than we think, but more complex than we can think" (Egler 1977). Despite this, we cannot be stymied by a lack of understanding of all details; we can be very successful working within this uncertainty.

Adaptive management will be discussed in a later chapter. The basic premises are: We don't know enough to predict all outcomes. Changing management, and changing military activities, will undoubtedly result in unanticipated results, as will purely natural, but unpredictable, events. A key is to capture the learning from that experience, and build it into our understanding of the systems.

Everything is an experiment; every project provides an opportunity to learn and improve. This doesn't mean that every activity needs to be designed as a rigorous scientific experiment. Rather, we must enter into every process with our eyes open, asking two questions up front: "If this doesn't work out as I expect, what do I want to know in order to do it better next time?" And, "If this does work out, what can I learn from this place that will allow me to carry that success to other situations?"

There is no simple protocol for implementing adaptive management. Managers from many agencies, and from many countries, have been experimenting and creating ways to make it more scientific and less of an art. The successful adaptive manager can call on a number of tools to assist in his or her job. One of these is the conceptual ecological model.

Developing a conceptual ecological model of the species, ecosystems and landscapes that are the focus of management activities can be a helpful tool. These models provide a framework for organizing information and thinking about the systems, their impacts and threats, and anticipated management responses.

An ecological model is a conceptual representation of a natural phenomenon. Ecological models are abstractions or simplifications of the real world that portray the dominant components and key processes. Typically, models define rela-

tionships among *states* (parts of the ecosystem) and *transitions* (processes that change the states). These relationships are the basis on which to predict changes in the targets of conservation work over time, depending upon trajectories of, or perturbations to, key ecological processes. Ecological models are excellent tools for generating questions about the behavior of our targeted biodiversity and guiding decision making for planning and management. These models are also key to documenting and recording major assumptions and current understanding (Maddox et al. 1999).

These ecological models, however, are not panaceas for solving every problem or answering every question. Models are a means of integrating data to comprehensively understand complex ecosystem dynamics. They are only as good as the information they are built upon. It would be unwise to think of models as answers in and of themselves. They are simply powerful tools for organizing and communicating ideas, synthesizing current understanding and data, discovering unknowns, and generating hypotheses. In the best of circumstances, they provide a peek into the future to help guide present decisions (Bestelmeyer et al. 2004).

The most useful models integrate the needs and input of many stakeholders with different perspectives and goals. This might require a suite of conceptual models, ranging from a landscape model, showing patterns of disturbance and connectivity, to forest stand level state-transition models that capture our understanding of ecosystem response to mechanical thinning and prescribed fire management.

One of the most powerful aspects of conceptual ecological models is that they create a valuable communication tool that can resonate with many audiences. Stakeholders who see their concerns integrated into a conceptual model will more readily see how those issues link to, and impact, others' concerns and issues.

During the past decade the conservation community has collaboratively developed standards and tools for designing, managing, monitoring and learning from conservation projects. This effort has resulted in the Conservation Action Planning (CAP) process and toolbox developed by The Nature Conservancy, and it has been implemented by conservation practitioners worldwide. The toolbox was originally programmed in Microsoft Excel, and its current version, and much supporting information, is available at **http://conserveonline.org/workspaces/cbdgateway/cbdmain/cap.**

The CAP toolbox has been recently redesigned and reprogrammed by the Conservation Measures Partnership as the open source software package Miradi. The software is available at **https://miradi.org/.**

The exceptionally rich prairie grasslands of the Smoky Hills National Guard Range, Kansas, are high in biological diversity. The range supports the largest agricultural outleasing program in the Air Force, generating nearly $400,000 annually to support Air Force natural resources programs. (Photo: Douglas Ripley)

## Conservation Targets: Planning for Biodiversity

When the job is conserving a single threatened or endangered species, the focus of planning is clear: Maintain the current population(s) or the meta-population. Similarly, conserving a wetland ecosystem is fairly straightforward: Maintain the current condition, prevent encroachment and limit sediment and pollutants from entering the system. However, when one is given the task of conserving the biodiversity on an installation, the challenges mount up fast. Experience has shown managers the importance of identifying a limited number of conservation targets on which to focus planning and management efforts; you cannot plan for everything in isolation.

Biodiversity conservation targets are a limited number of species, natural communities, or entire ecological systems that natural resources managers select to

## Selecting Targets

**A common recommendation is that planning teams use a coarse-filter/fine-filter approach to identifying planning targets. First, teams should focus on the selection of ecological communities or systems as conservation targets at the onset. These act as the "coarse-filter" targets (Noss and Cooperrider 1994, Poiani et al. 2000). Teams should then add those species with unique ecological requisites, not already captured by the conservation of those communities, or ecological systems in which they are embedded.**

**The combined suite of species, community, and ecological system targets—preferably a small and practical number—must collectively create a safety net, such that their conservation will help ensure that suitable environmental conditions exist for the persistence of all native species within a landscape, installation or protected area. Often, even though there are many species and communities of interest, most can be flagged as nested targets: those that we expect will respond to management.**

represent the biodiversity of a conservation landscape or protected area, and that therefore serve as the foci of conservation investment and measures of conservation effectiveness. Thus, conservation targets are simply those ecosystems, communities, or species upon which we focus planning and management efforts. Because we use only a handful of targets to plan for biodiversity conservation, selecting the appropriate suite of targets is crucial to successful conservation planning and adaptive management. The reasoning behind such use of limited elements of focal biodiversity is richly addressed in the literature (see for example Noss and Cooperrider 1994, Christensen et al. 1996, Schwartz 1999, Poiani et al. 2000, Carignan and Villard 2002, Sanderson et al. 2002).

### PRIORITIES FOR MANAGEMENT ATTENTION

Conserving a species or ecosystem is more than simply ensuring its presence on site. The overarching goal is really to ensure that those conservation targets are currently, and will continue to be "healthy," or to continue to have integrity. *Ecological integrity* is defined here as the ability of an ecological system to support and maintain an adaptive community of organisms, having the species composition, diversity, and functional organization comparable to that of natural habitats within a region (Karr and Dudley 1981). An ecological system has integrity, or a species is viable, when its dominant ecological characteristics (e.g., elements of composition, structure, function, and ecological processes) occur within their natural ranges of variation, and can withstand, and recover from, most perturbations imposed by natural environmental dynamics or human disruptions. Effective conservation occurs when the integrity of the ecological systems is maintained. The keystone of effective conservation, then, is managing those factors, or attributes, that are absolutely key to the target's persistence.

To identify what is most important to manage for the conservation of biodiversity in protected areas on military installations, we must first synthesize our best understanding of the ecology of the conservation target—a process greatly aided by the development of ecological models. An ecological model for a species,

community, or ecological system will identify a limited number of biological characteristics, ecological processes, and interactions with the physical environment—along with the critical causal links among them—that distinguish the target from others, shape its natural variation over time and space, and typify an exemplary, reference occurrence (Maddox et al. 1999). Some of these characteristics will be especially pivotal, influencing a host of other characteristics of the target and its long-term persistence. Such defining characteristics of a target are labeled as "key ecological attributes" (see Figure 2.3).

To illustrate, consider a riparian ecosystem situated within the foothills of a montane ecoregion. One can identify enormous suites of species and describe numerous biotic and abiotic interactions that typify this system. The magnitude, spatial extent, timing, and duration of a snowmelt-fed, spring flooding may play a pivotal role in a cascade of biological dynamics such as seed dispersal for native riparian vegetation, variation in soil composition and fertility, elimination of invasive species that compete with native species, and patterns of succession. If so, the spring flooding regime would qualify as a key ecological attribute of this ecosystem. Of course, the timing, duration, and intensity of these spring flood

**FIGURE 2.3**

**Conservation Target Rank Factors and Key Ecological Attributes.**

(From NatureServe 2007. Ecological Integrity Assessment Standards. May 2007 Draft.)

| FACTOR | KEY ECOLOGICAL ATTRIBUTES | SPECIES | ECOLOGICAL ELEMENTS |
|---|---|---|---|
| Size | area of occupancy; relative to expected natural range, or historic extent | ■ | ■ |
| | population abundance | ■ | |
| | population density | ■ | |
| | population fluctuation (average population and min. population in worst foreseeable year) | ■ | |
| Biotic Condition | reproduction and health (evidence of regular, successful reproduction; age distribution for long-lived species; persistence of clones; vigor, evidence of disease affecting reproduction/survival) | ■ | |
| | development/structure/maturity (stability, seral stage proportion, old growth) | ■ | |
| | species composition and biological structure (richness, evenness of species distribution, observed vs. expected composition) | ■ | ■ |
| Abiotic Condition | ecological dynamics (e.g., measurable effects of disturbance by changes in hydrology or natural fire regime) | ■ | ■ |
| | abiotic physical/chemical factors (stability of substrate, physical structure, water quality) | ■ | ■ |
| Landscape Context | landscape structure and extent (pattern, connectivity, e.g., measure of fragmentation/patchiness, measure of genetic connectivity) | ■ | ■ |
| | condition of the surrounding landscape (i.e., development/maturity, species composition and biological structure, status of landscape-scale ecological dynamics, abiotic physical/chemical factors) | ■ | ■ |

events differ (often dramatically) among years, and also respond to longer term climatic changes.

The Nature Conservancy's Measures of Success framework (http://www.nature.org/aboutus/howwework/cbd/science/art14311.html) rests on the premise that it is these "key ecological attributes" that must be managed and conserved to sustain each conservation target. By explicitly identifying such attributes, managers of protected areas can specify more concretely what is important to manage and monitor about individual conservation targets, and, through them, assess conservation success. Together, conservation targets and their key ecological attributes become the essential currency for conservation management at any scale.

The key ecological attributes of any conservation target are many. They include those of not only its biological composition and crucial patterns of variation in its composition over space, but also the biotic interactions and processes, including disturbance and succession dynamics, environmental regimes and constraints, again including disturbance dynamics, and attributes of landscape structure and architecture that sustain the target's composition and its natural dynamics (Noss 1990, 1996, Noss et al. 1995, Christensen et al. 1996, Schwartz 1999, Poiani et al. 2000, Young and Sanzone 2002). Identifying key attributes that address more than just biotic composition is important for two reasons. First, the abundance and composition of a target may lag in their responses to environmental impairments; and data on biotic interactions, environmental regimes, and landscape structure can help ensure the early detection of threats and change resulting from human activities. Second, conserving only those targets on which we focus our planning is not the ultimate goal but they are a means for conserving all native biodiversity in an area. Consideration of these additional types of key ecological attributes will further ensure that crucial aspects of ecological integrity are managed for the conservation of all native biodiversity.

Key attributes of a target's biological composition and its spatial variation will differ depending in part on whether the target is an individual species, an assemblage of species, or a natural community, or an ecological system. This category includes attributes of the abundance of species and the overall spatial extent (range) of the target. Noss (1990) and Karr and Chu (1999) summarize the types of key attributes of composition that are relevant to these different scales of biological organization. Key biotic interactions and processes are those that significantly shape the variation in the target's biological composition and its spatial structure over space and time. These may include not only interactions among specific species and functional groups, but also broad ecological processes that emerge from the interactions among biota and between biota and the physical environment. Examples include productivity, nutrient cycling, distribution of biomass among trophic levels, biological mediation of physical or chemical habitat, and the potential for trophic cascades (e.g., Pace et al. 1999, Scheffer et al. 2001).

Key environmental regimes and constraints, including their "normal" and extreme variation, are those that shape physical and chemical habitat conditions, and thereby significantly shape the target's biological composition and structure over space and time. Examples include attributes of weather patterns, soil moisture and surface- and groundwater regimes, fire regimes, water circulation patterns in lakes, estuaries, and marine environments, soil erosion and accretion, and geology and geomorphology. Key attributes of landscape structure and architecture form a special subset of environmental constraints that include connectivity and proximity among both biotic and abiotic features of the landscape at differ-

ent spatial scales (e.g., Holling 1992). Such constraints, for example, affect the ability of that landscape to sustain crucial habitat requirements in individual species and the processes that transport habitat-forming matter (nutrients, sediment, plant litter) across the landscape, and permit re-colonization of disturbed locations and demographic sinks.

Thus, biodiversity conservation requires a winnowing of a relatively few key components—a.k.a. conservation targets—from the universe of possible options within the installation. The integrity, or viability, of each of these targets is defined by identifying those attributes that contribute to the target's persistence. Thus, a team that is planning for conservation at an installation could follow the following sequence to identify its targets for planning:

- List those species explicitly identified for conservation, including those threatened and endangered and other listed species that require protection.
- List the natural communities and ecosystems (coarse filter targets) located on the installation.
- Nest the species within the coarse filter targets, as much as possible.
- Aggregate the coarse filter targets, as appropriate vis-à-vis land management. For example, pocket wetlands (small constructed systems, usually designed to aid in stormwater control) may be most effectively managed as part of the larger upland matrix.
- Determine those species that are not captured and assess whether they require special attention, including wide-ranging species.
- Finalize the list of targets to be the minimum sufficient set to capture all required species, and important systems.

## Assessing Threats to Biodiversity

Measurement of threat status has gained increasing attention among practitioners and students of conservation (e.g., Salafsky and Margoluis 1999b, Hockings et al. 2001, Margoluis and Salafsky 2001, Ervin 2002). Clearly, without reduction in the threats to biodiversity, those species and ecosystems that are the focus of conservation efforts will rapidly degrade and disappear. Yet, regardless of its importance, measuring threat status is insufficient on its own, for several reasons. Most significantly, a focus on threat status alone must assume that there is a clear, often linear, relationship between a threat and the ecological condition of biodiversity. This runs counter to recent evidence of the non-linear dynamics of ecosystems and threshold effects (e.g., Scheffer et al. 2001). Secondly, a singular focus on threats can lead to a "zero-tolerance" approach to threat activities in human influenced landscapes. Under most circumstances, this is unrealistic. Thus, it is preferable to link threats assessment to ecological integrity of viability assessments.

Here, a threat is defined as something negatively impacting a key ecological attribute. Conservation and management actions work to abate these impacts. Thus, there is a direct (and, it is hoped, clearly understood) linkage between the actions of the managers working on threats and the benefits to the ecological integrity and viability of targets of biodiversity.

Facing page: Freshwater pond at Otis Air National Guard Base, Cape Cod, Massachusetts. Military lands often contain extensive wetlands that are protected under state and federal laws. (Photo: Douglas Ripley)

## Regional Conservation Planning

Every military installation is only one piece of a much larger ecological matrix, or landscape. Often it is impossible to achieve the installation's conservation mission without fostering a conservation ethic on surrounding lands. External encroachment, for example, not only impacts military activities within the installation's boundary, but it will dramatically impact the biodiversity within those bounds as well.[1] As surrounding lands are fragmented, for example, the biodiversity within the installation becomes simultaneously more isolated and more susceptible to random events. Where, at one time, a sub-population could be re-colonized or reinvigorated from migrants from surrounding populations, as those surrounding populations become extirpated, the targets on the installation are ever more likely to be lost. Similarly, patterns of disturbance often extend beyond the military boundaries. As an installation becomes isolated, the managers must begin managing their lands[2] as a microcosm of the larger landscape.

It is often very useful to take even a larger perspective of the distribution of those conservation targets on an installation. Ecoregions are large areas that have been defined based on environmental variables known to influence patterns of biodiversity. Therefore they provide an appropriate foundation for large-scale conservation planning. While even the largest installation is dwarfed by the scale of an ecoregion (ten thousands of hectares versus millions of hectares), it is always valuable to understand how the conservation targets found within an installation are distributed across the continent. Understanding this spatial diversity can provide very useful insights into the natural variation potentially found, or managed for, on the installation.

The Nature Conservancy has completed ecoregional assessments for all terrestrial eco-regions in the United States. These are available (**http://www.conserveonline.org**) for download and review.

## Monitoring Biodiversity

What is monitoring? The Latin root of the word monitoring means "to warn," and an essential purpose of monitoring is to raise a warning flag that the current course of action is not working. Monitoring is a powerful tool for identifying problems in the early stages, before they become dramatically obvious or critical. If identified early, problems can be addressed while cost-effective solutions are still available. For example, an invasive species that threatens a rare plant population on an installation is much easier to control at the initial stages of invasion, compared to eradicating it once it is well established. Monitoring is also critical for measuring management success. Good monitoring can demonstrate that the current management approach is working and provide evidence supporting the continuation of current management.

In order for monitoring to function as a warning system or a measure of success, we must understand what monitoring is and the close relationship between monitoring and improved natural resources management decision-making. In this guide, we define monitoring as the collection and analysis of repeated observations, or measurements, to evaluate changes in condition and progress toward meeting a management objective.

Monitoring is the glue that binds the adaptive management cycle. The monitoring provides the information to assess success and guide future actions. To be

successful, any monitoring project must reflect two key concepts. The first is that monitoring is driven by objectives. What is measured, how well it is measured, and how often it is measured are design features that are defined by how an objective is articulated. The objective describes the desired condition. Management is designed to meet the objective. Monitoring is designed to determine if the objective is met. Objectives form the foundation of the entire monitoring project. The second concept is that monitoring is only initiated if opportunities for management change exist. If no alternative management options are available, expending resources to measure a trend in a species population is futile. What can you do if a population is declining other than document its demise? Because monitoring resources are limited, they should be directed toward species for which management solutions are available.

When does monitoring succeed? Unfortunately, most monitoring projects are initiated seemingly in a vacuum, and thus are destined to fail. The reasons for this lack of success can easily be traced to one of several causes:

**CONFUSING MONITORING WITH INVENTORY.** Inventory can be described as a point-in-time measurement of the resource to determine location or condition and number. The types of information collected during an inventory can be identical to those collected during monitoring. A key difference is that inventory data are rarely related to a management goal or objective. Collecting this type of data is often justified as providing a "baseline" for later comparison to allow for change detection. However, the question "Are things different now than they were X years ago?" is facetious. Of course things are different! The more appropriate questions are "How different are they?" and "What is the cause of these changes?"

**CONFUSING MONITORING WITH RESEARCH.** A second common failing of monitoring efforts is equating monitoring with research. The goals of a research study are different from those of a monitoring project. Typically, monitoring addresses one of two questions: (1) Has the variable of interest changed by some defined magnitude (e.g. 20 percent decline over 5 years), or, (2) Has that variable crossed some defined threshold (e.g. federal water quality standard)? Research usually tries to understand the causes of change—if such change occurs. These are more complicated questions, requiring greater sophistication in design, and thus larger expense. Too often, research, couched in terms of monitoring, repeatedly answers the same question because it is thought that monitoring needs to be focused on long-term data collection. Thus, its value decreases over time, as its relevance to current needs disappears.

For example, a common question when initiating a prescribed burning project is "What is the impact of prescribed fire on the rare plant species *x*?" This is a research question, and the parameters of interest might be survivorship, changes in reproduction, changes in vigor, and the like. In order to know that any differences detected pre- and post-burning are a result of the treatment, and not due to weather, a rigorous experiment needs to be implemented and data need to be collected in unburned (control) plots in addition to those plots in the burned area. The results of this experiment may, after five years of data collection, show that species *x* responds well to fire, with the survivorship and vigor of individuals being higher in the burned area than in the controls, and the reproduction rate is dramatically higher as well. The clear conclusion is that fire management is beneficial to species *x*. The logical result would be to declare the research successful, and reallocation of efforts to different, or new, problems. Unfortunately, it is too

### Six Components of a Good Monitoring Plan

**1. Who: What is the biological or ecological aspect of interest?**

**2. What: What is the indicator that you will be measuring?**

**3. Where: What is your area of interest?**

**4. When: What time of year do you need to make your observations?**

**5. How much: How much change is important? What is the minimum difference you want to detect?**

**6. For how long? What is the interval during which you want to detect this change?**

Right and facing page: The highly successful nesting of the red-footed booby on the artillery and small arms range of Marine Corps Base Hawai'i demonstrates that military operations and biodiversity conservation need not be mutually exclusive. (Photo: Douglas Ripley)

often argued that even though we now know how the species responds to fire, data collection cannot be stopped because the original study was called a "monitoring" study and monitoring is a long-term effort. Similarly, these sorts of research studies are repeated, over and over, at many places because the original experimental design was couched as a monitoring study that becomes ossified as the accepted method. Thus, the experiment is repeated ad infinitum, and we rediscover that species *x* responds well to fire over and over again.

**DEPENDENCE ON "STANDARD METHODS."** A common failing of monitoring programs is to blindly follow some standard sampling protocol. Most often, such standard protocols have been developed with the goal of providing a common dataset across many sites. Because there is typically no common question among these installations, the protocol designers try to design sampling to capture the maximum amount of data possible, in hope that when a question arises, there will be data available. Experience has shown that this hope is rarely, if ever, fulfilled. When a question does arise, invariably it turns out that the data were collected in the wrong places, the wrong variable was measured, or the sampling proto-

col provided such low statistical power as to be worthless.

The keys to designing a monitoring program that is efficient, effective, and empowers adaptive management are simple: First, you need to know what you need to know. What is the question that needs to be answered? If there is no clearly defined question, the likelihood that the data collected will provide value is nil. Some questions are easily articulated: Is the number of breeding pairs of *x* above our stated threshold? Has the spatial extent of prairie declined by more than 5 percent over the past decade? Has the habitat suitability index for grassland birds increased by 10 percent, on average, across the installation since 1990?

Monitoring questions about natural communities, or ecosystems, are more difficult to articulate so that they adequately address the conservation need. The common ecosystem descriptors (species composition, physiognomic structure, and function) rarely provide the information needed for management decisions. Documenting that arthropod species richness has declined by a few species, for example, doesn't lead to obvious management actions.


Earlier, key ecological attributes were identified as *those characteristics that must be maintained to ensure the integrity or viability of a conservation target*. Threats to the targets manifest themselves as stresses on these attributes, and conservation actions should be focused on abating these threats. Effective monitoring should address changes in these threats, and the response in the key attributes.

That is obviously not a simple task and achieving success requires a deep understanding of the ecosystems of concern. As has been pointed out earlier, one way to achieve the necessary contextual understanding to accomplish useful and effective monitoring is through participation in an ecoregional study. In Colorado, Fort Carson's participation in the Central Shortgrass Ecoregional Assessment is an excellent example of where participation in an ecoregional study helped the installation focus its monitoring efforts of natural communities or ecosystems to make useful management decisions. Through that collaborative initiative, Fort Carson obtained ecological analyses, suggestions for priority areas, a monitoring framework, and ideas to help it address conservation management decisions. See **http://conserveonline.org/coldocs/2005/10/revisedCSP.pdf.** See also **http://sites-conserveonline.org/gpg/projects/era.html#erp5.**

Science's curiosity about, study of, and understanding of environmental matters has grown prodigiously in recent years, as has its understanding of human effects on the natural world. We—scientists, policymakers, land managers, ordinary citizens—know better than ever that the actions we do and do not take can and will influence the globe on which we depend for life. This goes for natural resources managers on military installations as well as for homeowners who put chemicals on their lawns or people shopping for a new car.

The natural resources managers have a huge burden of responsibility that was never completely recognized before, but they also have an enormous storehouse of useful knowledge that only recently has been assembled. Science has supplied them with information about ecosystems, species populations, habitat and communities, landscapes, monitoring, fragmentation, and hundreds of other ways to keep track of, and protect, the biodiversity in their care—and to do so while also serving the military mission.

**NOTES**

1. For more on encroachment, see chapter 4.
2. For more on disturbance, both natural and human-caused, see chapter 8.

## Sources of Information

**THE NATURE CONSERVANCY'S CONSERVATION GATEWAY** (http://conservationgateway.org). TNC's web portal contains a diversity of information on conservation planning at the project, landscape, eco-regional, and major habitat scales. TNC's Conservation Action Planning software package is available for download. The gateway also provides access to several thousand documents on a diversity of conservation topics.

**PATUXENT SITE AND SOFTWARE** (http://www.mbr-pwrc.usgs.gov/software.html). The U.S. Geological Survey's Patuxent Wildlife Research Center maintains a software library for resources managers. The majority of the titles are for wildlife research and monitoring, but some (e.g. "Distance") can be utilized for estimating abundance of plants or physical phenomenon.

**DATA ANALYSIS** (http://www.utexas.edu/its/rc/world/stat/Freeware.html). This web page, provided by the University of Texas, includes a listing of a wide variety of free statistical packages.

**ECOLOGICAL MODELING**

- **Vensim** (http://www.vensim.com) is a powerful, free software package that enables the development of state-transition and other stock/flow models.
- **Stella** (http://www.iseesystems.com/softwares/Education/StellaSoftware.aspx) is the state-of-the-art software for developing complex ecological models—the current model of the Chesapeake Bay ecosystem was developed using Stella.
- The **Conservation Measures Partnership** (http://fosonline.org/CMP/) site provides access to Miradi, an open source conservation planning software. It also provides a "Rosetta stone" document that compares the conservation planning protocols developed by all the large conservation organizations.

**NATURESERVE EXPLORER** (www.natureserve.org/explorer). This website, a searchable database maintained by NatureServe, provides authoritative 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.

**NATURESERVE VISTA** (http://www.natureserve.org/vista). NatureServe Vista is a decision support system developed by NatureServe that integrates conservation information with land use patterns and policies, providing planners, resource managers, and communities with tools to help manage their natural resources. It enables users to create, evaluate, implement, and monitor land use and resource management plans that operate within the existing economic, social, and political context to achieve conservation goals.

## Literature Cited


Bestelmeyer, B.T., J.R. Brown, K.M. Havstad, R. Alexander, G. Chavez and J.E. Herrick. 2003. Development and use of state-and-transition models for rangelands. *Jour. Range Manage.* 56:114–126.

Carignan, V. and M-A Villard. 2002. Selecting indicator species to monitor ecological integrity: A review. *Environmental Monitoring and Assessment* 78: 45–61.

Christensen, N.L., et al. 1996. The report of the Ecological Society of America Committee on the Scientific Basis for Ecosystem Management. *Ecological Applications* 6: 665–691.

Clements, F.E. and V.E. Shelford, 1939. *Bioecology.* (New York: John Wiley and Sons, 1939).

Egler, F. 1977. *The Nature of Vegetation: Its management and mismanagement*. (Norfolk, Connecticut: Aton Forest,1977).

Ervin J. 2002. Rapid Assessment and Prioritization of Protected Area Management (RAPPAM) Methodology. Gland (Switzerland): World Wide Fund for Nature.

Forman, R.T.T. 1995. Land *Mosaics. The ecology of landscapes and regions*. (New York: Cambridge University Press, 1995).

Groves, C.R. 2003. *Drafting a conservation blueprint: a practitioner's guide to planning for biodiversity*. (Washington: Island Press, 2003).

Hockings, M., S. Stolton, N. Dudley, and J.D. Parrish. 2001. *Enhancing Our Heritage Toolkit: The Workbook on How to Build Assessment, Monitoring, and Reporting Systems on Management Effectiveness of World Heritage Sites*. (Accessed 18 August 2003 at **www.enhancingheritage.net/docs_public.asp**)

Holling, C.S. 1992. Cross-scale morphology, geometry, and dynamics of ecosystems. *Ecological Monographs* 62: 447–502.

Karr, J.R., and E.W. Chu. 1999. *Restoring Life in Running Waters: Better Biological Monitoring*. (Washington: Island Press, 1999).

Karr, J.R., and D.R. Dudley. 1981. Ecological perspective on water quality goals. *Environmental Management* 5: 55–68.

Leopold, A. 1933. *Game Management*. (New York: Charles Scribner's Sons, 1933).

Leopold, A. 1953. *Round River*. (New York: Oxford University Press, 1953).

Maddox, G.D., K.A. Poiani, and R.S. Unnasch. 1999. Evaluating management success: using ecological models to ask the right monitoring questions. p 563-584 In: Sexton, W.T, A.J. Malk, R.C. Szaro and N.C. Johnson (eds). *Ecological Stewardship: A common reference for ecosystem management. Vol III* (Oxford, UY.K.: Elsevier Science, 1999).

Margoluis, R., and N. Salafsky. 2001. *Is Our Project Succeeding? A Guide to Threat Reduction Assessment for Conservation*. (Washington: Biodiversity Support Program, 2001).

Noss, R.F., E.T. LaRoe, J.M. Scott. 1995. *Endangered Ecosystems of the United States: A Preliminary Assessment of Loss and Degradation*. (Washington: US Department of the Interior, National Biological Service. Biological Report no. 28, 1995).

Noss, R.F. 1990. Indicators for monitoring biodiversity: A hierarchical approach. *Conservation Biology* 4:355-364.

Noss, R. F. and A. Y. Cooperrider. 1994. *Saving nature's legacy: Protecting and restoring biodiversity*. (Washington: Island Press, 1994).

Noss, R.F. 1987. From plant communities to landscapes in conservation inventories: A look at The Nature Conservancy (USA). *Biological Conservation* 41:11–37.

Noss, R.F. 1996. Ecosystems as conservation targets. *Trends in Ecology and Evolution* 11: 351.

Noss. R. F. 1990. Indicators for monitoring biodiversity: A hierachical approach. *Conserv. Biol.* 4:355–364.

Orians, G.H, and M.J. Groom 2006. *Global Biodiversity: Patterns and Processes*. In: Groom, M.J., G.K. Meffe, and C.R. Carroll. *Principles of Conservation Biology* 3d ed. (Sunderland, Massachusetts: Sinauer Associates, 2006).

Pickett, S.T.A. and P. S. White (eds). 1986. *The ecology of natural disturbance and patch dynamics*. (New York: Academic Press, 1986).

Poiani, K.A., B.D. Richter, M.G. Anderson, and H.E. Richter. 2000. Biodiversity conservation at multiple scales: functional sites, landscapes, and networks. *BioScience* 50:133–146.

Salafsky N., and R. Margoluis. 1999. Threat reduction assessment: A practical and cost-effective approach to evaluating conservation and development projects. *Conservation Biology* 13: 830–841.

Sanderson E.W., K.H. Redford, A. Vedder, P.B. Coppolillo, and S.E. Ward. 2002. A conceptual model for conservation planning based on landscape species requirements. *Landscape and Urban Planning* 58: 41–56.

Sanderson, E.W., Redford K.H., A. Vedder, P.B. Coppolillo, and S.E. Ward. 2002. A conceptual model for conservation planning based on landscape species requirements. *Landscape and Urban Planning* 58: 41–56.

Scheffer, M., Carpenter, S., Foley J.A., Folke C., and B. Walker. 2001. Catastrophic shifts in ecosystems. *Nature* 413: 591–596.

Schwartz, M.W. 1999. Choosing the appropriate scale of reserves for conservation. *Annual Review of Ecology and Systematics* 30: 83–108.

Yoakum, J., and W. Dasmann. 1971. Habitat manipulation practices. Pages 173–231 in R. Giles, editor, *Wildlife Management Techniques*. 3rd ed. (Washington: The Wildlife Society, 1971).

Young, T.F., and S. Sanzone, eds. 2002. A Framework for Assessing and Reporting on Ecological Condition: An SAB Report. Washington: EPA Science Advisory Board. Report no. EPA-SAB-EPEC-02-009. (Accessed 29 July 2003 at **http://www.epa.gov/sab**).

CHAPTER THREE

# Legal and Policy Background

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The conservation and enhancement of biological diversity on the public's military lands have emerged as significant components of the Department of Defense's overall environmental and natural resources management programs. This is due to a variety of influences, some from within the Department of Defense (DoD) and others directed by Congress. This chapter provides a summary of current policy issues and legislative initiatives within the DoD that directly or indirectly relate to the conservation of biological diversity on the public's military lands.

## PART ONE: CURRENT POLICY ISSUES

### Encroachment

Encroachment is defined here as the cumulative result of any and all outside influences that inhibit normal military training, testing and operations.[1] Encroachment has emerged in recent years as a major issue for the DoD, as ever-increasing population growth continues near once remote and isolated military installations. Military impacts such as overflights, artillery noise, interference with radio spectra, or the need for safety buffer zones around impact areas and unexploded ordnance are some of the more important aspects of military operations that are incompatible with civilian development near military ranges. From an environmental perspective, the loss of natural habitats through development on areas adjacent to military installations can negatively impact the biodiversity on military lands. Encroachment may contribute to the loss of migration corridors for wildlife, the reduction in size of critical natural populations of imperiled species and their critical habitats, increased air and water pollution that may negatively impact native species, and many other potential direct and indirect effects.

All the services focus on community partnering and intergovernmental planning to achieve compatible land use and zoning to protect ever-evolving management needs. They integrate these activities as appropriate with such programs as the Air Installations Compatible Use Zones (AICUZ) program (http://www.dtic.mil/whs/directives/corres/text/i416557p.txt) and the Joint Land Use Study (JLUS) Program (http://www.oea.gov/OEAWeb.nsf/CEA72EC600311122885256E8300449772/$File/Jlus4pgr07.pdf). For the past several years, the DoD has been developing policies to address encroachment. This has largely been accomplished through its efforts to comply with the provisions of Section 2684a of the FY2003 Defense Authorization Act, 10 USC 2684a, described in the Legislative Initiatives section, below. The most conspicuous element of this effort has been the establishment of the Readiness and Environmental Protection Initiative (REPI), a component of the Sustainable Range Initiative, also described below.

The Army began the first formal program to address encroachment in 1995 at Fort Bragg, N.C., where it worked with stakeholders in and around the installation to develop the Fort Bragg Private Land Initiative (also called the North Carolina Sandhills Conservation Partnership) as a way to work cooperatively to conserve private lands to help restore the red-cockaded woodpecker, a federally listed endangered species.[2] This effort led to the Army's partnering with The Nature Conservancy and other stakeholders to buy lands or interests from willing owners. The lands were then used as additional off-base habitat for the bird, while providing open space for the community and a buffer from encroachment for the

installation. The results were that the Army could once again use training lands that had been previously set aside exclusively to protect woodpecker habitat, habitat for the bird was expanded, and open space was preserved from encroachment around Fort Bragg, thus reducing potential conflicts with military activities. In 2005, Fort Bragg reached a woodpecker population size of 436 groups, an increase from 350 in 2000, and exceeded the population recovery size dictated by the Endangered Species Act. (See **https://www.denix.osd.mil.**)

From its highly successful initiative at Fort Bragg, the Army developed the Army Compatible Use Buffer Program (ACUB) that allows for the establishment of conservation easements and other strategies to protect its training ranges from encroachment (**http://www.sustainability.army.mil/tools/programtools_acub.cfm**). Through the ACUB program the Army enters into cooperative agreements with partners to purchase land or interests in the land and/or water rights from willing sellers as part of a comprehensive approach to protect its testing and training requirements. Under these arrangements, cost-sharing agreements are individually negotiated between the Army and the partners.

Building on DOD's REPI guidance, the Navy and Marine Corps have also addressed encroachment issues in the past several years through what they term Encroachment Partnering (EP) Programs, part of an overall Encroachment Control Program that develops encroachment action or control plans that delineate short, medium, and long-term strategies for each installation. The Department of the Navy's practice has been to acquire a recordable interest in property in the form of a restrictive use or conservation easement or deed covenants similar to a real estate civil easement, in which one party grants permission for a road or utility right-of-way.

The Air Force, probably the military service least impacted directly by infringement, has only recently begun to address the encroachment issues, primarily by focusing on community partnering and intergovernmental planning to achieve compatible land use and zoning to protect ever-evolving airspace management needs.

### What is Encroachment?

**One definition is to take another's possession or rights gradually or stealthily. But encroachment exists in the eye of the beholder. In this discussion we have focused on the military's view, but civilian communities adjacent to military installations may see expansion of no-development zones, noise, and disruption of frequency spectra as encroachment upon them.**

The U.S. Army transferred the Presidio of San Francisco to the National Park Service in 1994 after more than two centuries of military use. (Photo: Douglas Ripley)

Egrets roosting in baldcypress wetlands at Barksdale AFB, Louisiana. (Photo: Douglas Ripley)

The authority in 10 USC 2684a represents a significant step forward in encouraging open communication and collaboration between the military and a wide array of stakeholders, leading to successful conservation/compatibility partnerships that are focused on common objectives. These partnerships allow DOD to make clear-cut gains in achieving conservation and protecting the military mission by leveraging funds to accomplish the protection of vital lands and habitats.

## Mission Sustainability

Ever-increasing demands on limited land resources, especially for the Army and Marine Corps, have resulted in new concerns about the sustainability of the military land base. This is attributable to the increasing demands on the land base by larger and more complex military equipment, along with the employment of new training strategies. Also, the loss of some large training areas, such as the Navy's Vieques Training Range in Puerto Rico, have further emphasized the need for ensuring the sustainability of remaining military lands. And the many new operational constraints imposed by encroachment further threaten the sustainability of military testing and training lands.

The DOD has developed a comprehensive plan as part of its evolving Sustainable Range Initiative (SRI) to ensure the sustainability of military ranges and installations while simultaneously protecting the environment and ensuring that realistic training lands will be available in perpetuity. The DOD's annual Sustainable Ranges Report to Congress describes the importance of range sustainability to the DOD and the specific steps it is taking to address this critical issue (**https://www.denix.osd.mil.**).

The overarching policy for this Sustainable Range Initiative is presented in DOD Directive 3200.15, *Sustainment of Ranges and Operating Areas,* signed in January 2003 (**http://www.dtic.mil/whs/directives/corres/pdf/320015p.pdf**).

The Army has taken the most structured and significant strides to address the practical aspects of long-term sustainability of its lands through the establishment in 1984 of its Integrated Training Area Management (ITAM) program. This effort established long-term monitoring and assessment protocols for Army training lands with a view to ensuring their sustainability. Only in very limited cases has the ITAM program been employed in the other military services (**http://aec.army.mil/usaec/range/sustainmento1.html**).

## BRAC

The Base Realignment and Closure (BRAC) process has had profound effects on both the military and surrounding civilian communities, since it involves wide-ranging and sometimes wrenching changes in populations and fortune. BRAC has been employed five times since the enactment of the Defense Realignment and Closure Act in 1990, most recently in 2005. The process has closed or realigned hundreds of installations, some with significant natural resources.

DOD policy, as established in DOD Instruction 4715.3, *Environmental Conservation Program,* requires that before disposing of DOD properties, the DOD component with responsibility for the property involved shall: (1) Identify all significant natural and cultural resources, and determine whether they may be affected by the disposal action; and (2) Provide disposal plans to appropriate agencies, organizations, and individuals, and provide a reasonable opportunity for review and comment before proceeding with the disposal action (**https://www.denix.osd.mil.**).

The most significant impact of the BRAC process on current military natural resources programs has been with the realignment or movement of military forces and their families and missions from closing installations to new installations. In addition to the general DOD policy established in DOD Instruction 4715.3, each military service has developed policies and procedures for assessing the environmental and natural resources conditions on installations being considered for closure or realignment. These assessments typically consider the occurrence of rare, threatened, or endangered species and the general level of biodiversity present (**http://www.dod.mil/brac/**).

### BRAC Success Stories

**Some military installations closed through the BRAC process have been transferred to other land management agencies because of their exceptional natural and cultural resources. Among those are the U.S. Army's Presidio of San Francisco, California (transferred to the National Park Service); the U.S. Army's Jefferson Proving Ground, Indiana; Fort Ord, California, and the North Tract of Fort Meade, Maryland (all transferred to the U.S. Fish and Wildlife Service); the U.S. Navy's Midway Atoll (transferred to the U.S. Fish and Wildlife Service), and the U.S. Air Force's Pease Air Force Base, New Hampshire (transferred to the U.S. Fish and Wildlife Service).**

## Ecosystem Management and Biodiversity Conservation

The DOD formally established a policy for an ecosystem approach to natural resources management and for the conservation of biological diversity in its 1996 Conservation Instruction (DODI 4715.3). The 1996 DOD *Biodiversity Handbook* and this revision to the handbook informally reinforce that policy. The policy regarding ecosystem management and biodiversity conservation was derived largely from the recommendations of the *Keystone Center Policy Dialogue on a Department of Defense (DOD) Biodiversity Management Strategy* (Keystone Center, 1996). The Keystone Center, a private non-profit organization, helps individuals and organizations approach environmental and scientific issues and disagreements creatively and proactively. The center assisted the DOD in addressing the issue of biodiversity conservation through a series of dialogues involving the military, the academic community, environmental organizations, and concerned individuals (**https://www.denix.osd.mil.**).

The key elements of the policy for ecosystem management include the following goals, principles, and guidelines:

**GOAL OF ECOSYSTEM MANAGEMENT.** To ensure that military lands support present and future training and testing requirements while preserving, improving, and enhancing ecosystem integrity. Over the long term, that approach shall maintain and improve the sustainability and biological diversity of terrestrial and aquatic (including marine) ecosystems while supporting sustainable economies, human use, and the environment required for realistic military training operations.

### PRINCIPLES AND GUIDELINES

- Maintain and improve the sustainability and native biodiversity of ecosystems.
- Administer with consideration of ecological units and timeframes.
- Support sustainable human activities.
- Develop a vision of ecosystem health.
- Develop priorities and reconcile conflicts.
- Develop coordinated approaches to work toward ecosystem health.
  - Involve the military operational community early in the planning process.
  - Develop a detailed ecosystem management implementation strategy for installation lands and other programs.
  - Meet regularly with regional stakeholders (e.g., state, tribal, and local governments; nongovernmental entities; private landowners, and the public) to discuss issues and to work towards common goals.
  - Incorporate ecosystem management goals into strategic, financial, and program planning and design budgets to meet the goals and objectives of the ecosystem management implementation strategy.
  - Seek to prevent undesirable duplication of effort, minimize inconsistencies, and create efficiencies in programs affecting ecosystems.
- Rely on the best science and data available.
- Use benchmarks to monitor and evaluate outcomes.
- Use adaptive management.
- Implement ecosystem management through installation plans and programs.

Facing page: Even small installations, such as Randolph AFB in San Antonio, Texas, may provide important habitat for many native species. (Photo: Douglas Ripley)

DoD Directive 4715.3 establishes the following goals for the conservation of biological diversity on military lands:

- **Goals.** Biodiversity conservation on DoD lands and waters shall be promoted when consistent with the mission and practicable to achieve the following goals:
  - Maintain or restore remaining native ecosystem types across their natural range of variation.
  - Maintain or reestablish viable populations of all native species in an installation's areas of natural habitat, when practical.
  - Maintain evolutionary and ecological processes, such as disturbance regimes, hydrological processes, and nutrient cycles.
  - Manage over sufficiently long-time periods for changing system dynamics.
  - Accommodate human use in those guidelines.

Bill Tate, USFWS fish biologist, with Okaloosa darters. Eglin AFB, Florida, is home to more that 90 percent of the darter's stream habitat. Projects for the protection of this federally listed species qualify for Class I funding. (Photo: Jerron Barnett, U.S. Air Force)

Each of the services has incorporated policies regarding ecosystem management and biodiversity conservation into their natural resources directives. These policies are subject to periodic review and revision because of their relationship to so many other natural resources management issues (e.g. sustainability, encroachment, etc.).

## Natural Resources Funding

### APPROPRIATED FUNDING

Another important policy issue at the heart of biodiversity conservation is funding. Obtaining appropriated funding for natural resources projects is the responsibility of each military service, based on policy guidance issued by the Department of Defense in DOD Instruction 4715.3. Each military service has therefore developed individual environmental funding policy based on the DOD policy.

The DOD funding policy establishes the following natural resources funding priorities for appropriated Operations and Maintenance (Funding Appropriation 3400):

- **Class 0:** Recurring natural and cultural resources conservation management requirements. Includes activities needed to cover the recurring administrative, personnel, and other costs associated with managing DOD's conservation program that are necessary to meet applicable compliance requirements (federal and state laws, regulations, presidential executive orders, and DOD policies) or which are in direct support of the military mission.

- **Class I:** Current compliance: Includes projects and activities needed because an installation is currently out of compliance (has received an enforcement action from a duly authorized federal or state agency, or local authority); has a signed compliance agreement or has received a consent order, or has not met requirements based on applicable federal or state laws, regulations, standards, presidential executive orders, or DOD policies, and/or are immediate and essential to maintain operational integrity or sustain readiness of the military mission. "Class I" also includes projects and activities needed that are not currently out of compliance (deadlines or requirements have been established by applicable laws, regulations, standards, DOD policies, or presidential executive orders, but deadlines have not passed or requirements are not in force) but shall be if projects or activities are not implemented in the current program year.

- **Class II:** Maintenance requirements. Includes those projects and activities needed that are not currently out of compliance (deadlines or requirements have been established by applicable laws, regulations, standards, presidential executive orders, or DOD policies) but deadlines have not passed or requirements are not in force), but shall be out of compliance if projects or activities are not implemented in time to meet an established deadline beyond the current program year.

- **Class III:** Enhancement or actions beyond compliance. Includes those projects and activities that enhance conservation resources or the integrity of the installation mission, or are needed to address overall environmental goals and objectives, but are not specifically required under regulation or executive order and are not of an immediate nature.

### Watchable Wildlife

**The development of the Watchable Wildlife site at Marine Corps Base Quantico, Virginia, is an example of a Class III conservation project that addresses important conservation and outdoor recreation goals but is not required under service regulations or federal law.**

**https://www.denix.osd.mil.**


Nature Trail Sign, Dobbins ARB, Georgia. The construction of nature trails is a Level III natural resources funding project. (Photo: Douglas Ripley)

Far left: Commercial forestry operations at Fort Pickett, Virginia. (Photo courtesy of U.S. Army)

Left: Fishing programs at Eglin AFB, Florida, supported by the funds collected in permit fees, provide recreational opportunities for military members and their familes. (Photo: Jerron Barnett, U.S. Air Force)

### NON-APPROPRIATED FUNDING

In addition to appropriated funding, several other sources exist for funding natural resources projects on military lands. Among those are the revenues derived from the outleasing of agricultural lands, the sale of commercial forestry products, and the sale of hunting and fishing permits. The procedure for the collection, expenditure and accounting of these funds is provided in DOD Instruction 4715.3, that reinforces legal mandates for each funding sources. That policy conforms to the unique legal requirements for each of the funding sources.

- Agricultural leases: Title 10, Section 2667(d) prescribes procedures for agricultural leases, which are also delineated in the individual services' natural resources directives (**http://www4.law.cornell.edu/uscode/html/uscode10/usc_sec_10_00002667----000-notes.html**).

- **Commercial forestry programs:** A special feature of this program is the DOD Forestry Reserve Account, which serves as an emergency holding account to ensure that the self-supporting DOD forestry program remains solvent in times of

low revenue. The Army serves as the DOD executive agency for this account, as specified in Department of Defense Financial Management Regulation (DODFMR 7000.14-R Volume 11A, Chapter 16) (**http://www.dod.mil/comptroller/fmr/11a/11a_16.pdf**). Specific policy and guidance for the management of each service's forestry account is contained in the individual service's natural resources directives.

■ **Hunting and fishing fees:** The authority for the collection of these fees derives from the Sikes Act (**http://epw.senate.gov/sikes.pdf**). As with the other reimbursable accounts, specific policy and guidance for the management of each service's hunting and fishing fee accounts is contained in the individual service's natural resources directives (http://aec.army.mil/usaec/natural/21xguidance.pdf).

#### OTHER FUNDING SOURCES

Other funding sources are available to military natural resources managers, including research grants, cooperative partnerships with other government agencies, and cooperative agreements with nongovernmental organizations. The Sikes Act grants authority for the DOD to enter into cooperative agreements with nongovernmental organizations. One very important source of funding for DOD natural and cultural resources projects is the Legacy Resource Management Program, a special Congressional appropriation established in 1991 specifically to fund natural and cultural resources projects on military lands. Initially the criteria for Legacy Program funding were very general and allowed for the funding of many relatively small natural and cultural resources enhancement projects on individual military installations. In 1997, Congress modified Legacy project selection criteria to support mainly larger, regional, and DOD-wide projects (**http://www.dodlegacy.org/Legacy/intro/guidelines.aspx**).

Walter Briggs, Staff Forester, Naval Engineering Field Activity, Northwest, Washington, exemplifies the Sikes Act requirement for the employment of professionally trained natural resources managers. (Photo: Douglas Ripley)

## Staffing of Natural Resources Positions with Qualified Personnel

The Sikes Act requires that professionally trained natural resources managers be employed at all installations requiring an Integrated Resources Management Plan (INRMP). The Sikes Act further stipulates that if qualified individuals can not be found within the military service to implement the INRMP, then priority should be given to an appropriate federal or state wildlife management agency to execute it. However, this policy has not been formally adopted by all the military services. Even where it has, such as in the Air Force, it is sometimes not enforced. The result is that some natural resources positions are filled with individuals lacking formal natural resources backgrounds or training. Typically, individuals with civil engineering backgrounds are selected for these positions or, in some cases, individuals with no formal professional natural resources training whatsoever.

## Water Conservation

Particularly at installations in the Southwest, water conservation has emerged as a significant policy issue. Water conservation issues, such as at Fort Huachuca, Arizona, Fort Carson, Colorado, and the military installations in the San Antonio, Texas, area, are often linked to a number of other environmental issues (e.g. Endangered Species Act compliance, encroachment of civilian housing, etc.). To

date, these issues have been addressed locally on a case-by-case manner without a consistent DoD or individual service policy.

## Impacts on Nonmilitary Lands and Waters

Military testing and training often impact non-military lands and waters (wilderness areas, national parks, ocean basins) and their associated natural resources. Examples include Air Force overflights or low level training in wilderness areas and national wildlife refuges, and impacts to marine life by Navy SONAR operations and ship shock testing in the open oceans.

## Invasive Species

In some cases, invasive species directly affect military training operations. On almost every DoD installation—as elsewhere—invasive species are having a deleterious effect on the natural resources.[3] Military invasive species issues involve efforts to control the introduction or spread of invasive species due to military operations (e.g. return shipments to the U.S. of military equipment from overseas deployments, discharge of ballast water by Navy vessels in U.S. ports, etc.) to the control of invasive species on military lands. Efforts to deal with this issue are being addressed primarily through the DoD Armed Forces Pest Management Board and by the individual services' natural resources guidance (**http://www.afpmb.org/**).

The DoD has issued guidance, via memorandum for the implementation of Executive Order 13112, *Invasive Species* (**http://www.nepa.gov/nepa/regs/eos/eo13112.html**).

Tamarix (or salt cedar) at Edwards AFB, California. DoD programs to control this serious pest are important to many ecosystems throughout the southwestern U.S. (Photo: Douglas Ripley)

## Development, Implementation, and Revision of INRMPS

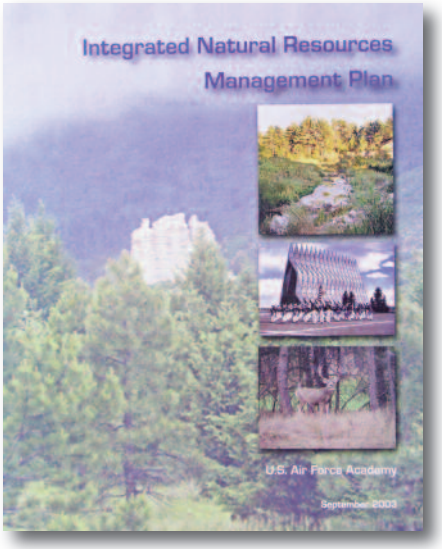
The amendments provided in the Sikes Act Improvement Act of 1997 significantly strengthened DoD natural resources programs by mandating the development and implementation of INRMPs for all installations with natural resources. As discussed in the Legislative Initiative section, below, the 1997 amendments required that INRMPs be prepared in cooperation with the appropriate state fish and game agency and the U.S. Fish and Wildlife Service, and that they be subject to public review and comment. Additionally, the services must fund and implement their INRMPs, review them annually, and update them as necessary at least every five years.[4]

The current DoD conservation instruction (DODI 4715.3) has not been revised since the enactment of the 1997 Sikes Act Improvement Act. However, the DoD has implemented policy on the development and revision of INRMPs via several official memoranda and also has provided INRMP guides, handbooks, and other development tools. Among those are:

- 10 October, 2002. Memorandum providing policy on INRMP coordination, reporting, and implementation (https://www.denix.osd.mil).
- 1 November, 2004. Memorandum providing policy on scope of INRMP review, public comment on INRMP review, and Endangered Species Act consultation on INRMPS (https://www.denix.osd.mil).
- 17 May, 2005. Memorandum providing policy on the applicability of the Sikes Act INRMP requirement for DoD lands leased to a non-DoD party (**https://www.denix.osd.mil**).

- August 2005. *Best Practices for Integrated Natural Resources Management (INRMP) Implementation* (https://www.denix.osd.mil).
- September 2005. *Resources for INRMP Implementation. A Handbook for the DOD Natural Resources Manager* (https://www.denix.osd.mil).
- 14 August, 2006. Memorandum outlining an INRMP template for new and revised INRMPs (https://www.denix.osd.mil).

Each military service has developed specific policy guidance for INRMP implementation in their individual natural resources directives and through other guidance, as outlined below.




U.S. Air Force Academy INRMP. The implementation of the INRMP requirements of the 1997 Sikes Act Improvement Act have strengthened and expanded military natural resources programs. (Photo: U.S. Air Force Academy)

#### ARMY

- 1997 INRMP Guide (http://aec.army.mil/usaec/natural/guidnatu.doc).
- Army Natural Resources Regulation 200-1 (http://www.usapa.army.mil/pdffiles/r200_1.pdf).

#### NAVY

- 1 Nov 94: OPNAVINST 5090.1B, *Environmental and Natural Resources Program Manual* (https://acc.dau.mil/CommunityBrowser.aspx?id=25705).

#### U.S. MARINE CORPS

- 2006 USMC INRMP Handbook (https://www.denix.osd.mil).

#### U.S. AIR FORCE

- September 2004: *Air Force Instruction 32-7064, Integrated Natural Resources Management*

## Endangered Species Act (ESA) issues

Compliance with the ESA has long been a major component of the DOD's environmental programs (http://www.fws.gov/endangered/bulletin/2006/ES_Bulletin_07-2006.pdf).

Although the DOD endangered species policy is well established in DOD Directive 4715.3 and the individual services, natural resources directives, recent legislative initiatives regarding the designation of critical habitat, as discussed in Part 2, below, have necessitated some modifications to the DOD policy which are yet to be formalized. However, the Army has prepared specific guidance regarding the designation of critical habitat under the ESA that addresses the issue of using the existence of an installation INRMP to preclude the designation of critical habitat, as discussed in Part 2, below (**http://aec.army.mil/usaec/natural/apg-chd.pdf**).[5]

## Law Enforcement

The Sikes Act mandates that natural resources law enforcement be provided on military lands, and the DOD has developed very general law enforcement policy in DOD Directive 4715.3. However, comprehensive DOD law enforcement policy is lacking and each military service has historically addressed the subject individually on an installation-by-installation basis. This has included a range of law

enforcement options ranging from employment of civilian game wardens, military police, or combinations of civilian game wardens and military police. Further, there is no DOD standard for law enforcement training, firearms, or civilian job descriptions. In 2003, the U.S. Marine Corps developed a standard law enforcement policy described in Marine Corps Order 5090.1, *Conservation Law Enforcement Program* (http://www.usmc.mil/marinelink/ind.nsf/publications/).

The Marine Corps policy provides standardized job descriptions, prescribes training requirements, and sets staffing levels for all Marine Corps installations. Although the Air Force has endeavored to develop a similar program, it has yet to be formalized. A standard DOD policy on natural resources law enforcement, therefore, remains to be developed.

## Cooperation Conservation Efforts

It has long been DOD policy to encourage cooperation on natural resources management issues with federal organizations, states, local governments, nongovernmental organizations, and individuals to maintain and improve natural resources, as outlined in DOD Directive 4715.3. Prior to the enactment of 10 USC 2684a, discussed above in the Encroachment section, the Sikes Act was used as the primary authority for the Secretary of Defense to enter into cooperative agreements. However, this authority was almost entirely directed to the protection of

A fisherman is checked by a Fort Riley conservation officer for compliance with the post's regulations. (Photo courtesy of U.S. Army)

resources within the boundaries of DoD installations. The authority of 10 USC 2684a allows for cooperative conservation efforts through the acquisition of land or easements in the vicinity of military installations and ranges, thus adding valuable flexibility to wildlife protection efforts.

Finally, Executive Order 13352, *Cooperative Conservation,* specifically directs federal agencies to develop cooperative conservation programs (**http://www.nepa.gov/nepa/regs/Executive_Order_13352.htm**).

Over the years, cooperative conservation efforts with federal and state agencies, nongovernmental organizations, universities, and museums have provided many opportunities for the DoD to obtain invaluable, cost-effective research and other services in support of its natural resources conservation programs. With the authority of 10 USC2684a, many new cooperative agreements are being established that help to enhance off-base habitat and to ease encroachment problems in the vicinity of military installations. [6]


Natural resources law enforcement sign, Charleston Naval Weapons Station, South Carolina. (Photo: Douglas Ripley)

## Public Access to Military Lands

Public access to military lands for recreational purposes has long been a requirement of the Sikes Act. The Defense Authorization Act of 1999 expanded this requirement to specifically encourage access to hunting, fishing, and other outdoor recreation opportunities for disabled veterans (http://www.ogc.doc.gov/ogc/contracts/cld/hi/105-261.html).

However, DoD policy has always stated that the local military commander has the authority to decide the extent of public access to his or her installation, based on security and safety considerations. And, following the events of 11 September 2001, public access has been significantly reduced to most military installations. Consequently, no DoD formal policy exists for public access to military bases and ranges, and public access is handled mainly on a case-by-case basis at individual installations.[7]

## Wetlands Regulations

The U.S. Army Corps of Engineers defines wetlands as "those areas that are inundated or saturated with ground or surface water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted to life in saturated soil conditions." Wetlands are important natural system because of the diverse biological and hydrologic functions they perform. These functions could include water quality improvement, groundwater recharge, pollution treatment, nutrient cycling, provision of wildlife habitat and niches for unique flora and fauna, stormwater storage, and erosion protection.

Wetlands are protected as a subset of the "waters of the United States" under Section 404 of the Clean Water Act (CWA). The term "waters of the United States" has broad meaning under the CWA and incorporates deepwater aquatic habitats and special aquatic habitats (including wetlands). "Jurisdictional" waters of the United States are areas regulated under the CWA and could also include coastal and inland waters, lakes, rivers, ponds, streams, intermittent streams, vernal pools, and "other" waters that if degraded or destroyed could affect interstate commerce.

Section 404 of the CWA authorizes the Secretary of the Army, acting through the Chief of Engineers, to issue or deny permits for the discharge of dredged or fill materials into the waters of the United States, including wetlands. In addition, Section 404 of the CWA also grants states with sufficient resources the right to assume these responsibilities.

Section 401 of the CWA gives the state board and regional boards the authority to regulate, through water quality certification, any proposed federally permitted activity that might result in a discharge to water bodies, including wetlands.

Furthermore, wetlands are protected under Executive Order 11990, *Protection of Wetlands* (43 FR 6030) (**https://www.denix.osd.mil**), the purpose of which is to reduce adverse impacts associated with the destruction or modification of wetlands. The secretary of each military service has established procedures to redelegate authority for the protection of wetlands to a lower administrative level, typically at the major operational command. The commander at that level, typically serving as chair of command's Environmental Protection Committee, must sign a Finding of No Practicable Alternative (FONPA) before any action within a federally-designated wetland may proceed. In preparing a FONPA, the military unit must consider alternatives that will satisfy justified program requirements, meet technology standards, are cost-effective, do not result in unreasonable adverse environmental impacts, and other pertinent factors. When the practicality of alternatives has been fully assessed, only then should a statement regarding the FONPA be made into the associated FONSI or Record of Decision (ROD).

As a result of the previously cited federal and state regulations, the military services are responsible for identifying and locating jurisdictional waters of the United States (including wetlands) occurring on military lands where these resources have the potential to be impacted by military mission activities. Such impacts could include construction of roads, buildings, runways, taxiways, navigation aids, and other appurtenant structures or activities as simple as culvert crossings of small intermittent streams, riprap placement in stream channels to curb accelerated erosion, and incidental fill and grading of wet depressions.

## Changes in Public Expectations of DoD Conservation Programs

Public perceptions of DOD conservation programs have characteristically been difficult to assess, owing to a general lack of understanding or exposure to them. Formal public surveys have not been performed. Most public reaction to DOD natural conservation programs is derived through the public comment phase of the NEPA process, but that is usually focused on a specific proposed action and does not typically provide a specific assessment of the overall conservation program.

Recent successful efforts by the DOD to modify some aspects of the various natural resources protection laws (as discussed in Section 2, above) have generated extremely negative responses from various environmental organizations (e.g. Natural Resources Defense Council, The Audubon Society, National Sierra Club, and others).

Overall, it is very difficult to assess changes in public expectations of DOD conservation programs, owing to the lack of a comprehensive means of measuring current expectations of such programs, as well as a valid baseline with which to compare such data. Most expectations are very local in nature, based on individ-

ual experiences at a specific installation. While DoD and the individual services have established outreach and education programs to inform the public of their conservation programs, it is very difficult to measure the success of those efforts.

Some private environmental organizations, particularly The Nature Conservancy, and other government agencies, such as the U.S. Fish and Wildlife Service, have made tremendous efforts to educate the public on DoD conservation programs (for example, see the USFWS endangered species web site at **http://www.fws.gov/endangered/**). But no formal program has endeavored to assess public perceptions or expectations of military conservation programs.

Facing page: Vernal pool wetland at Beale AFB, California. Situated in the northern Sacramento Valley, Beale AFB possesses thousands of vernal pools, protected wetlands of exceptional biological diversity. Several species of endangered invertebrates occupy these wetlands and Beale AFB has developed a comprehensive management plan for their protection and conservation. (Photo: Douglas Ripley)

## PART TWO: IMPORTANT LEGISLATIVE INITIATIVES

The first section of the chapter discussed current policy issues, such as encroachment and ecosystem management. This section deals with the more important legislative initiatives during the past decade relating directly to the management of natural resources on military lands or waters, or to the impacts of military operations on natural resources on public or private lands or waters. While many of these initiatives were requested by the DoD, others were instigated by the Congress without specific requests from the DoD.

## Sikes Act Improvement Act (1997)

Enacted in 1960, the Sikes Act provides the authority, and defines the responsibilities, for the management of natural resources on military lands. In its original form the Sikes Act mainly addressed public access to military lands for hunting and fishing activities. Over the years the act has been significantly strengthened, and its scope expanded, to the point that it now represents a comprehensive law mandating the conservation of all aspects of natural resources on military lands.

The most significant amendment, known as the Sikes Act Improvement Act of 1997, was enacted with the strong support of the U.S. Fish and Wildlife Service and the Association of Fish and Wildlife Agencies (representing state fish and game agencies). Major provisions of the Sikes Act Improvement Act of 1997 include:

- Mandatory requirement for all DoD installations with natural resources to prepare a comprehensive Integrated Natural Resources Management Plan (INRMP).
- The INRMP must be prepared in cooperation with the U.S. Fish and Wildlife Service and the pertinent state fish and game agency.
- Public comment is required on the INRMP.
- The INRMP must be implemented.

Subsequent modifications to the Sikes Act, mainly through provisions specified in the Defense Authorization Act, have addressed a number of issues, ranging from providing disabled veterans with access to hunting and fishing programs on military, to control of invasive species, and compliance with the Endangered Species Act. The more important of these provisions are discussed below.

### The Sikes Act

**The Sikes Act is named after Rep. Robert L.F. Sikes, Democrat representing Northwest Florida, home to Eglin AFB and other major DoD installations. It was enacted in 1960 "to promote effectual planning, development, maintenance, and coordination of wildlife, fish, and game conservation and rehabilitation in military reservations." (See http://epw.senate.gov/sikes.pdf.)**

## Migratory Bird Treaty Act

Although the DoD has a long history of positive contributions to the conservation of migratory birds (**http://www.dodpif.org/**), the Navy was sued successfully regarding the "unintentional take" of birds at a bombing range in the Western Pacific on the island of Farallon de Medinilla. The Migratory Bird Treaty Act has many provisions for the regulated "intentional taking" of migratory birds. Examples include waterfowl hunting, depredation of nuisance species, or birds that pose a safety hazard. However, the act has no provision for the "unintentional taking" of migratory birds. That is, if birds are taken by accident or in conjunction with some activity (e.g. military operations) whose primary purpose is not the taking of birds, the law has no provision to issue a permit for such activities. Hence, there would be no legal way to conduct military operations if any birds were taken in the process. To address this problem and the legal decision against it at Farallon de Medinilla, the Navy sought and achieved legislative relief regarding "unintentional take" during military readiness operations in the FY 03 Defense Authorization Act. A Final Rule reflecting this was published on 28 February 2007 in the Federal Register (**http://www.fws.gov/migratorybirds/issues/dodmbtarule/FederalRegister.final.pdf**).

This change allows the military to obtain permits for the "unintentional take" of a migratory bird if it is in support of a military readiness operation. The specific details of this new procedure are spelled out in a memorandum of understanding between the DoD and the U.S. Fish and Wildlife Service (USFWS), as required by E.O. 13186, Migratory Birds that was signed on 31 July 2006. These procedures contain significant safeguards to ensure that the taking of birds is minimized when the new rule is used and that conservation measures are employed to compensate for the losses that may occur (**https://www.denix.osd.mil**).

On 3 April 2006, the Assistant Deputy Under Secretary of Defense issued a memorandum providing specific guidance on the implementation of the MOU (**https://www.denix.osd.mil**).


The vermillion flycatcher (left) at Fort Huachuca, Arizona, and the yellow-throated warbler (right) at NAS Patuxent River, Maryland. Protection of migratory birds is a major objective of military natural resources programs. (Photos: Arlene Ripley)

## Endangered Species Act

Long considered a federal agency leader in the conservation of endangered species, the DoD has implemented a comprehensive program to ensure compliance with the Endangered Species Act. For that reason, there was considerable concern when the U.S. Fish and Wildlife Service began a court-ordered effort to designate critical habitat for all federally listed species. The concern in the DoD with the new USFWS effort was that declaring critical habitat would add a new administrative burden on military installations with no added benefit to listed species. The DoD argued that it was already providing extensive protection to listed species through its formal consultations with the USFWS and the conservation measures specified in installation INRMPs. It therefore argued that designating military land as critical habitat would only add an additional compliance and consultation burden on the DoD while not enhancing protection for listed species. The DoD achieved relief from the provision in the FY 2004 Defense Authorization Act (Section 318) (see http://www.dod.mil/dodgc/olc/docs/2004NDAA.pdf). This legislation granted the USFWS specific authority to exempt DoD lands from the designation of critical habitat provided:

- A comprehensive and approved INRMP was in effect.
- The INRMP specifically addressed the conservation of the species under consideration.
- The INRMP was implemented.

## Marine Mammal Protection Act

The Navy actively sought and achieved through the 2004 Defense Authorization Act (Section 319), a clarification of the definition of "take" under the Marine Mammal Protection Act. Specifically, this provision modified the meaning of Level B Harassment of a marine mammal when caused by military activities. The net result of this change was to increase slightly the harassment threshold and thereby reduce the number of occasions in which the military services would need to consult the National Marine Fisheries Service regarding their testing or training operations (http://www.dod.mil/dodgc/olc/docs/2004NDAA.pdf).

### Harrassment

**Under the Marine Mammal Protection Act, "harassment" is one component of a larger prohibition known as a "taking" and consists of two levels:**

**Level A Harassment: Action with the potential to injure marine mammals or marine mammal stock in the wild (e.g. ship strike, underwater explosion).**

**Level B Harassment: Action with the potential to disturb marine mammals or marine mammal stock in the wild by causing disruption of behavioral patterns. (e.g. sonar, aircraft overflight).**

## Invasive Species

The FY 2004 Defense Authorization Act (Section 311-c) also contained legislation establishing a pilot program for the control of invasive species on military lands in Guam. This effort is mainly focused on the control of the brown tree snake and enhances earlier legislative efforts to address this serious issue.[8]

## Incompatible Land Use

Some of the most significant recent environmental and readiness legislation concerns efforts to fund conservation easements adjacent to military lands. As discussed above, the DoD and the services worked with Congress to define a statutory authority to address encroachment. The result was that Congress, in Section 2811 of the National Defense Authorization Act for FY 2003, provided the mil-

Security forces at Vandenberg AFB, California, use horses for patrols in sensitive habitats and rough terrain. (Photo courtesy of U.S. Air Force)

itary with an important new tool for using partnerships to prevent incompatible land use. This new authority allowed DOD to enter into agreements with private conservation organizations or state and local governments to cost-share acquisition of land or interests in land to preserve valuable habitat and limit incompatible land use.

In FY 2005, Congress appropriated $12.5 million to the Deputy Under Secretary of Defense (Installations & Environment) to allocate funds to military service conservation buffer projects at seven DOD installations. In FY 2006, Congress appropriated $37 million, which was applied towards projects at 22 installations. Since then, the program has continued to grow in scope and funding.

- **Funding.** The FY 2007 appropriation bill provided $30.1 million for the REPI Program. Of those funds, the DOD provided the Army with $16.4 million for 17 individual projects. The Navy received $5.4 million for three separate projects. The Marine Corps received $6.7 million for three projects while the Air Force received $2.2 million for three projects.

- **Scope of Authority.** In FY 2006, the scope of the geographic applicability of the buffer authority was expanded from the original "in the vicinity of a military installation" to "in the vicinity of, *or ecologically related to*, a military installation *or military airspace*." These changes allowed the DOD to work to protect land and habitat of interest even if it is many miles distant from the "fence line" of any military base.

The authority in 10 USC 2684a represents a significant step forward in encouraging open communication and collaboration between the military and a wide array of stakeholders, leading to successful conservation/compatibility partnerships focused on common objectives. These partnerships allow DOD to make clear-cut gains in achieving conservation and protecting the military mission by leveraging funds to accomplish the protection of vital lands and habitats (see **https://www.denix.osd.mil**).

**NOTES**

1. For more on encroachment, see chapter 4.
2. See chapter 1 for an account of the Fort Bragg experience.
3. For more on invasive and non-indigenous species, see chapter 7.
4. For more on INRMPS, see chapter 11.
5. See footnote 1 in chapter 6 for a more complete explanation of the "critical habitat" designation.
6. Partnerships are discussed in chapter 10.
7. See chapter 5 for more on multiple uses of military lands.
8. See chapter 7 for more on invasive species and efforts to control them.

## Literature Cited

Keystone Center. 1996. Keystone Center Policy Dialogue on a Department of Defense (DOD) Biodiversity Management Strategy. (Keystone, Colorado: The Keystone Center, 1996).

CHAPTER FOUR

# Too Close for Comfort

## Encroachment on Military Lands

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On May 22, 2001, members of the House Armed Services Committee first heard testimony that formally introduced Congress to the term "encroachment." It was loosely defined at the time as "external influences that can have the effect of threatening or constraining training." Congressman Curt Weldon implored the body's Military Readiness Subcommittee and witnesses that day to focus on the "effect encroachment has on our training and readiness levels." Although the Department of Defense (DOD) proposed no definitive solutions to the problem, senior Defense representatives detailed examples where encroachment had limited or stopped training activities. In subsequent years, the DOD has characterized encroachment as taking a number of forms.

## Forms of Encroachment

### ENDANGERED SPECIES AND CRITICAL HABITAT

Currently, DOD lands are home to at least 355 species that are listed, proposed, or candidates under the Endangered Species Act.[1] Successful efforts in managing habitats, combined with destruction of these habits outside installation boundaries, have resulted in military ranges becoming havens for at-risk species. In some cases, protection of endangered species on military lands has restricted use of training areas. Furthermore, recent moves by the U.S. Fish and Wildlife Service (USFWS) to designate parts of these ranges as critical habitat under the Endangered Species Act may reduce the military's flexibility to use the designated training lands even further, thus jeopardizing its testing and training mission.

### UNEXPLODED ORDNANCE AND MUNITIONS

The DOD is concerned that the Environmental Protection Agency (EPA) could apply provisions of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and the Resource Conservation and Recovery Act (RCRA) to the intended use of military munitions, thereby shutting down or disrupting training on active ranges.

### FREQUENCY ENCROACHMENT

The growth of consumer communication devices has resulted in pressure from the telecommunications industry to reallocate portions of the radio frequency spectrum from federal to non-federal control. DOD is concerned that the available and adequate spectrum may not be able to support current and future military operations and training requirements.

### MARITIME SUSTAINABILITY

Provisions of the Marine Mammal Protection Act require that DOD consult with the National Marine Fisheries Service on any activities that may "harass" marine mammals. Some in DOD feel that the regulatory definition for harassment is too expansive, and that interpretation could unnecessarily restrict operations and training activity.

### AIRSPACE RESTRICTIONS

Increasing airspace congestion from commercial sources restricts the military's ability to provide effective testing and training of pilots. Expansion of the cellular phone industry and wind power energy development promises towers that are

The construction of luxury housing immediately adjacent to Camp Bullis, San Antonio, Texas, has the potential to create conflicts with the Army's training activities. (Photo: Douglas Ripley)

## Encroachment Defined

Like many things, encroachment thrives in the eye of the beholder. To the civilian who lives near an airfield, it may be the scream of jet engines that drowns out a favorite TV soap opera. To the airfield's commander, it may be the housing development that presses ever closer to a runway approach.

J. Douglas Ripley, writing in chapter 3 of this handbook, defines encroachment succinctly as "the cumulative result of any and all outside influences that inhibit normal military training, testing, and operations." And a 2003 U.S. Army Corps of Engineers document states: "Encroachment is any outside activity, law, or pressure that affects the ability of military forces to train to doctrinal standards or to perform the mission assigned to the installation. Pressures result from urban growth near installations, noise, legislation protecting habitat, regional fragmentation, airspace use, and stakeholder group issues."

hundreds of feet tall which impede training, particularly when they interfere with the flight path. The accident potential zone (APZ) of established airfields frequently encompasses private lands that have been developed or are in the planning stages of development, not realizing that the APZ exists.

### AIR QUALITY

Air quality regulations could limit DOD's ability to install equipment for units to train. Conformity rules require federal agencies to analyze emissions from proposed projects or activities. Application of these rules could limit the department's ability to transfer missions to new locations. This is especially critical for re-basing decisions that result from base realignments and closures elsewhere. Air opacity limitations restrict the military's use of obscurant smoke, ground maneuvers and prescribed fire for hazard reduction and environmental management.

### NOISE

Even though weapon systems are exempt from the Noise Control Act of 1972, pressure from community, regional, and state organizations could serve to restrict or reduce military training due to noise. Unfortunately, restrictions on the existing noise environment will be exacerbated by future missions as weapons systems change.

### URBAN GROWTH

Incompatible commercial or residential development and activities near military installations compromise the health and safety of both military and civilian communities. Limitations caused by sprawl could reduce the effectiveness of military training activities.

If left unchecked, the growing pressures of the various issues summarized above could have a significant impact on military training.

## One-way Street?

Often, though, the military frames the encroachment issue in a unidirectional manner: It is the community that's encroaching on military activities. A landowner in North Carolina, quoted in a local newspaper, sees it differently: "We are not encroaching on Fort Bragg, Fort Bragg is encroaching on us."

Military demands for land and airspace have grown dramatically since World War II. A World War II infantry battalion operated in a 4,000-acre maneuver space. According to current Army publications, a maneuver space of 61,281 acres is now necessary to train a battalion task force. The required training space is expected to triple again as information dominance, a concept that recognizes the importance of communication, computers, intelligence, and surveillance, becomes increasingly important. Total space is not the entire issue; irregular shape and terrain can also be a factor. Fragmentation of habitat due to environmental restrictions further exacerbates the problem.

Airspace training requirements have grown significantly, also. A World War I dogfight between opposing aircraft occurred within visual range. A World War II fighter required a five-nautical-mile maneuvering radius. Modern aerial fighters require about 80 nautical miles (Rubenson 1996).

For the Navy, deeper draft vessels are having an increasing impact as dredging is required to maintain port facilities. Moreover, changes in naval strategy that require more ships to operate in coastal areas increase the Navy's need for training space closer to population centers (ibid.).

No military installation, range, or training space is sized sufficiently to conduct unobstructed ground brigade or air wing training maneuvers to the full capabilities of U.S. weapon systems. The military's use of resources exceeded the boundaries of its installations sometime in the last half-century. Installations have become proficient in working around or avoiding these obstructions; alternatively, they have become accustomed to using a larger share of surrounding regional resources (air, land, water) than exist in their inventory.

The military's "free" use of the air, space, and land resources is now challenged on many fronts. As much as communities value the positive effects of having a military installation in their community, they almost assuredly will become less tolerant over time of the intrusive effects of military training. The level of community tolerance varies from installation to installation, depending on the relationship that has been fostered by the commanders with community leaders and the general public. In addition, the economic impact that the installation has on the surrounding communities is an integral factor in the degree of tolerance and/or level of annoyance that is tolerated.

In the face of local, regional, and national pressures, the military has tried to adjust its training activities to resolve perceived or real conflicts. These "good neighbor" changes have generally been initiated at the local level. Commanders, when faced with operational restrictions, will invariably find other ways to conduct training. The armed services have dubbed such procedures "workarounds," and some observers believe their net effect can be a diminished sense of realism and expanded limits on commanders' ability to train. These workarounds generally take the following forms:

- **Reductions in training frequency.** Training activities are skipped or the cycle for repeating them is lengthened.

New suburban homes with ocean views atop ridgeline overlooking Marine Corps Base Camp Pendleton just north of San Diego. (Photo: Douglas Ripley)

- **Reduction in training duration.** Training ranges often experience reductions in available time. Training exercises are often reduced in duration to fit into the reduced time allotments.

- **Changed locations.** Training is moved to different, frequently more constrained, locations on the same installation. Under extreme circumstances this may result in abandoning or wasting valuable training facilities that will otherwise have to be reconstructed at an alternative location on the installation. If such locations are not available, training may be moved to areas off the installation. This compounds cost and personnel requirements.

- **Reductions in size.** Units are trained in smaller groups to reduce impacts (platoons are trained, rather than companies, for example).

- **Segmentation.** Linear training (such as an amphibious invasion) is broken down into sequential tasks (such as marshalling, beach movement, inland movement, then breakout maneuvers), and not performed continuously and completely—and, thus, realistically.

- **Administrative halts.** Training is temporarily halted to avoid sensitive places or times.

- **Unrealistic timing.** Training activity is avoided during specific times to avoid encroachment. Examples of this are stopping nighttime or weekend training, or avoiding training in certain areas during nesting season for an endangered species.

Facing page: Davis-Monthan AFB, Arizona, occupies nearly 9,000 acres, three thousand of which have been set aside as buffers to protect the base's military mission against encroachment. Such buffer zones here, as well as on other military installations, are often regions of exceptionally high biological diversity. (Photo: Douglas Ripley)

- **Use of simulations.** This can range from the injection of minor false restrictions in the field (e.g., no live fire) to the complete substitution of virtual training for live training (e.g., video simulations).

- **Limits on task execution.** The types of activities conducted during training are restricted. Examples include declining to use smoke, limiting digging of foxholes, and altering runway approaches for aircraft.

The effects of military training must be anticipated and addressed in planning. Impacts on communities should be managed, especially since community expansion is almost inevitable. Encroachment-based collision is imminent, if not already occurring, at all military installations. It is unlikely that the problem can be made to vanish through legislation. Military installations can, however, mitigate the impacts if commanders are vigilant in establishing positive community relations that enable installations to be participants in long-range comprehensive planning and zoning with all surrounding communities. However, because planning and zoning are subject to change, a more comprehensive encroachment strategy is needed by all installations. A comprehensive and inclusive encroachment strategy is the preferred way to achieve that goal.

## Military Lands, Remoteness, and Population Growth

A description of Fort Bragg, North Carolina, from the 1942 edition of *Army Posts and Towns: The Baedeker of the Army*, by Charles Jackson Sullivan, states: "Fort Bragg, for practically all purposes, is its own post town. It is ten miles from Fayetteville, population 18,000. You are most likely to get what you want… on the reservation than in any civilian community within easy reach." The fort reached an extraordinary peak population of 159,000 during the war years. By 1992, Fort Bragg was no longer an isolated military outpost. A DOD report found that "if

some degree of compatible land use is not adopted, future development is likely to alter military operations and ultimately threaten the viability of Fort Bragg and Pope Air Force Base," its neighboring facility. Now the headquarters of the 82nd Airborne Division, today Fort Bragg is home to about 29,000 persons, according to the 2000 census.

Remoteness and isolation from population centers have always been valued when choosing sites for new military camps, posts and bases. Fort locations before 1900 were selected to best protect extended business interests (e.g. trappers, miners), enforce separation between Indian nations and expanding white settlements, and project the power of the United States. The Army was always too small for the task assigned to it, so it had to focus its resources on the frontier. It thus established forts in advance of expanding white populations. There was no competition for land or the best sites. Once established posts became surrounded by settlements, they were disbanded. U.S. policy was to let state and local militias provide the self-defense, once they were able.

Remoteness was still valued for fort and base selection into the twentieth century. This is best demonstrated by site selection for the construction of airfields. Aircraft technology expanded at a rapid rate from 1903 to 1941. The required runway length and unobstructed glide slope requirements of airfields grew at the same rate. By the mid-1930s, when Congress started approving military airfield construction programs as Depression-era relief, planners found that poor siting was degrading airfield capability. When planners sketched out new airfield sites, their calculations included potential future expansion. Large tracts of land were sought, away from the hazardous flying conditions of surrounding buildings.

Secondly, planners purposely sited airfields away from more heavily populated coastlines as a strategic defensive measure. Communities and states vying for the economic boost that a military airfield would bring to their region competed for these locations. They often donated or subsidized land for the military to locate near them. The donated land would be far enough from the community so that land prices were affordable. This was another factor that thereby tended to increase separation.

The mobilization for World War II brought with it a surge of construction and new military infrastructure that was unprecedented in American history. Mostly due to strong isolationist sentiment in the nation, Congress had provided only meager funds for military construction in the aftermath of World War I. The 32 installations that had been sited and built for that war had deteriorated significantly. The focus of the Quartermaster Real Estate Division of the 1920s was to divest the Army of surplus war property. With the exception of some Work Progress Administration and Public Works Administration projects directed toward defense (mostly airfields) in the 1930s, no new facilities were sited until the pre-World War II mobilization.

After Germany invaded Norway in the spring of 1940, the Roosevelt administration began to invest significant resources in construction of military installations. Planners would eventually work towards creating facilities for a 12 million-man army. From May 1940 to November 1941, the War Department acquired over 8.75 million acres of new land to support these new facilities. This was a significant transfer of land from the private to the public sector. Although published siting criteria (from the War Production Board) included economic and social objectives, resources conservation, ease of construction, ease of land purchase, and military significance tended to be the prime drivers. National and local politics


**FIGURE 4.1**
**Population growth over time around Camp Pendleton, California.**

Graphic courtesy of Curtis Bowling and Dan Gardner, DoD.

had some influence, but this was muted by the speed of the mobilization. The War Department was able to play a heavy hand on where each base was sited. The need for rapid construction and real estate acquisition tended to favor more isolated installations. For the most part, these World War II acquisitions provided the military with the land base it has today. The major exception was a series of public land withdrawals in the West (mainly from the Bureau of Land Management) to support the expanding range of new weapon systems.

Even though remoteness from population centers was a critical factor in installation siting then, it most assuredly has not remained. The dramatic population increases near Fort Carson, Colorado, and Camp Pendleton, California, are just a few examples (see Figure 4.1). Similar encroachment has constrained most DoD installations.

Obviously, complete separation of the military and civilian communities is not an answer to encroachment. The perfect military training installation is not one that is totally isolated. There are also DoD-driven factors that draw local communities and military bases closer together. A viable military installation requires a viable employment base, especially as DoD tries to convert many uniformed jobs to civilians or contractors. Access to key transportation infrastructure is critical to mobilization of equipment to combat zones around the world. DoD has moved to integrate installation activities more closely with the civilian community. Examples include privatization of utilities, closing of Defense Department schools and health facilities, housing, and integrated postal services. The quality of life for service members has always been inextricably linked to the quality of community life. Now the linkage is even stronger.

## The Value of Military Lands

Trends in population, environmental regulation, and basic American attitudes toward land use and national security have changed markedly over time. Most (but not all) of these trends have made military efforts to control encroachment more difficult.

### POPULATION GROWTH

The population of the United States has grown considerably in the last fifty years. While this growth has not been as significant as in other parts of the world, it has

The once remote southern boundary of the U. S. Air Force Academy is now completely lined with luxury homes, resulting in trespass issues, including erosion from pedestrian and horse traffic on closed trails and illegal fires. The Academy's eastern boundary, seen in the distance, is now nearly completely built out. (Photo: Douglas Ripley)

doubled from 151 million in 1950 to an estimated 302 million today, thus significantly increasing competition for land, water, and airspace.

Population growth by itself does not necessarily lead to increased land use pressures for the military. However, simultaneous with population growth, there has been a trend toward the increasing dispersion of the population. The distinction between rural and urban population has diminished considerably since World War II. Lower mobility and communication costs relative to family income allowed populations to migrate out from city cores. According to the U.S. Census, total housing units have increased 75 percent faster than population, creating the dispersion phenomenon known as suburban sprawl.

Another overlay on these population trends is the attractiveness of military installations. Population growth around these facilities has grown at a much faster rate than the U.S. population at large. Growth exceeds the national average at 80 percent of the military's installations. Development near military installations is also desirable because of the privacy and the environmental attractions that the installation affords its neighbors. A similar trend is emerging with development adjacent to national parks, wildlife refuges, and wildlife management areas.

### ENVIRONMENTAL REGULATION

The trend toward land use controls is large and growing, and there is no reason to assume that it will reverse itself. From the country's beginnings until around 1964, the primary focus of land use regulation was on resource extraction. The granting of public lands to homesteaders and low-cost sale of public land to others was viewed as a way to encourage development and harness the wealth of the country. Other laws passed by Congress facilitated the harvesting of what were considered "endless resources"—often encapsulating in law the sale of mineral, timber, water, or other rights at below-market prices. The first federal land preservation initiative came in 1872 with the creation of Yellowstone National Park. Legislation creating National Forests came along in 1891. The land available for military expansion began to diminish as the American people began to see value other than resources in these public lands.

The passage of the Wilderness Act in 1964 signaled a new era in environmental regulation. Poor land use practices, industrial malfeasance, and a growing en-

vironmental awareness led to the passage of a series of laws that protected air, land, and water, which the population was increasingly seeing as its "commons." The Clean Water Act, Clean Air Act, Endangered Species Act, and the National Environmental Policy Act (NEPA), each in its own way placed limits on the military and the public on how land under their control could be used. (For a detailed examination of these legislative efforts, see chapter 3, *Legal and Policy Background*).

A public perception that federal agencies were slow to implement the requirements of these laws led to the passage of the Federal Facilities Compliance Act (FFCA) in 1992. It made clear that the people expected their government to obey the same laws they were required to comply with. (See **http://www.fws.gov/laws/laws_digest/fedfaci.html**). The 1996 reauthorization of the Safe Drinking Water Act extended the same federal government compliance mandate to drinking water protection that the FFCA had done for solid waste requirements.

A significant portion of military lands is not actually owned by DOD, but has been withdrawn from public use for the military. Over 60 percent of DOD property falls into this category (Rubenson, op. cit). Withdrawn land has the potential to be returned to public use in the future. Each withdrawal act specifies the date of return or land use conditions. Until 1958, the withdrawal process was managed by the Interior Department. Congressman Clair Engle of California described the process at that time:

> The Army, the Navy, and the Air Force would simply take out a slip of paper in the nature of the application to the Interior Department asking for an area perhaps one hundred miles long and fifty miles wide. . . , and send it over to the Secretary of the Interior saying it was absolutely necessary.

Public pressure and congressional discontent with the lack of clarity in DOD's land requests resulted in the passage of the Engle Act of 1958. It required congressional approval for all withdrawals over 5,000 acres. Each withdrawal since that date has come with more conditions.

The Engle Act was only the beginning of closer monitoring of military land needs and management. An expanding western population created new classes of recreational users who demanded access to public lands. These groups, well organized at the state and federal level, scrutinized each military land request in detail. They have continued to successfully use the courts and Congress to fight military land use.

Competition for land will only grow more intense in the future. DOD should expect that justification for withdrawals will generate even greater public scrutiny. Airspace withdrawals, now managed as a federal interagency matter, also could generate the same type of Congressional oversight as land withdrawals have to date.

In the last decade, the American people have demonstrated that open space has great value to them. The siting of public projects has become more difficult due to growing opposition from those who fear land will be "taken out of circulation." Even if members of the public value the military's mission, they can be expected to oppose expansion of military training activities when it directly affects them.

Military installations often are the last open space in the middle of an expanse of suburban sprawl. They are important components to a region's ecosystem and critical to the preservation of the area's biodiversity. Generally speaking, the public does not care or even know how the military manages its lands.

The good news is that the public also values the military mission. Respondents to U.S. polls consistently rate the military as having a "great deal" or

### The Growing Popularity of Public Lands

**There is increasing public pressure to support the multiple use of public lands rather than a dominant use policy. (See chapter 5, Multiple Uses, for further discussion.) This inhibits the military's efforts to restrict federal land use to military activities. National parks visitation has grown at a faster rate than that of the population generally. Total park visits in 1950 were 33 million. In 2000, this rose to 286 million. Population during that same period only doubled. The general public has become aware of the negative effects of suburban sprawl and has demanded that legislatures and local elected bodies address the problem. In 2003, citizens placed 99 open space initiatives in 23 states on referendum ballots. Voters passed 77 percent of these measures despite extraordinary pressures to reduce spending.**

"quite a lot" of public confidence. Such goodwill conceivably could translate into public acceptance of the ever-increasing military training impositions on local communities.

## Buffers and Adjacent Lands

History suggests that the U.S. population will continue to grow and require greater land area. Weapon systems will become ever more capable, and land use conflicts will inevitably become more common. The public will demand that government meet the same environmental standards to which citizens are held. In the end, the military could have its ability to train seriously curtailed, or the federal government will be faced with extraordinarily expensive decisions to resolve the issues. The task before military land managers, then, is to find ways to enable communities and the military to grow together and share the available land, water, and air. The creation of buffers offers a tried and proven way.

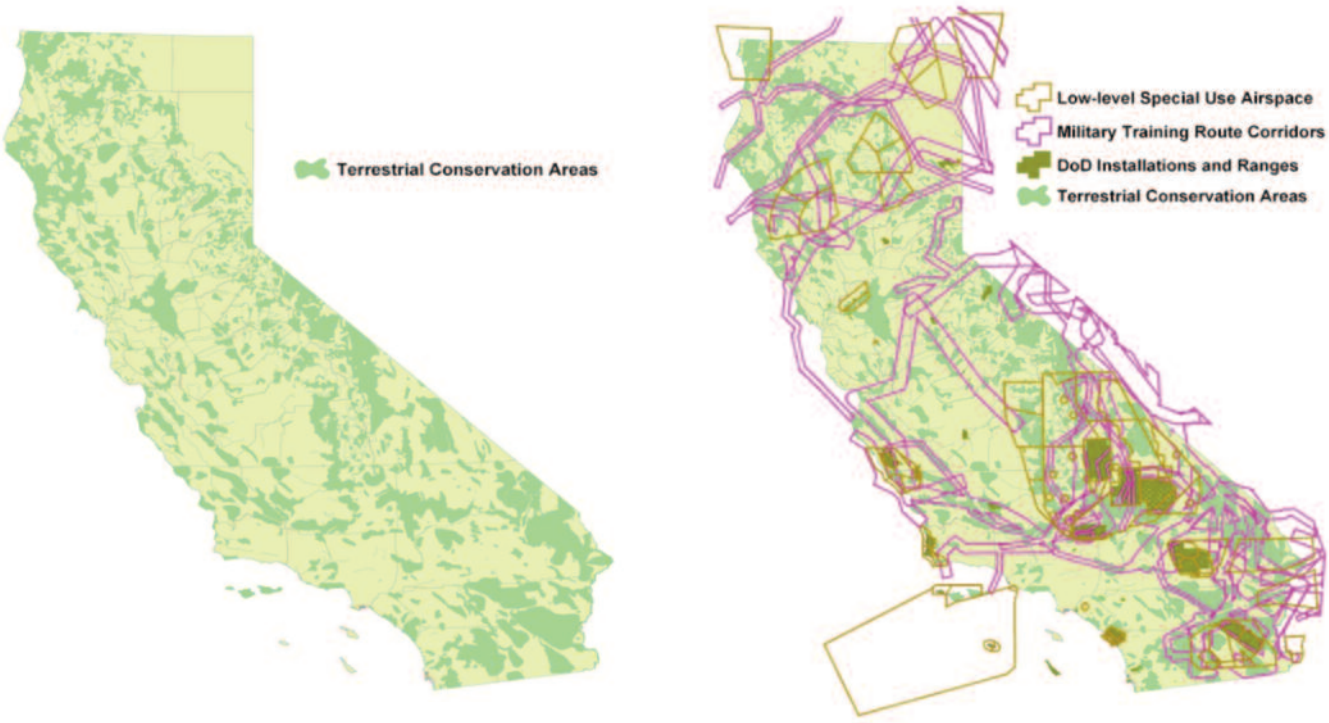
Any attempt to influence land-use decisions outside military property must consider what drives those decisions, identify who cares, and determine why. Stakeholders can generally be divided into three groups: federal and state governments, local governments, and nongovernmental organizations. Federal and state land "owners" have specific legal mandates to manage the land for specific purposes, national or state interest. DoD, for example, manages its nearly 30 million acres of land to generate, support, and sustain military forces.

Legislation passed in the 1920s established the roles of different levels of government in land use regulation. Federal and state agencies generally do not have direct authority to affect local land use decisions, but they do influence it indirectly through regulations or permitting processes. Examples include the authority to issue permits regulating actions affecting wetlands and pollution mitigation.

Local governments control land use more directly through zoning, segmenting the types of activities so they do not intrude on each other. Local governments

**FIGURE 4.2**
**DoD Lands and High-Priority Conservation Areas, California**

Map 1 (left) depicts high-priority conservation areas (on public or private lands) as defined by The Nature Conservancy (TNC). Map 2 (right) shows the overlap with these areas of DoD-managed lands as well as military training corridors. Working with TNC, DoD has successfully reduced the impact of its training operations on regions of high biological diversity. (Maps produced by The Nature Conservancy)



will zone to preserve their economic base and ensure the right mixes of industry, agriculture, residential, and commercial properties to satisfy their constituents—and, increasingly, to protect the environment.

A growing voice in land use decisions comes from nongovernmental organizations (NGOs) and other outside interests. As the U.S. population has become larger and more mobile, it has also become more regional and less purely local in orientation. Groups regularly coalesce around people's interests and act on regional or even national scales. NGOs generally have a core mission and seek to promote that interest everywhere they can through many methods, such as political advocacy, cooperative ventures, legal action, and education. These groups, increasingly active as they are, must be engaged rather than ignored.

The good news is that there is significant commonality in the values these stakeholders share. Membership in one group obviously does not preclude membership in another. All—military and civilians alike—have a stake in the livability of their communities. At the same time, there is utility in establishing or preserving some measure of separation between military and community activities. Buffers thus provide a mechanism for ensuring compatibility of interests.

Before planners can begin creating buffers, though, they will need to understand what a buffer is. In its most basic form, a buffer is any sort of zone that keeps two or more areas apart. The buffer can be a fenced-in area, a line of trees, a body of water, or a set of otherwise invisible lines on a map. It can be a zone declared to be demilitarized, or a greenbelt around a city. Often (perhaps usually) buffer areas can be empty of population. They can be established to protect the environment as nature reserves, separate residential from industrial areas, or for dozens of other purposes. When used in a military sense, a buffer can serve to separate the installation and its often dangerous activities, from bombing ranges to aircraft approaches, from the surrounding civilian community.

Is a buffer's sole purpose to promote separation, enhance cooperation, or both? How is the success of a buffer measured? Despite the term's frequent use in literature and practice, it is not a well-defined concept. Scientists have been grappling with the term "buffer zone" ever since it became widely used with UNESCO's Man and the Biosphere (MAB) program and the Biosphere Reserves that were launched in the 1970s.[3] MAB's aim was to establish terrestrial and coastal areas representing the main ecosystems of the planet and to protect them. Two major questions emerged from that initiative: First, how can we conserve the diversity of plants, animals, and microorganisms that make up the living biosphere and maintain healthy ecosystems while, at the same time, meet the material needs and aspirations of an increasing number of people? Second, how can we reconcile conservation of natural resources with their *sustainable* use?[4]

The DOD is confronted by similar questions in attempting to reconcile military training requirements and the community resource needs around its installations.

A successful buffer strategy must start with a common understanding of what a buffer is. This is more difficult than one would expect. Buffers are used widely and in a variety of ways. They can be local measures to mitigate intrusions from one property owner to another, such as rules that separate industry from residences. They can be focused on a specific purpose, such as agricultural riparian buffers to protect waterways from soil erosion and contamination by farm chemicals. They can be part of a regional or even global effort to protect a resource of value.

The definition of a buffer for each of these examples may differ. The difficulty of defining "buffer" lies within the UNESCO biosphere dilemma. How do you rec-

oncile conservation and development interests? Or, in the military's case, how do you reconcile training and development?

For a buffer to be effective, it must be valued by all stakeholders. If the only test is value added to the military installation, why have a buffer at all? If the military is the only recipient of value, then surrounding communities probably will not support the buffer. The buffer then is only an extension of the installation, so why (some might ask) not just extend the installation boundary (and by the way, pay for it with DoD funds)? For a buffer to be effective, it must include the interests of all parties, its size must be adjustable, and it does not necessarily have to be adjacent to the installation. It must only enhance each stakeholder's core mission. It must have a clear purpose. A definition is offered here:

Any designated area, on or off an installation, that is managed with the aim of enhancing the positive and reducing the negative impacts of military activities on neighboring communities and neighboring communities on military activities.

Creating a successful buffer requires several elements. The armed services already have employed a variety of tools for this purpose. The encroachment partnership legislation that was part of the 2003 defense appropriation is one such tool, but not the only one. Buffering success also requires three elements: military requirements, the concerns of the surrounding community, and the environment.

### MILITARY REQUIREMENTS

Accurately and precisely assessing the impacts of encroachment is a difficult task. To do it correctly, military managers must fully understand their weapon systems and associated activities. Weapons systems are commonly thought of in terms of their range and maneuver requirements, but this is insufficient. Resource requirements translate into demands on property rights. Too often, such rights are defined in unduly narrow terms. Law students are trained to treat property rights as a bundle of sticks with each stick representing a different right (e.g., air, noise, water, land, development, height). Range and training activities impact each stick differently. Accordingly, military land managers need to evaluate their activities in sufficient depth to fully capture the complete resources requirements. In addition to weapons range and maneuver area requirements, these also have important impacts:

- **Tactics, techniques, and procedures.** How weapon systems are used affects their overall impact.
- **Life-cycle analysis.** Cumulative small effects can magnify and expand the reach of activities, thereby increasing total impact on communities. For example, the accumulation of explosive residue in an aquifer creates a large plume of polluted groundwater.
- **Intensity.** The frequency and duration of activities can produce variable impacts on different resource components
- **Local conditions.** Climate and terrain affect the way weapon systems are used. Models of prevailing climatic conditions can help predict impacts and thereby dictate changes in tactics.

Many useful tools are already available to DoD environmental professionals. The Air Force Resource Capability Model "catalogues the volume and capability of resources needed to carry out mission activities."[5] Metrics or measures of merit are established for each resource (air, land, and water). The Army uses the

most thorough impact analysis tool for internal land management among the military services. The Integrated Training Area Management (ITAM) program is a mature program that is intended to systematically provide uniform training land management across the Army.[6] It attempts to integrate land stewardship principles and conservation management practices to ensure that Army lands remain viable for future mission requirements. It does this by establishing a systematic framework with five components: a Range and Training Land Assessment (RTLA) program[7], a Training Requirements Integration (TRI) program, a Land Rehabilitation and Maintenance Program (LRAM)[8], a Sustainable Range Awareness program (SRA)[9], and a Geographic Information System (GIS).

The Marine Corps conducted an encroachment quantification analysis of Camp Pendleton, California. This type of study assessed the capability of the installation to perform each core training task. It, and other tools, convinced environmental professionals to seek a thorough understanding of the mission requirements. (For natural resources managers' enthusiastic acceptance of this idea when writing an Integrated Natural Resource Management Plan, see chapter 11.)

### COMMUNITY CONCERNS

The management of property and associated rights is inherently a local prerogative. A buffer strategy that ignores this reality will most likely fail. The profusion of stakeholders, combined with more accessible local government (compared to the state or federal levels), makes consensus extremely difficult. The local economic base, culture, and political structure all affect the development of buffers.

Commanders would do well to understand the composition and relationships of local government structures. A typical community's land use planning may be consolidated into one board or divided among several agencies, each having key shares of responsibility (separate planning and zoning boards, for example). Different agencies may have opposing interests. One may seek increases in the tax base, for example, rather than concentrate on preserving existing land use. Knowing who needs to be influenced is important. Federal and state legislators have great influence on the success or failure of an encroachment strategy, and federal and state agencies can play a role, especially if they are landowners near the installation. Nongovernmental agencies may also have influence, whether they are local or not. Frequent military personnel rotations tend to work against developing the relationships so necessary for consensus decisions in these settings.[10]

Involvement in local land use forums is critical. Multiple installations around the nation have achieved great results from participating in these gatherings. Where none have existed, often the DOD has taken the lead and created them. It is the best way to start to understand the complexities of local stakeholders. One of the most effective ways a military installation can establish continuity within the community is to organize a citizen's advisory committee that comprises community leaders who meet regularly to discuss issues facing the installation, including encroachment. For some installations these committees have been organized in a very formal capacity whereby committee members are appointed by the governor (e.g. Camp Ripley, Minnesota).

### ECOLOGICAL CONTEXT

Human and industrial dynamics are only part of the equation for successfully implementing a buffer strategy. Military and community impacts must be understood in the context of the surrounding environmental landscape. The effects of

**TABLE 4.1**

**Buffer Toolkit**

| TOOL | DESCRIPTION |
|---|---|
| Mission restrictions | Reduce the impact of activities so that their impact to the community is diminished. Careful consideration must be given to the cumulative impacts of these individual buffer decisions. |
| Joint planning and management | Cooperative land management across boundaries can have synergistic effects that create a buffer for both community and installation. |
| Shared land use | Reimbursable or by agreement. Temporary or permanent. Common in the North Atlantic Treaty Organization. |
| Cooperative agreements | Funding is provided by multiple parties to pursue buffer acquisitions that benefit partner interests. |
| Temporary or mobile restrictions | Land use restrictions that are in place for a set amount of time or are rotated for most effect. Examples include internal restrictions on use of training areas that are used to allow restoration activities. |
| Transferable development rights | Obtain specific property rights to insure compatible development in designated buffer. |
| Land exchanges | Exchange control of excess military land or rights for similar concession from private or public landowners where buffer development is required. |
| Voluntary acquisition | Purchase fee-simple property to ensure no development. |
| Legislative relief | Pursue specific legislation at the local, state and federal levels to restrict incompatible land use or enable any of the buffer tools. |
| Seek involuntary acquisition ) through eminent domain | If the public good can be justified sufficiently, acquire land or development rights from unwilling sellers. |

military and community activities can either exacerbate or enhance ecosystem integrity. Some management actions to correct problems, although well intentioned, can go wrong. Avoiding mismanagement requires research, and an ecosystem-based approach is a preferred approach for focusing such research efforts. Ecosystem dynamics will drive such things as the boundaries of the planning area and the determination of indicators for buffer identification and success. Knowledge of the species that regulate and enable the environment and its ecological processes will enhance the likelihood that buffers will actually achieve their intended positive effects.

Is there a solution for the encroachment that continues to pressure military installations and the communities around them? Trends in population growth, regulatory actions, social climate, and weapon systems indicate that this may be difficult. As is the case with Earth's resources generally, there is too much competition for too few resources.

If it is going to be successful—and it must, since national security depends upon it—the military must work cooperatively with its neighbors. Conservation organizations came to the realization over two decades ago that fences and hard boundaries do not work when protecting a valuable resource. The military is learning the same lesson. A buffer can't be viewed simply as a measure to force separation between communities and military installations. Encroachment cannot be stopped by erecting fences. Buffers need to be created and managed as zones of transition and cooperation. Separation will only be temporary and will ultimately fail.

Too often, encroachment is defined only in terms of the community's encroachment on the military. But it obviously is a two-way problem. Military installations are concerned about land use practices outside their boundaries, and communities are concerned about activities inside those boundaries. Both bodies worry about activities that cross the boundaries. Buffer actions accordingly must include options across these boundaries.

Commanders need to engage encroachment on many fronts. Too often they focus only on land acquisition. A successful strategy must include a whole spectrum of buffer tools, such as those described in Table 4.1. (Note that several of these tools may be employed only by governmental entities or through legislation, rather than by a commander's action.)

**NOTES**

1. On August 8, 2007, the U.S. Fish and Wildlife Service removed the bald eagle from its list of endangered and threatened species. The bird, adopted as the national symbol in 1782, had undergone a remarkable population recovery as a result of conservation efforts. As of 2005, the bald eagle had been found on 102 DoD installations—more than any other animal. See Chapter 1 for additional discussion of numbers of listed species on DoD lands.

2. The Engle Act of 1958 (Public Law 85-337, H.R. 5538) provided that withdrawals in excess of 5,000 acres "shall not become effective until approved by Act of Congress." The act may be seen at **https://www.bliss.army.mil/homepage/mrlwr/html/ENGLEACT.htm.**

3. The term "biosphere" was coined by a Russian scientist, Vladimir Vernasky, in 1929. It refers to Earth's zone of life, including all living organisms and organic matter that has not decomposed. (See **http://web.geology.ufl.edu/Biosphere.html**.) For more on the Man and the Biosphere program, see **http://www.unesco.org/mab/**.

4. The term "sustainable" and its many modifiers (sustainable agriculture, sustainable development, sustainable land use systems, and the like) came into wide use as a major environmental buzzword after it was introduced as part of the World Conservation Strategy in 1980. The term gained star status with its 1987 publication in the World Commission on Environment and Development's *Our Common Future*. Basically, "sustainable" refers to a process that does not degrade the environment, is technically appropriate, economically workable, and socially acceptable. (United Nations Development Programme, *Benefits of Diversity: An incentive toward sustainable agriculture*, [New York: United Nations, 1992].)

5. **http://en.wikipedia.org/wiki/Capability_Maturity_Model; http://www.afcee.brooks.af.mil/products/so/guide/resource.asp.**

6. **http://aec.army.mil/usaec/range/sustainment01.html**

7. **http://www.cemml.colostate.edu/rtlainfo.htm.**

8. **http://sill-www.army.mil/itam/LRAM.htm.**

9. **http://aec.army.mil/usaec/range/sustainment00.html.**

10. For examples of a setting in which there is close cooperation between military installation and community leaders, see Kyle Rambo's comments in chapters 9 and 10.

## Literature Cited

Rubenson, David, Marc Dean Millot, Gwen Farnsworth, Jerry Aroesty. 1996. *More than 25 Million Acres? DoD as a Federal, National, and Cultural Resource Manager.* (Santa Monica, California: RAND, 1996).

CHAPTER FIVE

# Balancing Biodiversity Conservation with Multiple Uses

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Today's management of military lands is increasingly sophisticated and is the product of a range of influences both direct and indirect. This chapter focuses on incorporating biodiversity management into military land use. But first, with a basic understanding of how military land uses developed over the years—by understanding the legal and sociological origins of today's military land uses—commanders and land managers should be able to successfully incorporate biodiversity management into the installation multiple-use mix.

Training has always been the primary use of military lands. However, since their establishment, military reservations have served additional purposes in response to national priorities, mission needs, public pressure, and advances in land management practices. Military installations—including training and testing lands, ammunition manufacture and storage plants, and depots and terminals—have incorporated forestry, agriculture outleasing, and hunting and fishing land uses into daily operations because they provide a variety of benefits. Military lands are also managed for natural resources, threatened and endangered species, cultural resources, and a range of environmental compliance related issues.

## Forest Operations and Agriculture Outleasing

Forestry was one of the first non-military training land uses to be incorporated and was part of an expanded military use. World War I demonstrated the military's need for wood products and in 1918 the military established its first forestry program at the U.S. Military Academy at West Point, New York, for the purpose of producing timber.

In the first half of the twentieth century, military reservations were not particularly extensive, but erosion and wildfires were ongoing problems. Woodlots and forested areas had to be managed due to the buildup of fuels, and Forest Service advisors, following their mandate of water supply protection and continuous timber production, recommended wildfire and erosion control measures through active forest management programs that included timber production.

In the 1940s there were about 3 million acres (excluding Alaska) under military control, but by the 1960s the figure had increased to nearly 30 million acres. This large land area required the knowledge and experience of professional land managers, foresters, and agronomists. Subsequent installation land management under these professionals progressed beyond land stabilization and wildfire management, to non-military uses including timber production and agriculture outleasing for crops and grazing. These added land uses not only helped to maintain military lands in good condition and suitable for training, but also saved military labor costs and provided financial support for the forestry and agriculture outleasing programs. In many cases, lands acquired by the military were often in poor condition and unsuitable for training. Many were former farm lands or otherwise devoid of forest or native vegetation, and it was critical that these lands be revegetated. Under the direction of Forest Service, many of these lands were converted to forest, which was then managed for timber production.

In 1956 Congress provided authority for the military departments to retain the receipts from the sale of forest products, and this led to a significant increase in timber production by the military—between 1956 and 1963, gross income from military forest lands increased from $10.5 million to $26.7 million. Today, surplus funds (after installation forestry program expenses and state entitlements[1]

are paid) are deposited into the DOD Forestry Reserve Account. The DOD retains a minimum balance in this account to fund emergency forestry program contingencies (e.g. to pay the salaries of forestry employees in years of low timber sales or low timber prices). But the DOD annually returns some of the excess funds in the account to the individual services for forestry enhancement programs, or in some cases, for general natural resources projects (LRMP 2005, Part 3-24).

World War II also saw the introduction of outleasing of military lands for agriculture. For a fee, farmers could apply to lease military lands around airfields, ammunition storage areas, and other grasslands or arable land where grazing or crop production would not interfere with military activities. At first, income from outleases was deposited into the U.S. Treasury. It was not until later that outleasing became the Reimbursable Agriculture and Grazing Program, allowing the services to retain agricultural receipts and use them to fund natural resources projects at individual installations.

The establishment of the reimbursable program had the effect of increasing incentives to offer land for lease and outleasing was promoted by the military as an inexpensive land management option. The lessees often provided in-kind services on leased lands, often in lieu of cash rent, such as mowing, weed and brush con-

### What is Multiple Use?

**The Department of Defense (DOD) defines multiple use as "[T]he integrated, coordinated, and compatible use of natural resources so as to achieve a sustainable yield of a mix of desired goods, services, and direct and indirect benefits while protecting the primary purpose of supporting and enhancing the military mission and observing stewardship responsibilities."**

**(Source: DODI 4715.3, Environmental Conservation Program, Enclosure 3 Definitions. 3 May 1996.)**

Cattle grazing at Beale AFB, California. Beale manages extensive cattle grazing leases on many grasslands that serve as buffers for military operations, such as performed by the Precision Acquisition Vehicle Entry (PAVE), Phased Array Warning System (PAWS) radar seen in the distance that is used to detect and track sea-launched and intercontinental ballistic missiles. (Photo: Douglas Ripley)

### Multiple Use as a National Policy

**Demand for wood products for the post-World War II housing boom coincided and competed with an increased demand for recreation and wilderness and a concern for environmental values. These changes in public attitudes and the need to balance competing demands led to the concept of multiple-use which was declared national policy in two Congressional acts—the Multiple-Use Sustained Yield Act of 1960, which applied to the Forest Service, and the Classification and Multiple Use Act of 1964, which applied to the Bureau of Land Management.**

trol, fence construction and repair, drainage maintenance, fire lane construction, and rodent control. Agriculture and grazing operations on the leased lands were also important for fire control because the underbrush and grasses that could fuel fires were reduced.

## Hunting, Fishing and Recreational Uses

The restoration of military lands and conversion to forest brought an increase in wildlife populations, and so hunting was introduced on some installations to assist in controlling populations of deer and other game species. Consistent hunting policies did not exist for military installations until the passage of the Engle Act[2] in 1958. The act tried to resolve basic conflicts between the military and civilian conservation agencies by requiring that all hunting, fishing, and trapping on military installations be conducted in accordance with state and federal laws, and under the appropriate state licenses.

On most installations, commanders restricted hunting privileges to the military and their dependants until passage of the Sikes Act of 1960, which authorized public recreational access and the collection of fees by installations for that privilege. This led to the widespread opening of military areas to public recreation. Although outdoor recreation included camping, picnicking, boating, swimming, and a host of other outdoor activities, hunting and fishing were in greatest demand by the public at that time. Fees collected for hunting and fishing activities are used to cover administrative expenses and support conservation initiatives. Unlike forestry and agricultural lease fees, hunting and fishing fees must only be used for funding activities on the installation from which they were collected.

## Managing for Biodiversity as an Added Multiple Use

By the early 1990s, military training and testing lands were being used not only for direct mission support but, when appropriate, were also supporting forestry (primarily timber production), agriculture and grazing on outleased lands, and recreational hunting and fishing. These three land use programs continue to provide a range of benefits to the military and are self-financing and, in some cases, are significantly profitable. Funds raised by these programs have benefited natural resources management on installations throughout the nation and have significantly benefited the quality of military training lands by supplementing the limited funding designated for natural resources management.

**TABLE 5.1**

### Summary of FY06 Department of Defense Reimbursable Accounts

(IN MILLIONS OF DOLLARS)

| | ARMY | NAVY | MARINES | AIR FORCE |
|---|---|---|---|---|
| **Fish & Wildlife Collections** (Sikes Act) | $1.820 | $0.464 | $0.152 | $0.850 |
| **Agricultural Outleasing Receipts** | | | | |
| Cash receipts | 3.000 | 2.370 | 1.880 | 0.850 |
| In kind services in lieu of rent | 1.070 | — | — | 0.439 |
| **Forestry** (Gross Receipts) | 20.000 | 3.010 | 1.160 | 3.200 |

Revenue from the sale of timber products, agricultural leases, and the sale of hunting and fishing fees have long been an important funding source for Department of Defense natural resources programs. By law, these funds must first be used to support the programs from which they were derived. Funds in excess of those requirements may be used for other natural resources projects.

Military training and testing activities have intensified considerably due to the Base Realignment and Closure Act (BRAC) of 1988, and subsequent BRAC actions, which have resulted in the closure and realignment of military bases throughout the country. Remaining installations now accommodate more troops, many rotations, and a diversity of training activities, and are under continual pressure to sustain their ranges and maintain military readiness while remaining stewards of the land. They achieve this by following a comprehensive and integrated ecosystem management approach, implemented through the Integrated Natural Resources Management Plan (INRMP) process which aims to balance an installation's various activities and land uses with its military mission requirements.[3]

Conserving and improving native biodiversity is the first principle of DOD's ecosystem management approach (DODI 1996). Just as military lands are managed for use as training lands, and for forestry, agricultural outleasing, hunting and fishing, and recreation, so too they can be managed for biodiversity. When regarded as a management initiative, biodiversity can readily be incorporated into all facets of land management through the installation's INRMP. Goals and objectives for biodiversity management should be identified in the INRMP, and then integrated with the installation's training requirements, and with other natural and cultural resources management goals and objectives. Its explicit inclusion within the INRMP means that actions that benefit biodiversity, as well as actions that may negatively impact biodiversity, will be clearly identified and monitored through the INRMP review and update process.

## Strategic Planning for Biodiversity Management

Planning for the conservation and/or enhancement of biodiversity on installations with multiple land uses requires that a strategic approach is taken to ensure ecosystem integrity and sustainability. Ecological integrity is one of the operating tenets of ecosystem management, and maintaining system integrity is consistent with DODI 4715.3 (1996). Ecosystem integrity, as defined by Angermeier and Karr (1994), is "the ability to support and maintain a balanced, integrated, adaptive community of organisms having a species composition, diversity, and functional organization comparable to that of natural habitat of the region."

Biodiversity management involves restoring, protecting, conserving, and enhancing the variety of biological resources. When land use goals vary or conflict with biodiversity conservation, then biodiversity management must be proactive and protective. Restoring biodiversity once it has been degraded is not simple damage repair. In some cases repair may not be possible, and so every effort must be taken to protect and conserve biodiversity.

Conserving biodiversity in the context of multiple land uses and within the confines of DOD lands has indisputable merits. However, the benefits are more likely realized when they extend "beyond the fence" and are conducted within a regional context, and when they are defined more by ecosystem considerations than by legal or political boundaries. Initiatives such as the Army Compatible Use Buffers (ACUB) Program (**http://aec.army.mil/usaec/natural/natural03a.html**), provide an opportunity for installations to pursue biodiversity conservation goals beyond the installation boundary. ACUBS present the opportunity to more effectively manage for biodiversity by incorporating approaches over large scale regional and sub-regional landscapes—a primary tenet of ecosystem management.

To meet the challenges of biodiversity conservation, specific long-term biodiversity management goals and objectives should be developed and the associated actions and projects should be identified and described, and incorporated into an installation's INRMP. During the annual INRMP review and update, resource managers and planners should consider the following biodiversity points for military training, and for other installation land uses (agriculture, hunting, fishing, recreation, special management areas, etc.):

- Determine biodiversity priorities for each specific land use.
- Estimate the ecological conditions necessary to sustain the biodiversity priorities.
- Identify alternative land use strategies that may have less impact on or benefit biodiversity.
- Develop monitoring objectives and methods that include biodiversity and are based on the stated management goals and desired future scenarios.
- Develop and implement adaptive management as needed when uncertainty of the outcome is high and/or when previous efforts have been less than successful.

Specific considerations for biodiversity management are outlined below for the typical installation land uses—forestry, agriculture outleasing, hunting and fishing, recreation, special natural areas, and training lands.

This carefully managed forest stand at the U.S. Air Force Academy demonstrates many qualities of biodiversity conservation, such as structural diversity and good understory management. (Photo: Douglas Ripley)

## Biodiversity Management in Forestry and Silviculture Programs

Managing forest biodiversity at an installation requires consideration of landscape elements of scale, disturbance, fragmentation, and habitat. At the local level, forest stand attributes such as structural diversity, crown closure, fuel loads, soils, standing dead trees, coarse woody debris, tree species diversity, and large wildlife trees, have a direct impact on biodiversity. When considering the various forest elements critical to biodiversity, it is also essential to consider the interaction of forests with other habitats, and the interdependence of habitats (e.g. unimproved grassland, wetlands, and hedgerows).

Regardless of size, forests can provide habitats for a range of flora and fauna. Even small, recently established forests within otherwise intensively cultivated land can be useful, although the scope may be limited due to isolation and, in certain circumstances, they can harbor pest species. Forest management scales are generally defined by human-made or jurisdictional boundaries (e.g., landscape unit, watershed, forest stand) and on military installations by mission-related requirements. They do not necessarily apply to biological systems and managers may need to adapt them to accommodate more biologically sound scales. This may require coordination with local and regional neighbors.

Natural disturbances are important to biodiversity and help shape plant and animal communities. For example, areas with high fire frequency have more early-successional taxa than areas with longer intervals between fires (Bunnell 1995). The degree to which species have co-evolved with and are dependent on natural disturbances varies with the species. However, at some scale, all species require natural disturbances for persistence (Bunnell 1995).[4]

Disturbances due to forestry practices have different impacts on biodiversity than natural disturbances. Natural disturbances interact with the geology, cli-

mate and vegetation, and result in a complex mosaic of habitats at the landscape scale, while conventional logging, such as clearcutting, tends to homogenize the landscape. This can be compensated to some degree by creating snags, leaving standing and downed dead wood, and using other means to create a mosaic of habitats.

Within the landscape context, fragmentation and habitat loss are two separate processes (Andrén 1994, With and King 1999). Two areas may have the same amount of habitat, but the spatial arrangement of remnant habitat and thus the amount of fragmentation within each, can be drastically different. Fragmentation of forest habitat into smaller isolated patches reduces the total amount of habitat area, increases edge effects around habitat patches, reducing the core area, and increases patch isolation. Current research findings suggest that overall habitat loss has a much larger effect on biodiversity than the spatial arrangement of remnant habitat (Fahrig 2001).

Biodiversity management strategies for managed forests should be applied in the preparation of forestry plans; silviculture prescriptions, and logging and fire management plans. To maintain or restore biodiversity in managed stands, some or all of the following attributes should be present:

- *Structural diversity* is achieved when there is a variety of canopy layers (vertical structure) and spatial patchiness (horizontal structure). This creates more habitat and micro-climate diversity than in homogeneous stands. Structural diversity can be maintained or created through the choice of silvicultural system, harvesting methods, and stand-tending activities such as tree planting, pruning, fertilization, and pre-commercial and commercial thinning.

- *Soil biodiversity* can be achieved by forest soils management and forest practices that minimize soil disturbance and help maintain the below-ground biodiversity. Soil structure, nutrient spectrum, organic matter content, water retention, drainage, and pH combine to determine the vegetative composition of ecosystems.

- *Standing dead trees* provide nesting and foraging habitat for many species. Some existing snags in managed forests should be retained, but equally important is ensuring that new snags will be recruited into the stand in the future. Small diameter snags are adequate for some species, while large diameter snags are required by other species and endure longer.

- *Coarse woody debris* from decaying logs on the forest floor provides cover, micro-climates, and breeding habitat and should be retained in the stand. Larger size pieces are preferable as they provide the greatest longevity and potential for nutrient cycling and wildlife use in second-growth forests. Coarse woody debris is rarely evenly distributed, but it should be well distributed throughout the stand, if possible.

- *Tree species diversity* can provide habitat for a greater variety of organisms than that provided by a homogeneous stand. When applicable, an ecologically appropriate variety of tree species, including hardwoods, should be retained in a stand.

- *Large wildlife trees* are any standing live or dead trees with special characteristics that provide valuable habitat for conservation or enhancement of wildlife. Characteristics include large size; condition, age, and decay stage; evidence of use; valuable species types; and relative scarcity. These trees serve as critical habitat (for denning, shelter, roosting, foraging, and establishment) for vertebrates, insects, mosses, and lichens.

Air Force Forester Kevin Porteck conducting a timber inventory at Andrews AFB, Maryland. Professional military foresters play a critical role in ensuring the viability of commercial forestry programs while simultaneously supporting the military mission and biodiversity conservation. (Photo: Douglas Ripley)

## Biodiversity Management for Agriculture Outleases for Range and Croplands

Outleasing of areas for agriculture affects biodiversity directly by converting natural habitats to cultivation, grazing, or other manipulation, and through the associated repeated disturbances that accompany conversion. Agriculture affects biodiversity indirectly through water management practices for irrigation and drainage, soil erosion and sedimentation, and elevated nutrient and pollutant discharges into the environment.

Agroecosystems (agricultural ecosystems) can be mosaics of pasture, cropland, woodland, and wetlands, and this patchiness may benefit some species. Agricultural lands may provide more suitable habitat for native wildlife and birds than do fragmented and extensively modified urban or suburban lands. When developing agriculture management plans, it is important that the resources manager consider the compatibility between biodiversity and agriculture, with key considerations being habitat availability for species at risk, as well as the potential for economic damage to agriculture caused by wildlife. At the landscape level, agriculture can best preserve biodiversity when it is incorporated as part of a matrix of habitats connecting natural areas. In agroecosystems, the conservation of aquatic biodiversity requires consideration of impacts to aquatic systems from agricultural nonpoint source pollution and the potential affects on aquatic ecosystem structure and function from altered hydrology (Blann 2006).

Habitat and threats from non-native and invasive species in agricultural lands directly compete with biodiversity goals. Approximately 46 percent of the plants and animals federally listed as endangered have been negatively impacted by invasive species (USDA 2006). The significant threat of invasive species to biodiversity increasingly is being recognized both internationally and domestically (see **http://invasivespecies.nbii.gov/**). Biodiversity goals and objectives outlined in the INRMP should include contingencies for impacts resulting from invasive and non-native species. Early warning of possible negative impacts is possible when biodiversity management includes monitoring and adaptive management measures.[5]


The restoration of this longleaf pine forest at Fort Jackson, South Carolina, was accomplished through the Army's commercial forestry program. (Photo: U.S. Army)

### GRAZING AND RANGELAND

Rangeland and pasture management has typically focused on simplifying ecosystem structure and achieving uniform disturbances across a landscape. Most rangeland and grazing management techniques were developed under the model of increasing and sustaining livestock production by decreasing the rangeland diversity. This approach is obviously incompatible with biodiversity management and prevents development of an ecological framework for alternative management objectives. Maintaining biodiversity and preserving habitats for many individual species is contrary to the typical range management model and depends on the interspersion of diverse habitat types throughout a heterogeneous rather than a homogeneous landscape (Fuhlendorf and Engle 2001).

Grazing management includes fencing needs, water development, seeding, brush control, fertilizing, salt distribution, and intensified animal husbandry (Laycock 1983). Management can be aimed at improving range biodiversity with careful study of the desired plant species, their phenological characteristics, how they respond to grazing pressures during each annual season, and annual re-seeding (Gayaldo 1996). For example, light to moderate grazing of grasslands, oak forests

Harvesting wheat from an agricultural outlease at the Smoky Hill Air National Guard Range, Kansas. Grazing and cropland leases at the Smoky Hill Range generate nearly $400,000 annually, the largest single outleasing program in the Air Force. (Photo: Douglas Ripley)

and savanna habitats can potentially promote plant and associated vertebrate wildlife diversity (EBMUD 2001).

Many of the biological-physical-management interactions associated with rangeland biodiversity are only beginning to be understood (West 1993). However, a number of studies have shown that grazing does affect the vegetational composition of a community (Gayaldo 1996). Long periods of time (several decades) are required for significant vegetational changes to occur in rangelands, and are dependent on soil and climatic conditions, competing species, and available native seed sources. Also, it is documented that more time is required for a site to progress from a poor to fair condition than from a fair to good condition (Gayaldo 1996). Livestock grazing and rangeland practices that pertain to water quality protection are also applicable to habitat protection, and the maintenance and enhancement of biodiversity. This is particularly true for riparian and aquatic habitats when livestock access is excluded by establishing buffer zones, and by providing alternate water supplies for livestock. Prescribed grazing, livestock exclusion, fencing control and location and timing of livestock impacts are commonly used to protect and enhance plant and wildlife diversity. Also, establishment of proper stocking rates and judicious monitoring form the basis for biodiversity management on outleased watershed lands that are grazed.

At Avon Park AF Range, Florida, aircraft and cattle share the range. (Photo: Douglas Ripley)

Biodiversity guidelines that may be applicable to grazing management at some military installations include the following (taken from the East Bay Range Resource Management Plan [2001]):

- Identify high-priority sites for habitat restoration based primarily on water quality protection and on the value of restored habitats and locations relative to important wildlife use areas and corridors.
- Monitor listed species populations and conduct site surveys.
- Identify key habitat areas necessary for protection and management of special-status plants and animals. Provide buffer areas to reduce disruption of nesting and roosting areas for sensitive wildlife species.
- Recognize the ecological value and likely permanence of certain non-native

species and habitats (e.g., annual grassland), and incorporate the management of those species and habitats into biodiversity planning efforts.

- Use prescribed fire, periodic grazing, mastication (chipping trees on site with either a mulcher head or hydro-axe), or other means to discourage shrub encroachment and maintain grassland conditions where annual grazing has been eliminated from grassland habitats and grassland retention is a biodiversity priority.

### CROPLANDS

In the United States there have been substantial changes in the mix of cropland and pastureland over the past century (Blann 2006). The expansion of crop production over hay and pasture production has been accompanied by more intensive farming practices, increased farm size, and reductions in shelter belts, field borders, wetlands, and remnant habitat areas that were previously inconvenient to farm. Fencerow-to-fencerow farming has reduced biodiversity by eliminating much nesting, feeding, and winter cover for wildlife (Blann 2006), and croplands do not provide the stubble fields and harvested grassland habitats important to many invertebrate, bird and small mammal species.

The influence of agriculture on biodiversity often goes beyond farmed land itself, as the majority of semi-natural habitats are linked to the surrounding agricultural land and may be fragmented or isolated within the larger agricultural landscape. Cropland practices which may impact biodiversity include fertilizer use; monoculture; abandonment of farmland; removal of field margins such as hedges, ditches, and fencerows; poor drainage and irrigation, and soil erosion.

It is possible to provide a balanced environment, sustained yields, biologically mediated soil fertility, and natural pest regulation through the design of diversified agroecosystems and the use of low-input technologies (Altieri 1995). Different types of habitats in agricultural landscapes, depending upon their size, shape, and

Hay lease harvest, McEntire Air National Guard Station, South Carolina. (Photo: Douglas Ripley)

location, may support different types of biodiversity. Non-farmed areas can be used to provide *patches* of certain habitat types, or to form *corridors* linking protected areas and enabling species to maintain genetic contact between otherwise isolated populations. Such benefits can be achieved on outleases via lease agreement language and through programs such as the ACUB process. Agricultural areas can make a positive contribution to diversity when the surrounding matrix is managed with biodiversity in mind.

Blann (2006) offers the following cropland practices for biodiversity management (adapted from Granatstein [1997] and Bird et al. [1995]). These practices could readily be implemented on outleased lands through the lease agreements and enforcement procedures.

- Practice soil conservation measures. Increase protective cover on the soil surface, using no-till, cover crops, windbreaks, contour strip cropping, and grass waterways.
- Eliminate or minimize intensive row-cropping and tillage on highly erodible land, and on sensitive lands such as floodplains, riparian areas, wetlands, and steep slopes.
- Use a greater variety of crops grown in more complex rotations. This breaks weed and disease cycles.
- Enhance habitat quality to encourage and enhance wildlife diversity. Use cover crops and soil-building crops like legumes, such as clover and alfalfa, and grass. Integrate crops and livestock production with intensively managed grazing and recycling of manure to build soils.
- Use integrated pest management, in which pest levels are monitored, biological controls are used wherever available, and chemicals used only when an economic threshold is reached.
- Nutrient inputs should be managed to maximize efficiency and minimize nutrient movement to surface water and groundwater.
- Properly store and apply animal manures. Compost manures and other wastes.
- In arid regions and other areas relying heavily on irrigation, develop and implement management systems for efficient water use. Water-intensive crops that compete with instream uses often impose high costs on local ecosystems. Cropping systems should be matched to local and regional climatic and environmental conditions.


Fishing on many military bases (USAF Academy, top, and Edwards AFB, below) is an important recreational activity for military personnel and civilians. Fishing and hunting permits sold under the authority of the Sikes Act are a valuable source of revenue for military natural resources programs. (Photos: Douglas Ripley)

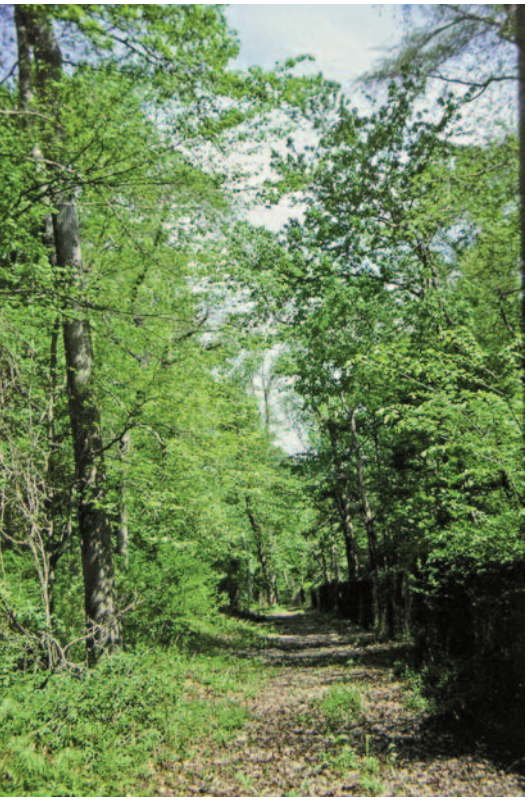
## Biodiversity Management for Hunting, Fishing, and Recreational Land Uses

The provision of leisure and recreational activities is one of the most valued land uses in an installation's mixed-use inventory, and biodiversity frequently plays a key role. The aesthetic qualities of an area are often tied to its range of biological diversity. People value biologically diverse areas for a variety of active (hunting, fishing, swimming, cycling, hiking) and passive (photography, bird watching, contemplation) recreational pursuits.

Recreation has its impacts on biodiversity and many of these impacts have been described in detail (Liddle 1997; Newsome, Moore, & Dowling, 2002). The most prevalent impact process is trampling, which damages and kills plants, displaces soil organic horizons, and compacts mineral soils. Off-road vehicles, horse traffic,

bikers, and hikers can damage fragile soils and introduce invasive species. These immediate, direct trampling effects, in turn, have additional longer lasting and cascading effects (Liddle 1997). In addition to trampling, substantial environmental effects are caused by such activities as firewood collection and campfire building, trail construction and maintenance, human intrusion into wildlife habitat, and the use of off-road vehicles.

In the field of recreation ecology, a primary conclusion is that impacts to biodiversity are an inevitable byproduct of recreation. Avoiding impacts is not an option, unless all recreational use is curtailed (Cole 2004). Managers must make decisions about appropriate levels of impact and implement management strategies that keep impacts to within their pre-determined acceptable levels. Biodiversity impacts from recreational pursuits can occur rapidly but may recover slowly. This effectively challenges management strategies based on periodically allowing sites to rest and demonstrates the importance of proactive management—avoiding impacts instead of repairing them. It also explains the common finding that impacts proliferate over time unless the sites are allowed to rest. The proliferation of impacts at new sites is usually more problematic than the deterioration of established sites (Cole 2004).



The Old Stand Timber Natural Area at Dover AFB, Delaware, is located in the explosive ordnance clear zone and therefore cannot be developed. A biological inventory revealed that the area contains some of the oldest and largest hardwood trees in the State of Delaware. (Photo: Douglas Ripley)

Hunting and fishing are an integral part of recreational activities on many military installations for both military personnel and the general public. When managed astutely, hunting can provide selective and area-sensitive wildlife management and be regarded as a service to farmers. However, in the United States, in some instances over-hunting has been responsible for the local extinctions of some wildlife species.

Resources managers should take into account the following biodiversity management recommendations when planning for hunting and fishing, and other recreation opportunities:

- Ensure biodiversity management is integral to recreation planning and management.
- Provide educational materials and/or workshops for target audiences to raise awareness of biodiversity.
- Strengthen wildlife management policies and practices to minimize impacts on biodiversity objectives.
- Encourage low impact recreation areas such as primitive campsites.
- Implement site-specific habitat and species plans.

## Special Natural Areas

Areas on DoD installations with natural resources that warrant special conservation efforts may be designated as special natural areas (DoDI 1996). These are recognized for their unique or exceptional natural resources or cultural qualities and attributes. In most cases management is directed at preservation and/or protection of the area with very specific management objectives. However, special natural area designations on military lands can not be set aside as permanent environmental preserves due to DoD's requirement to maintain flexibility to adapt the defense mission to political and technological developments (DoD Inst. 4715.3, para. F.1.i(4); refer to Appendix B). Even though an installation is precluded from establishing permanent environmental preserves, these special

Unfortunately, ORV use and vandalism are common on the lands of the Pike National Forest adjacent to the Air Force Academy's Farish Recreation Area. Controlling these highly negative impacts of recreation is a vital function of military natural resources managers. (Photo: Douglas Ripley)

natural areas can make a significant contribution to conservation of regionally important natural resources.

Conflicting management objectives and threats to the ecological integrity of the habitat such as invasive species and encroachment can directly impact the biodiversity of the special natural areas. Developing biodiversity management and invasive species management plans will complement management measures specific to these special natural areas, and can be incorporated in the installation's INRMP. Similarly, damage to cultural resources should be avoided through development of strategic planning which is incorporated into the installation Integrated Cultural Resources Management Plan (ICRMP). And both the INRMP and ICRMP should be reviewed and integrated to ensure that management of these resource categories is at best, beneficial, and at least not damaging.

## Military Training and Testing Lands

The Department of Defense is emphasizing the concept of Sustainable Operations at military training lands and ranges as an essential factor in maintaining mission readiness. Sustainable operations represent the capacity to conduct operations in a manner that preserves the resources that are necessary to conduct successful mission operations indefinitely into the future. The resources include human, natural, and man-made resources including facilities, equipment, financial and community support.

### A Special Natural Area

**Fort Belvoir, Virginia, has designated three special natural areas: the 1,360-acre Accotink Bay Wildlife Refuge; the Accotink Creek Riparian Area; and part of the upland plateau of the South Post training area. The primary management goal for these significant natural areas is conservation and biodiversity. Low-intensity military training and testing, as well as low-intensity recreation, environmental education, scientific research and study can be conducted within the special natural areas as long as access and use are compatible with resources conservation.**

### Options for Mitigation or Enhancement

- **Avoiding or limiting the threatening activity**
- **Changing the timing of and/or activities involved**
- **Applying measures that protect native biodiversity assets, such as establishing buffers or fencing**
- **Undertaking activities that result in net gains for native biodiversity, such as replanting, removing invasive species, or implementing biodiversity protection measures**

Military operations may not always be compatible with biodiversity conservation. In these instances, mitigation should be pursued with impact minimization as the goal.

In addition to mitigating activities that harm biodiversity, the resources manager should consider creating and/or restoring landscape components that are critical to species most at risk and that contribute to regional biodiversity. Another strategy for reducing habitat and wildlife damage that does not constrain training is to expand the environmental awareness and education programs for military personnel. Properly designed and implemented inventory and monitoring programs should also be important components of biodiversity conservation for training installations. Biodiversity conservation can be as simple as allowing fires to burn on a range, and this may, in turn, help maintain natural vegetation and native habitat. And the resulting vegetation may provide a more realistic setting for training.

#### NOTES

1. 10 USC 2665 grants a 40 percent entitlement of annual net forestry sale proceeds to the installation host state or states. The states distribute the funds to the appropriate host counties to be used to build, maintain, and fund roads and schools.
2. Engle Act. 10 USC 2671 et seq. (1958). See https://www.bliss.army.mil/homepage/mrlwr/docs/engleact.pdf.
3. See chapter 11 for a discussion of the INRMP process.
4. For more on disturbance, see chapter 8.
5. For more on invasive species, see chapter 7.

## Literature Cited


Altieri, M.A. 1995. *Agroecology: the science of sustainable agriculture* (2d ed.). (Boulder, Colorado: Westview Press, 1995.)

Alverson, W.S., W. Kuhlmann, and D.M. Waller. 1994. *Wild forests: Conservation biology and public policy.* (Washington: Island Press, 1994).

Andrén, H. 1994. Effects of habitat fragmentation on birds and mammals in landscapes with different proportions of suitable habitat: a review. *Oikos* 71: 355–364.

Angermeier, P. L. and J. R. Karr. 1994. Biological integrity versus biological diversity as policy directives. *BioScience* 44:690697.

Bird, E.A., G.L. Bultena, and J.C. Gardner, eds. 1995. *Planting for the Future: Developing an Agriculture that Sustains Lands and Community.* (Ames, Iowa: Blackwell, 1995).

Blann, K. 2006. Habitat in agricultural landscapes: How much is enough? Defenders of Wildlife, Washington, D.C. Available at: http://www.biodiversitypartners.org.

Bunnell, F.L. 1995. Forest-dwelling vertebrate faunas and natural fire regimes in British Columbia: patterns and implications for conservation. *Conservation Biology* 9: 636–644.

Cole, David N. 2004. Environmental impacts of outdoor recreation in wildlands. in Manfredo, Michael J.; Vaske, Jerry J.; Bruyere, Brett L.; Field, Donald R.; Brown, Perry J. eds, *Society and natural resources: a summary of knowledge.* (Jefferson, Missouri: Modern Litho, 2004).

Department of Defense Instruction 4715.3, Environmental Conservation Program, 3 May 1996. Internet: https://www.denix.osd.mil/denix/Public/ES-Programs/Conservation/Legacy/ETB/DoDI47153.htm. Accessed May 2007.

East Bay Municipal Utility District. 2001. East Bay Watershed Range Resource Management Plan, Section 3 Managing For Biodiversity. Watershed and Recreation Division. Orinda, California. Internet: http://www.ebmud.com/water_&_environment/environmental_protection/east_bay/default.htm.

Fahrig, L. 2001. How much habitat is enough? *Biological Conservation* 100:65-74.

Fuhlendorf, S.D. and D.M. Engle. 2001. Rangelands: Ecosystem Management Based on Evolutionary Grazing Patterns. *BioScience*, 51(8):625–632.

Gayaldo, P.F. 1996. Native shrub-steppe restoration at the Yakima Training Center, Yakima, Washington. Master of Science Thesis, University of Washington, Seattle. 130pp.

Granatstein, D. 1997. Stewardship Incentives: Conservation strategies for Oregon's working landscape. Cited by Vickerman, Sara. Washington State University Cooperative Extension. Available at: **www.biodiversitypartners.org.**

Laycock, W.A. 1983. Evaluation of management as a factor in the success of grazing systems. Managing Intermountain Rangelands—Improvement of Range and Wildlife Habitats; Proceedings of Symposia: Twin Falls, ID (September 15–17, 1981) and Elko, NV (June 22-24, 1982). Edited by S. B. Monsen and N. Shaw, USDA Forest Service. 166–171.

Legacy Resource Management Program, 2005. *Resources for INRMP Implementation—A Handbook for the DoD Natural Resources Manager.* Internet: **https://www.denix.osd.mil**

Liddle, M.J. 1997. *Recreation Ecology.* (London: Chapman & Hall, 1997).

Lindenmayer, F.B. and J.F. Franklin. 2002. *Conserving forest biodiversity: a comprehensive multiscale approach*. Washington: Island Press, 2002).

U.S. Department of Agriculture (USDA). 2006. Cooperating Across Boundaries, Partnerships to Conserve Open Space in Rural America. Forest Service, Publication FS-861, August.

U.S. National Park Service (NPS). 2005. Fact sheet: Leafy Spurge. Plant Conservation Alliance Alien Plant Working Group, Weeds Gone Wild: Alien Plant Invaders of Natural Areas. Available at: **http://www.nps.gov/plants/alien/fact/eues1.htm**

West, N.E. 1993. Biodiversity of Rangelands. *Journal of Range Management* 46: 2–13.

With, K.A. and A.W. King. 1999. Extinction thresholds for species in fractal landscapes. *Conservation Biology* 13: 314–326.

Wildlife viewing tower (right) at Watchable Wildlife site, Lake Arbuckle, Avon Park Air Force Range, Florida. (Photos: Douglas Ripley)


CHAPTER SIX

# Managing for Threatened, Endangered, and Sensitive Species

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## PLANNING WITH ENDANGERED SPECIES IN MIND

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.) [1]

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.umt.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 though 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

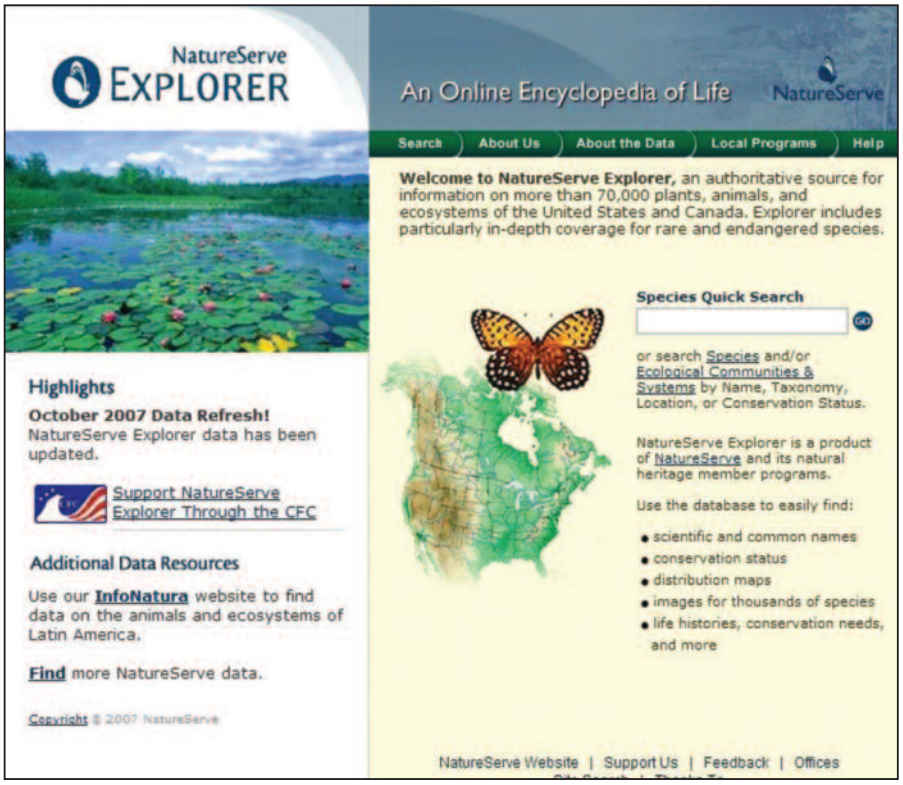
In addition to the information on birds provided by the groups and agencies mentioned above, other organizations provide conservation support for other major plant and animal groups. Partners in Amphibian and Reptile Conservation (PARC) is "an inclusive partnership dedicated to the conservation of the 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 Societyat **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.

## 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.

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

## 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.

**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) Blackjack oak / Hillside blueberry (Deerberry) Woodland | Northern harrier | Red-headed woodpecker |
| Eggert's sunflower | | Loggerhead shrike | |
| Pale purple coneflower | (Southern Red Oak, Post Oak) / Blackjack Oak / (Black Huckleberry, Dwarf Huckleberry) Woodland | Northern pine snake | Short-eared owl |
| Sand cherry | | Eastern slender glass lizard | Prairie warbler |
| Narrow-leaf bush-clover | | Meadow jumping mouse | Bachman's sparrow |
| Green milkweed | | | Blue-winged warbler |

* **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.

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)

### 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

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.

In some cases, such as on the playas 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)

**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."

## Literature Cited

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.

CHAPTER SEVEN

# Invasive Species Management on Military Lands

By Troy Weldy, invasive species specialist, The Nature Conservancy

Non-native invasive species are a leading threat to our nation's rich biodiversity, as well as to national security, the economy, and human health. Since colonial periods, thousands of non-native species have been introduced to the United States, some by accident and others quite deliberately. Based on the U.S. Department of Agriculture (USDA) Plants Database, currently 13 percent (5,303 of 40,140) of the vascular plant species in the nation are not native to North America. These would include most of Americans' favorite foods and many ornamental plants. The majority of non-native plants and animals existing in the U.S. are not harmful, but some non-native species cause tremendous damage when released outside of their native habitats. As defined by Executive Order 13112, invasive species are those non-native species that "cause economic or environmental harm or harm to human health." The Congressional Office of Technology Assessment reported in 1993 that 15 percent of invasive plants and animals cause severe economic and environmental harm.

Invasive species occur throughout the lands and waters of the United States, and military lands are no exception. These invaders are a major and growing problem on military lands, impacting the ability to train the nation's armed forces, degrading ecosystem health of these public lands, endangering native biodiversity, and potentially causing harm to human health. The military faces some unique challenges in combating invasive species on their lands, challenges related to their primary goal of maintaining the quality of military lands for realistic training exercises, while also meeting their responsibility to safeguard the quality of natural resources and biodiversity on their lands.

Numerous military installations across the country have employed successful and innovative methods to control invasive species, examples of which will be referred to throughout this chapter and in the case studies. Given the vast amount of land that the military owns and manages in the United States, the military has a unique responsibility in managing invasive species and in helping to prevent new introductions. The Department of Defense (DOD), however, can not stop the problem of invasive species on its own. Invasive species are a "beyond the fenceline" issue that must be addressed comprehensively, by Congress and other state and federal public land management agencies, as well as by private entities and individuals. Given the far-reaching nature of this problem, DOD has formed many diverse partnerships in battling invasive species, some of which are highlighted below.[1]

## Impacts on Military Operations

Invasive species affect the nation's military installations and operations worldwide. The National Wildlife Federation's recent report (Westbrook and Ramos 2005) on invasive species on military lands provides twelve cases outlining numerous threats and costs to military operations: from six-foot tall spiky yellow star-thistle shredding parachutes that average $4,000 apiece at Fort Hunter Liggett in California to *Phragmites* causing security concerns at Avon Park Air Force Range in Florida. Holloman AFB in New Mexico allocated over a half million dollars to remove invasive species from airstrips in order to protect the safety of Air Force pilots and prevent damage to aircraft worth tens of millions of dollars. And in Hawai'i, dense non-native mangrove thickets can breach "line of sight" security for Marines assigned to protect base borders along the shoreline (Westbrook and Ramos 2005).


Air Force C-130 aerial spray operations at Smoky Hill ANG Range, Kansas. These operations are used periodically to control extreme outbreaks of the noxious weed musk thistle on the range. (Photo: Douglas Ripley)

## ECOLOGICAL IMPACTS

Many reports have documented the ecological impacts of these non-native invaders, including citing invasive species as one of the greatest threats to biodiversity (e.g. Stein et al. 2000). Worldwide, an estimated 80 percent of endangered species could suffer losses due to competition with or predation by invasive species (Pimentel et al. 2005). In addition to direct competitive impacts to native species, some of the worst invasive species are able to alter native habitats and ecosystems. Invasions by non-native species have been shown to modify ecosystem processes, like nutrient cycling, fire frequency, hydrologic cycles, sediment deposition, and erosion (Kelly 2007). On the Marine Corps Base Hawai'i, non-native mangrove stands take over native marsh habitats, converting critical habitat for endangered Hawaiian waterbirds into mangrove thickets that are inhospitable to both native species and to realistic military training exercises on base. On Avon Park Air Force Range in Florida, invasive wild hogs compete with the endangered Florida scrub jay for food and destroy nesting habitat for many other endangered species (Westbrook and Ramos 2005). Such feral hogs are a growing menace at several other military installations. When invasive species cause habitat destruction and harm rare native species, the result can lead to reductions in available training lands on installations.

Beautiful invader? The mute swan (*Cygnus olor*) has been condemned by several policy makers and scientists as an invasive species. The bird was believed to have been imported to the U.S. to grace parks and estates, but now it is accused of eating an inordinate amount of submerged aquatic vegetation and displacing the native tundra swan. The darker-colored swans shown here are adolescents accompanying a parent. The control of this species is a particularly difficult problem for military bases in the Chesapeake Bay Region as it creates Bird Aircraft Strike Hazards (BASH) and eradication programs have been met with protests from animal welfare organizations. (Photo: Fred Powledge)

### ECONOMIC IMPACTS

Invasive species impact the United States economy in many ways, negatively affecting economic sectors such as western ranching, Great Lakes shipping, southern forest plantations, and midwestern farming, just to name a few. Within the U.S., the estimated damage and management cost of invasive species is more than $138 billion annually, more than any other natural disaster (Pimentel et al. 2005). In addition to these costs, many economic losses from recreational and tourism revenues are difficult to calculate (Simberloff 2001); as a result, the $138 billion estimate may be low.

If monetary values could be assigned to the extinction of species, loss of biodiversity, and reduction of ecosystem services, costs from impacts of invasive species would drastically increase (Pimentel et al. 2005). For the military, the costs related to invasive species are significant and are increasing each year. To name one example, Camp Pendleton in southern California spent approximately $1.2 million over a five year period trying to control giant reed (*Arundo donax*) and tamarisk or salt cedar (*Tamarix ramossima*) (Westbrook and Ramos 2005). While it also can be expensive to prevent invasive species on military lands—for example through programs to wash tanks and other military vehicles before and after transport—prevention is a critical first-line defense against new invaders on military lands. Once established, managing invaders such as the giant reed and tamarisk, mentioned above, can often be a multi-year and multi-million dollar effort.

### RECREATIONAL IMPACTS

As many boaters and fishermen can attest, invasive species like water hyacinth (*Eichhornia crassipes*), hydrilla (*Hydrilla verticillata*), Eurasian milfoil (*Myriophyllum spicatum*), and water chestnut (*Trapa natans*) can reduce or prevent access to water bodies. In some cases, it is the recreational activities that have introduced or spread invasive species. So have people out for innocent walks;

*Miconia calvescens*, a broad-leafed plant introduced as a handsome ornamental in Hawai'i in the 1960s, produces tiny seeds that must be removed from shoe soles by vigorous brushing, lest they plant themselves elsewhere. It and other invasives can limit hiking options or reduce the outdoor experience. Conservative estimates of the economic costs from invasive species impacts on wildlife-related recreation in Nevada alone range from $6 million to $12 million annually (Elswerth et al. 2005).

A seriously invasive species. Miconia (*Miconia calvescens*) was intentionally introduced in Hawai'i in the 1960s as an ornamental, but it quickly became an aggressive invader. Its seeds can remain viable in the soil for as many as eight years. The leaves, which can grow to 2.5 feet in length, are dark green on top, often reddish-purple underneath. (Photo: Fred Powledge)

## Invasive Species Vectors

Invasive species have arrived in the United States through a multitude of means, including introductions by early human settlers who seek reminders of their homelands, to importation of ornamental plants, to introductions by government agencies to combat some other problem (often an agricultural one), to an expanding global trade enterprise that inadvertently allows the rapid spread of species. Modern trade has greatly increased the spread of a number of species. Asian tiger mosquitoes hitchhike into new areas in rainwater pools in discarded tires and even aboard water-filled depressions on ship structures. This mosquito is associated with the transmission of many human diseases, including dengue virus, West Nile virus, and Japanese encephalitis (Global Invasive Species Database 2006).

Ship ballast, typically water pumped into a ship's tanks at one port and pumped out at another, is used to balance the weight and control the steerage of freight vessels and is a well-documented vector. The most noted species introduced by ballast is the zebra mussel. Zebra mussels (*Dreissena polymorpha*) are native to the Caspian Sea, but long ago began spreading throughout much of Europe. In 1988, they were detected in the Great Lakes where they had caused serious problems by out-competing native species for food and damaging harbors, boats, and power generation plants.

In some cases, the military itself unintentionally may have been responsible for the spread of invasive species. While it is difficult to pinpoint the precise time, location, and cause of introduction, there is speculation that the military introduced the brown tree snake to Guam, African iceplant to the San Francisco Bay area, black rats to the Midway Islands, and sakosia shrubs (*Timonius timon*) to Palau. The military has taken a leadership role to reduce future unintentional introductions. The Armed Forces Ballast Water Management Program, which requires DoD vessels to twice flush ballast water at least twelve nautical miles from shore, should be used as an example to commercial vessels. Transportation policy and procedures rules already require the washing of vehicles after field operations. The primary purpose is to extend the life of field equipment, but it also has a secondary purpose of reducing hitchhiking foreign pests from entering U.S. borders.[2]

The Asian Tiger Mosquito is a serious vector for many human diseases. (Photo: U.S. Department of Agriculture)

## Federal Guidelines for Invasive Species

The United States has several legal guidelines that are intended to prevent and combat invasive species. Chief among them is the National Invasive Species Act of 1996. This act is a reauthorization and amendment to the 1990 Nonindigenous U.S. Aquatic Nuisance Prevention and Control Act of 1990 (P.L. 101-646), which authorized the National Oceanic and Atmospheric Administration and the U.S. Fish and Wildlife Service to address aquatic invaders. Section 1103 of the

Zebra mussels are perhaps the most notorious invasive species. They are thought to be introduced to the Great Lakes via ships' ballast water. (Photo: NOAA, Great Lakes Environmental Laboratory)

1996 act states that the "Secretary of Defense shall implement a ballast water management program for seagoing vessels of the Department of Defense and Coast Guard (see **http://www.nemw.org/nisa_summary.htm**). The act also calls for the creation of state invasive species management plans, development of ballast water guidelines for commercial vessels, research studies, and demonstration projects. Advocates of the ballast program argue that the act needs reauthorization that includes the program's expansion to cover all commercial vessels similar to that of the armed services program. The Aquatic Nuisance Species Task Force (**http://www.anstaskforce.gov/default.php**) is an intergovernmental group that helps to implement the act. There is also a hotline to report sightings of aquatic nuisance species (ANS) in the U.S. (telephone 877-STOP-ANS; **http://cars.er. usgs.gov/Nonindigenous_Species/Stop_ANS/stop_ans.html**).

**EXECUTIVE ORDER 13112, INVASIVE SPECIES.** Executive Order 13112, which was signed in 1999, created the National Invasive Species Council (NISC) that is composed of 13 federal departments and agencies, including the Department of Defense. The council's principal objectives are to prevent the introduction of invasive species, monitor invasives' populations, promote restoration of native species, and promote public education on invasive species (**http://www.invasivespeciesinfo.gov/laws/execorder.shtml**). A five-year review of the NISC was recently completed (see **http://www.invasivespeciesinfo.gov/docs/council/fiveyearreview.pdf**). This document highlights the accomplishments to date and the NISC's future plans.

**ARMED FORCES PEST MANAGEMENT BOARD.** This board (**http://www.afpmb.org**) provides numerous resources regarding invasive species and other pests impacting military lands and operations. The AFPMB has developed best management practices, standard pesticide use guidelines, resources for identifying invasive species, and links to research activities. The AFPMB publishes technical guidance for installation personnel who are responsible for pest management plans (see **http://www.afpmb.org/pubs/tims/TG18/tg18.htm**). The DOD website lists a number of "Technical and Informational Resources Regarding Invasive Species" notices. They may be found at **https://www.denix.osd.mil.** Another useful document on the site is "Predicting the Spread of Non-Indigenous Invasive Species: Can It Be Done?" at **https: //www. denix.osd.mil.**

The DOD's Armed Forces Pest Management Board supports research on the control of invasive species. One extensive project involved an evaluation by scientists from Clemson University of various eradication techniques for the imported red fire ant at McEntire Air National Guard Station, South Carolina. (Photo: Douglas Ripley)

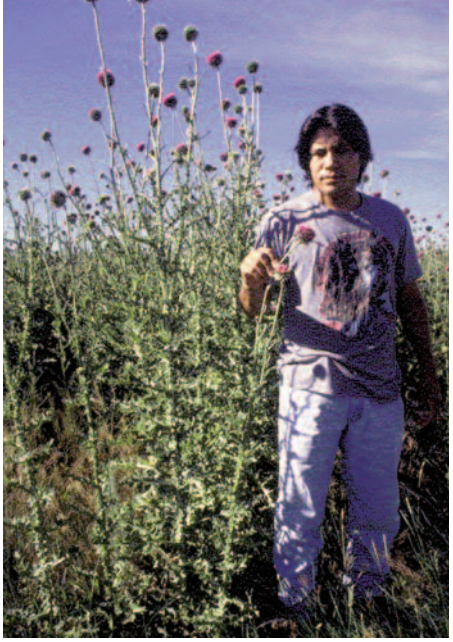
Spot chemical treatment for red imported fire ants at Shaw AFB, South Carolina. Early detection and rapid response are often the keys to successful invasive species control. (Photo: Douglas Ripley)

## Combating Invasive Species

The most cost-effective means to control invasive species is to prevent their initial arrival. The impacts of many of these species, however, are not understood until they are well established. For those species where environmental and economic impacts are known, measures need to be taken to reduce the risk of introduction, including surveys for these species at ports of entry and military bases where equipment and materials are imported or returned from foreign soils. Military vessels and equipment used in foreign lands and waters where potential invasive species are suspected should be thoroughly cleaned before leaving those foreign lands. If any invasive species are found at our first lines of defense (i.e. shipping ports), then immediate eradication should occur. As noted previously, preventing the discharge of foreign ballast water by military vessels in U.S. ports will reduce the introduction of invasive aquatic species.

On military lands where invasive species are already present, management activities should include restoration actions. The removal of invasive species without restoration can lead to the reestablishment of the same or new invasive species. Furthermore, on many installations, there is a chance that invasives species can reinvade from lands outside the installation boundaries. On Avon Park Air Force Range in Florida, the highly invasive and problematic climbing ferns and tropical soda apple occur in public and private lands nearby. It is important for military natural resources managers at all installations to think beyond the fenceline and cultivate public and private partnerships to keep invasive species under control.[3]

**EARLY DETECTION/RAPID RESPONSE.** The idea of early detection/rapid response is a two-part component: first, surveys to identify newly-established invasive species, and second, an effort to eradicate newly detected infestations. There are many cases where early detection has identified newly established pests, but managers have proven less adept at following up with eradication programs. Many scientists want to study the problem more, but agencies are bogged down in red tape that prevents immediate eradication. Given the potential environmental and economic impacts, a suggested strategy of "yank it now, ask questions later" may prove most cost effective. This is particularly important for species that are known to cause harm.



Because musk thistle, *Carduus nutans* (far right), is unpalatable to wildlife and livestock, selective grazing leads to severe degradation of native meadows and grasslands as wildlife focus their foraging on native plants, giving musk thistle a competitive advantage. To control this pest at the Smoky Hill ANG Range, Kansas, the Air Force has resorted to herbicide spraying with specially equipped C-130 aircraft (right) assigned to the 910th Airlift Wing, Air Force Reserve Command, Youngstown, Ohio. (Photos: right, Douglas Ripley; far right, U.S. Department of Agriculture)

**MECHANICAL CONTROL.** The use of mechanical control is often effective for dealing with small, newly established populations or as part of a large scale restoration program. Mechanical control may simply include hand pulling or the use of large equipment. No matter what control feature is employed, follow-up monitoring is necessary to ensure eradication.

**PESTICIDES.** Many modern pesticides have been vastly improved over earlier controls, such as DDT, with its notorious residual environmental impacts. Methodologies for applying pesticides have also improved. Cut-stump treatments (i.e. painting herbicides directly onto a cut surface), wet wicking (hand applying herbicides to individual target plants), and stem injections (the use of needles to inject herbicides directly into a target plant or impacted plant) allow applicators to directly apply chemicals to the target species with little or no non-target impacts. In extreme cases, broadcast spraying of herbicides may be viewed as the only option, in which case more care and review are needed. Drawbacks to chemical treatment include its cost and potential negative impact to the environment and to the applicators' health.

**BIOLOGICAL CONTROLS.** Biological controls are growing in use as non-chemical opponents of harmful invasive species and diseases. Biocontrols can be defined as the use of natural enemies, usually from a pest's native lands, to reduce the impact of problematic insects, diseases, and plants. There are many examples of successful use of biocontrols in the place of chemical poisons; a tiny parasitic wasp, part of a large group of parasitoids, controls many agricultural pests and diseases, for example. The Texas Agricultural Experiment Station has collaborated with the DOD to remove noxious weeds on military lands. The weeds include leafy spurge, field bindweed, spotted knapweed, Canada thistle, and St. John's wort; participating installations include Fort Carson, the Air Force Academy, Rocky Flats Environmental Technology Site, Buckley AFB, all in Colorado, and F.E. Warren AFB, Wyoming, (see **http://amarillo.tamu.edu/programs/entotaes/CNWB.htm; http://amarillo.tamu.edu/programs/entotaes/Biological_Noxious_Weed_Control. pdf**).

As with any effort to tinker with nature, biocontrol can have unintended, negative results. One danger is that the biological control agent—parasitoid, fungus, nematode, bacterium, competing organism, growth regulator—can gobble up or

infect not only its intended target but also beneficial organisms. In the 1970s, for example, biologists released the Asian ladybug in an effort to control aphids that were attacking pecan trees in the southeastern U.S. These ladybugs were successful at eradicating these aphids, but they also had appetites for other insects. The result has been a biocontrol that eats so many aphids and other native ladybugs that many native ladybugs became threatened or extinct. Even New York's official state insect, the nine-spotted ladybug (*Coccinella novemnotata*), is now extinct from New York State as a result of competition with the Asian ladybug.

These and other examples should be viewed as cautionary tales. When biocontrols are thought to be the only solution, detailed research and extensive testing must be done. Researchers and land managers need to learn from the biocontrol failures. They need to ensure that biocontrols do not become the next wave of invasive species, potentially worse than the species they were meant to control. But if carefully evaluated before introduction, biological controls can be highly effective, as Jerry Johnson at Fairchild AFB, Washington, can attest (see case study). Biocontrol agents are tightly controlled by the U.S. Department of Agriculture.

**PARTNERSHIPS.** As a member of the National Invasive Species Council (**http://www.invasivespeciesinfo.gov/council/main.shtml**), the Armed Forces Pest Management Board (**http://www.afpmb.org/**) works with multiple agencies to combat invasive species. Throughout the country, Cooperative Weed Management Areas (CWMAs) or similar partnerships are forming to address invasive species problems across multi-jurisdictions (see **http://www.weedcenter.org/weed_mgmt_areas/wma_overview.html**). These partnerships may allow the DOD, along with other federal agencies, state agencies, NGOs, and local land managers, to share resources and experiences to better manage invasive species.

Demonstration of how the Galenrucella beetle is used to control purple loosestrife in the biological control program at the U.S. Military Academy, West Point, New York. (Photo: Douglas Ripley)

## Conclusions

As with any land manager today, the military's first line of defense against invasive species must be prevention of new invasions and preventing expansion of existing invaders. The military already has many policies in place to aid in prevention, such as DOD's Customs and Border Clearance Program Regulations (**http://www.dtic.mil/whs/directives/corres/pdf/503049p.pdf**), but consistent funding is needed in order for prevention programs to be successful. Since funding is often linked to an installation's Integrated Natural Resources Management Plan (INRMP), prevention of invasive species should always be considered in the INRMP, along with early detection, rapid response, and long-term management of invasives.

Perhaps the most important weapon in the fight against invasive species on any installation is outreach and partnerships. Installations such as Fort McCoy, Wisconsin, have enlisted the help of citizen volunteers in controlling numerous invasive plants, such as garlic mustard and leafy spurge. Staff at the Wisconsin fort have reached out to local stakeholders and developed partnerships to educate the community about the harmful impacts of invasive species on and off base. These partnerships have even aided Fort McCoy with bringing in funding for their efforts, through the National Fish and Wildlife Foundation's "Pulling Together Initiative" (see **http://www.nfwf.org/AM/Template.cfm?Section=Browse_All_Programs**) which provides grants for public and private partnerships to combat invasive species (Westbrook and Ramos 2005). The military can also form very beneficial

The control of fire ants at Camp Bullis, Texas, requires extraordinary care because the infected areas provide habitat for several endangered invertebrate species. Therefore pesticides can not be used safely and superheated water is used to kill the ants. The U.S. Fish and Wildlife Service must be consulted before using any pesticide that may affect an endangered species. (Photo: Douglas Ripley)

partnerships with conservation organizations and invasive species researchers, to share resources, information, and best practices in the battle against invasives (see **https://www.denix.osd.mil**). The military has teamed with nongovernmental organizations, such as The Nature Conservancy, to combat some of the nation's worst invaders, such as tamarisk or salt cedar.

Not only do installation natural resources managers need to look outside their borders to form partnerships, but they also should look to their own operational forces as partners in controlling invasive species. In some cases, management of invasive species can be aided by training activities, such as on the Marine Corps Base Hawai'i, where Marines help clear out invasive pickleweed by running their amphibious assault vehicles over the invaded mudflats, helping to improve the habitat for native species such as the endangered Hawaiian stilt while simultaneously improving the training ranges for military maneuvers (Westbrook and Ramos 2005).

Managers of lands invaded by undesirable species also must consider native biodiversity and the entire ecosystem. When addressing the problem of invasive species in an INRMP, natural resources managers should always consider what they are managing *for*, not only what they are managing *against*. For example, in some cases, restoration efforts are necessary after invasive species have been removed from an area. Moreover, when managers think holistically, they are more likely to minimize any harmful environmental impacts of invasive species control efforts. Herbicides and biocontrols can be very useful management tools in some situations, but any potentially harmful side effects also must be examined, and the benefits weighed against the possible long-term costs. Partnering with other public and private land managers and with researchers in universities who have expertise in invasive species control can be critical for military natural resources managers seeking and testing the most cost effective and least environmentally harmful invasive species control methods.

Through sharing knowledge and expertise about invasive species prevention and management within the military, and among the military and various public and private partners, the battle against invasive species must continue in order to protect training lands from degradation and to safeguard the rich native biodiversity that occurs on military lands across the country.

**NOTES**

1. Some general sources of information about invasive species can be found at the National Invasive Species Information Center (**http://www.invasivespeciesinfo.gov/**); the National Fish and Wildlife Foundation (**http://www.nfwf.org/**), and **http://tncweeds.ucdavis.edu/** or **http://www.invasiveplants.net/**.

2. See *Retrograde Washdown: Cleaning and Inspection Procedures.* Armed Forces Pest Management Board. Technical Guide No. 31. November 2004. http://www.afpmb.org/pubs/tims/tg31/tg31.pdf.

3. For more on beyond-the-fenceline thinking, see chapter 10.

## Literature Cited


Baker, Sherry. 1994. The Redeeming Qualities of Zebra Mussels. *Omni* 16: 28–29.

Elswerth, Mark E., Tim D. Darden, Wayne S. Johnson, Jean-Marie Agapoff, and Thomas R. Harris. Input-output modeling, outdoor recreation, and the economic impact of weeds. *Weed Science* 53(1): 130–137.

*Global Invasive Species Database*. 2006. Aedes albopictus. Available from: **http://www.issg.org/database/species/ecology.asp?si=109&%fr=1&%sts=sss** (Accessed 22 April 2007).

Goodard, Jeffrey H.R., Mark E. Torchin, Armand M. Kuris, and Kevin D. Lafferty. 2005. Host specificity of Sacculina carcina, a potential biological control agent of the introduced European green crab *Carcinus maenas* in California. *Biological Invasions* 7: 895–912.

Kelly, Susan. 2007. Invasive Plant Impacts. Invasive Plant Management: CIPM Online Textbook. Available from: **http://www.weedcenter.org/textbook/** (Accessed 26 May 2007).

Ludke, Larry, Frank D'Erchia, Jan Coffelt, and Leanne Hanson. 2002. Invasive Plant Species Inventory, Mapping, and Monitoring: A National Strategy. Workshop Report: Office of the Regional Biologist, Central Region. U.S. Geological Survey BRD Information and Technology Report ITR 2002-0006. (Lakewood, Colorado, 2002) (available for download at: **http://lrs.afpmb.org/R4917RX4A391ABKHYQ8TRZY4/arc/al_06_tit_fetch/5/176164**)

Miller, S. 1992. ES&T Currents, International Agreements Show Poor Reporting. *Environmental Science & Technology.* 26: 2334–2335.

Pimentel, D., R. Zuniga and D., Morrison. 2005. Update on the environmental and economic costs associated with alien-invasive species in the United States. *Ecological Economics* 52:273–288.

Simberloff, D. 2001. Biological invasions: How are they affecting us, and what can we do about them? *Western North American Naturalist* 61:308–315.

Stegemann, Eileen C. 1992. The Zebra Mussel: New York's Carpetbagger. *Conservationist* 47: 37–41.

Stein, Bruce A., Lynn S. Kutner, and Jonathan S. Adams, eds. 2000. *Precious Heritage: The Status of Biodiversity in the United States.* (New York: Oxford University Press, 2002; The Nature Conservancy and Association for Biological Information.)

U.S. Congress, Office of Technology Assessment. 1993. Harmful Non-Indigenous Species in the United States. Washington: U.S. Government Printing Office (available online at: **http://www.wws.princeton.edu/ota/disk1/1993/9325/9325.PDF**)

USDA Plants Database. 2007. Available from: **http://plants.usda.gov** (Accessed 22 April 2007).

Westbrook, C. and Ramos, K. 2005. Under Siege: Invasive Species on Military Bases. National Wildlife Federation. Available from **http://www.necis.net/necis/files/nwfunder_seige_1005.pdf** (Accessed 25 May 2007).

Young, Eric. 2004. Ten invasive species that the United States exported. National Environmental Coalition on Invasive Species. Available at: **http://www.necis.net/necis/files/nwfunder_seige_1005.pdf.** (Accessed 28 May 2007).

Zimmerman, H., S. Bloem, and H. Klein. 2004. Biology, History, Threat, Surveillance and Control of the Cactus Moth, Cactoblastis cactorum. Joint FAO/IAEA Programme. Austria. 40 pp. Available at: **http://www-pub.iaea.org/MTCD/publications/PDF/faobsc_web.pdf.** (Accessed 28 May 2007).

## Other Resources

Baskin, Yvonne. 2002. *A Plague of Rats and Rubbervines.* (Washington: Island Press, 2002).

Committee on Ships' Ballast Operations. 1996. *Stemming the Tide: Controlling Introductions of Nonindigenous Species by Ships' Ballast Water.* (Washington: National Academy Press, 1996). Available at: **http://books.nap.edu/html/tide/.**

Simberloff Daniel, Don C. Schmitz, Tom C. Brown, eds. *Strangers in Paradise: Impact and Management of Nonindigenous Species in Florida.* (Washington: Island Press, 1997).

Military Installations Threatened by Invasive Species. *Currents.* Winter. 2006. Available at: **http://www.environavair.navy.mil/currents/contents_wi06.cfm.**

Mooney, H.A. and R.J. Hobbs. 2000. *Invasive Species in a Changing World.* (Washington: Island Press. 2002).

Staples, George W. and Robert H. Crowe. 2001. *Hawai'i's Invasive Species.* (Honolulu: Mutual Publishing and Bishop Museum Press, 2001).

CHAPTER EIGHT

# The Effects of Natural and Man-Made Disturbances

By Steve Orzell, botanist/ecologist, Avon Park Air Force Range and William J. Platt, professor of population biology/ecology at Louisiana State University

Not so many years ago, scientists and many others categorized major natural disturbances as catastrophic events disruptive of otherwise stable states (Clark 1991). Hurricanes, tsunamis, floods, and especially wildfires were thought to produce deviations from otherwise stable ecological systems—interruptions in the progression of species changes and ecosystems toward a climax, or a steady state (Cowles 1899, Clements 1937, Platt and Connell 2003). These views have changed. Natural disturbances are now recognized as integral and necessary components of ecosystems worldwide. Resources managers who once considered disturbances as deviations from orderly succession now view them as a natural part of ecosystems. Restoration and management actions are planned so as to include natural disturbances.

Now natural disturbances are considered non-catastrophic by many ecologists. Some individuals of most, if not all, species survive such events (Platt and Connell 2003). For natural communities, a self-sustaining "equilibrium" or "climax" state does not exist, even over a relatively large spatial scale. Moreover, the concept of "climax" states has yet to be demonstrated in the natural world (Sousa 1984). Instead, species are recognized as continually responding to changes in environments and to natural disturbances (Platt and Connell 2003). For example, we now know that fires favor species that survive fires in some life cycle stages and that are adapted for post-fire environments (Platt 1999). Different species thus may be favored under different fire regimes (e.g., Keeley and Zedler 1978, Glitzenstein et al. 1995). Moreover, some species may engineer disturbance, such as fires, through modification of characteristics and effects of fires, and thus these species influence species composition of ecosystems (Platt 1999). This more current thinking emphasizes the non-equilibrium nature of ecological systems—as a result of ongoing, recurrent, environmental changes, among which are disturbances. These changes are as much a part of biological life on military installations as they are anywhere else.

## Disturbance Regimes

Ecological disturbances, current thinking holds, are relatively discrete events that affect landscapes in disruptive ways. Each disturbance type and even successive disturbances of the same type are unlikely to affect natural landscapes in precisely similar ways. Thus, it is difficult to predict the exact effects of the next disturbance in any natural landscape. Nonetheless, if similar or different types of disturbances recur with some periodicity, then a *disturbance regime* is produced that may generate predictable consequences. These disturbance regimes often are characterized by the type of disturbance, frequency/return interval, and seasonal timing. Examples include be the intensity of windstorms, duration of floods, and the frequency and season of fires. The characteristics of disturbances often vary within landscapes and also may interact with landscape components, as well as prior disturbances, to influence the size of the area affected. Also, local effects may influence the intensity, patchiness, and frequency of gaps or voids on the biota and the environment.

Disturbances often are numerous and occur at many different spatial scales. Here, we contrast disturbances at the largest and smallest scales. Disturbances at smaller scales tend not to affect landscapes or even entire ecosystems. These dis-


Hurricane Felix was a major disturbance—a category 5 hurricane that came ashore over northeastern Nicaragua on 4 September 2007, with sustained winds of 160 miles per hour. Hurricanes and typhoons provide often devastating illustrations of natural disturbance. (Photo: NASA image by Jeff Schmaltz, Goddard Space Flight Center)

turbances may be important, however, as a result of their combined effects over space and time. Burrowing animals can alter soil structure, for example, and over time change the substrate in ecosystems, as well as directly affect the plant communities in which they occur. Likewise, lightning strikes affect individual trees, but as a consequence influence whole guilds of cavity-nesting birds or wood-consuming insects and their associated predators and parasites. In forested land, a fallen tree can open a gap in the canopy that might produce a sunlit microclimate on the ground below—and this could favor the growth of understory species.

At the other end of the disturbance scale are large-scale disturbances such as fires, hurricanes, and volcanic eruptions. Large-scale disturbances are those that affect entire landscapes and their component ecological systems (Pickett and White 1985). Some examples include disturbances created by fire, wind, ice, and flooding. Invasive species can generate large-scale disturbances. For example, grasses that easily tolerate fire, may change an ecosystem's fire frequency (Brown and Lomolino, 1998) or intensity (Platt and Gottschalk 1991). Invasives also can wreak profound disturbance on the incalculable value of biodiversity on soil, as can pollution, changes in land use, and climate change (Wall et al. in Soulé and Orians 2001).

Any of these large or small-scale disturbances are as likely to happen on a military base as elsewhere. Numerous types of disturbances occur on military lands. Those induced there by humans are primarily related to land management—forestry, grazing, use of prescribed fire—and military maneuvers.

## Variability

Natural disturbances vary in duration, scale, intensity, spatial pattern, and return interval in any landscape. Thus, similar or different disturbances occurring at different times and different places produce different effects on ecosystems at a landscape scale. An understanding of this is valuable for the military natural resources manager. For example, fires can be patchy and of differing intensities. Not all individuals of a species are affected equivalently by a single fire. Burning at different times of a year may affect species differently. Depending on the time between burns, some species may be able to complete their life cycles or reproduce before the next event. Survivors may be present in some, but not all, areas affected by a disturbance, and the environment may be changed in different ways in different parts of the area affected by a large-scale disturbance. Thus, diversity and heterogeneity at the landscape level are often enhanced by natural large-scale disturbances (Watt 1947, Bratton 1976, Connell 1978, Beatty 1984, Collins and Pickett 1982, Pickett and White 1985, Foster et al. 1998, Platt and Connell 2003).

Temporal heterogeneity of disturbances may be predictable or unpredictable (Platt and Connell 2003). If it is predictable, it can thus favor certain types of species. For example, large lightning-initiated fires in the southeastern U.S. tend to occur at certain times of the year and even under certain global weather patterns (Beckage et al. 2003, Slocum et al. 2007). This may favor the growth and survival of some plant species. For example, wiregrass, (*Aristida beyrichiana*) is recognized to flower primarily after growing season fires (Outcalt 1994, Mulligan et al. 2002, Peet 1993, Kesler et al. 2003). In some cases species may be uncommon because they thrive under certain disturbance regimes that occur rarely, but such species have mechanisms to survive the intervals between successive disturbances (e.g., Sheridan et al. 1997, Schuyler 1999, Norden and Kirkman 2004).

Ecological disturbances can also be categorized in other ways. Exogenous disturbances are external to the communities, ecosystems, or landscapes influenced by those disturbances. Most large-scale disturbances fall into this category. Endogenous or biotic disturbances are internal to the ecological system affected. Most smaller-scale disturbances fall into this category. Both exogenous and endogenous natural disturbances can be repetitive (recurrent fires or even volcanic eruptions; beaver dams on streams) or de novo (new volcanic eruptions; an invasion of a new species that re-engineers the ecosystem). Human disturbances can be considered as either exogenous (global climate change) or endogenous (clearcutting forests), but typically are de novo in nature. On military installations, disturbances caused by the military mission are examples of exogenous events. In summary, the role of disturbances (large- and small-scale, exogenous and endogenous; repetitive and de novo) is pervasive and of primary importance in natural landscapes.

Facing page: The eruption of Mount St. Helens in 1980 was an example of a major and intense natural disturbance. (Photo: U.S. Geological Survey)

## Not in Isolation

The effects of natural disturbances cannot be considered in isolation. Disturbances may interact with one another, such that effects of an initial disturbance alter characteristics and effects of subsequent disturbances (Paine et al. 1998 Robertson and Platt 2001, Platt et al. 2002, Suding et al. 2004, Schroder et al. 2005). As a result, species may invade following sequences of disturbances, especially when de novo disturbances are involved (Kercher and Zedler 2004, Zedler and Kercher 2004).

Natural landscapes can be greatly affected by human-caused alterations of natural disturbance regimes and by de novo anthropogenic disturbances. Altering disturbance regimes changes the environments to which species may have become adapted. Habitat fragmentation as a result of human activity is a major cause of indirect alteration of disturbance regimes, especially those of large-scale disturbances. Fires that otherwise might have swept across large regions of the southeastern U.S., for instance, are contained in much smaller areas by a fragmented landscape (Gilliam and Platt 2006). The result may be less frequent, but more intense fires that are now less dependent on global climate patterns and more dependent on fuel accumulation (Slocum et al. 2007). Similarly, floodplain communities once linked to natural flooding cycles are in altered hydrologic regimes (Sparks 1998, Sparks et al. 1990).

Human disturbances of ecological communities may reduce standing biomass and simplify community structure and composition (Menges and Quintana-Ascencio 2003)—or, on other occasions, they may actually increase biomass by interrupting normal burning cycles. Most significantly, human disturbance regimes typically deviate from historic ecological disturbance regimes and oftentimes result in radical shifts in the ecosystem, such as the introduction of exotic species (Menges and Quintana-Ascencio 2003).

## Military Disturbances and Associated Ecosystem Consequences

Ground disturbances at bombing ranges, such as here at the Warren Grove Air National Guard Range, New Jersey, are typical of impacts caused by military training operations. (Photo: Douglas Ripley)

Military lands are important ecological reserves because they often encompass large tracts of land that are protected from intensive agriculture and urban development (Boice 1997, Ripley and Leslie 1997a, 1997b, Lillie and Ripley 1998). Furthermore, some of the finest examples of fire-maintained ecosystems within the southeastern United States are found on military bases in and adjacent to artillery ranges where frequent fires are assured and unexploded ordnance provides protection from development (Peet and Allard 1993). But how do military training activities compare to the natural disturbance regimes? And how might military disturbances interact with land management activities on military bases?

Disturbances from military missions may enhance or exacerbate their effects on ecosystem components. In general, military training in terrestrial environments can be broadly categorized into two major types of disturbances—ground maneuvering (tracked and wheeled vehicles) and air-to-ground impacts. Military installations subject to usage by the U.S. Army are often subject to additional impacts from training exercises. Typically, maneuvers on Army installations involve large vehicles that can cover large areas in a single training exercise. The available land base for training has a strong influence on the intensity and frequency of usage (Demarais et al. 1999) and thus on the disturbance effects.

Large-vehicle maneuvers are a widespread use of land and consistently are shown to have negative effects across a variety of terrestrial ecosystems. These repeated human-induced disturbances have no natural analog. The negative effects of ground maneuvering training have been studied in California (Lathrop 1982, Prose 1985), Colorado (Milchunas et al. 1999), Georgia (Dilustro et al. 2002), Kansas (Quist et al. 2003), Washington (Severinghaus and Goran 1981), Wisconsin (Smith et al. 2002), Texas (Severinghaus et al. 1981), Manitoba (Wilson 1988), and western Europe (Vertegaal 1989). Although studies have been con-

ducted across a variety of ecosystems (e.g. deserts, prairies, pine-oak forests, etc.) several generalizations have emerged. In particular, it is the cumulative effect of repeated military disturbances that ultimately results in reduced abundance of perennial species, overall losses of native species, increased numbers of introduced species, and an increase in the amount of bare and compacted soil.

While most studies have focused on effects of large vehicles, the observed results probably also include the effects of other vehicular disturbances as well (i.e. off-road vehicles) that oftentimes occur in conjunction with tracked vehicle maneuvering activities. Road-like features, including active and remnant trails and vehicle tracks, are the most prevalent disturbance features at installations with high-usage maneuvering areas (Dilustro et al. 2002, Quist et al. 2003). These disturbance features act to increase fragmentation of the landscape, which can in turn affect ecosystem-level processes (i.e. spread of fire, flooding, drainage, etc.).

In native grasslands where maneuvering has been examined, at least one study, (in Central Plains grasslands at Fort Riley Military Reservation in northeast Kansas), has shown increased bare soil, reduced total plant cover, and compositional shifts in plant communities (Quist et al. 2003). Reduced cover of the perennial, matrix-forming grasses and native species, and increased cover of annual and introduced species were also associated with high-usage maneuvering training activity. Quist et al. (2003) also reported high-usage maneuvering associated with increased sediment and reduced abundance of benthic insectivores, herbivore-detritivores, and silt-intolerant aquatic species. Watersheds with high military maneuver usage also were characterized by an abundance of trophic generalists and disturbance-tolerant species. Overall, the Quist study suggests that high-usage maneuvering areas had significant ecological effects on the properties of both terrestrial and aquatic ecosystems, with respect to recovery from past disturbances and ecological resilience to future disturbances. In an effort to prevent significant degradation of training areas and to provide a coordinated assessment and monitoring of these impacts, the U.S. Army has implemented an Integrated Training Area Management (ITAM) program.[1] This program emphasizes monitoring of military impacts (erosion, siltation, soil compaction, loss of native plant cover, hydrologic alterations, etc.) on training lands.

The careful cleanup of inert ordnance at the Barry M. Goldwater Range, Arizona, is an important part of the range restoration programs by the U.S. Air Force and U. S. Marine Corps. (Photo: Douglas Ripley)

Seven students from the Young Women's Leadership School in New York City's Harlem assist in various aspects of the Mill Creek stream restoration project at Eglin Air Force Base, Florida. This program is part of an ongoing effort to restore streams on the Eglin Reservation that are home to the endangered Okaloosa Darter. (Photo: Jerron Barnett, U.S. Air Force)

In contrast to ground maneuvering activities, air-to-ground missions are capable of mimicking natural disturbance regimes in some ecosystems. This is particularly true when active bombing and gunnery ranges exist within fire-evolved ecosystems like prairies, savannas, and some wetland types. Aerial bombing and gunnery ranges used by fighter and bomber aircraft, and artillery and mortar gunnery from ground-based weapon systems can provide the ignition sources in fire-evolved ecosystems. Some of air-to-ground ranges that date back to pre-World War II contain remnant fire-maintained plant communities no longer found in the surrounding fire suppressed landscape.

An impact area on Avon Park Air Force Range in central Florida known to receive over a thousand high explosive rounds and several thousand non-explosive rounds strikes annually (Delany et al. 1999) has created a long history of frequent mission-caused wildfires that in turn have provided some of the variation inherent under a natural fire regime. Ordnance-ignited wildfires on this impact area are frequent (>1/yr), may occur year-round, and have occurred since the 1940s. As a result, the vegetation within the impact area has never been fire suppressed. Despite bomb craters created by high-explosive munitions, portions of the impact area with native vegetation support endangered birds, numerous rare plant populations, and some of the highest natural-quality examples of fire-maintained plant communities found in central Florida (Orzell 1997). Similar native species-rich plant communities, often containing enclaves of rare plants, have been recorded elsewhere in or near active air-to-ground impact areas in the southeastern United States (Peet and Allard 1993, Sorrie et al. 1997).

The influence of anthropogenic disturbance, in particular that associated with land management activities (forestry, grazing, etc.) and the military mission on ecosystem-level processes, is also pertinent when discussing disturbance effects. The interactive effects of ecological disturbance regimes and human disturbances (resulting from land management and military activities) also need to be considered, but few studies have examined these interactions. A study conducted by Dilustro et al. (2002) at Fort Benning, Georgia, in the Fall Line Sandhills ecoregion found significant interactions with other activities. In particular, forestry management practices with heavy mechanized training sites were found to favor pine dominance, and open-site, successional or fire tolerant ground cover plant species (Dilustro et al. 2002).[2]

Restoration of long-leaf pine forests and red-cockaded habitat at Fort Stewart, Georgia. These scenes show various stages of the prescribed burning process and the final result of a mature long-leaf pine forest providing excellent habitat for the endangered red-cockaded woodpecker. (Photo: U.S. Army)

## Management Implications

Management should be guided by ecological principles and approximate as near as possible ecologically appropriate disturbance regimes, while never neglecting the overarching need to support the military mission. In many cases, restoration of natural disturbance regimes has a positive long-term effect (Van Lear et al. 2005). Special care must be taken, of course, if there are threatened and endangered species involved. Restoration of ecological communities that have long been modified by anthropogenic activities or invasion of exotic species may not necessarily have the intended result or immediately positive consequences. For example, Varner et al. (2000) found that re-introduction of fire to a longleaf pine forest after many years of fire exclusion and organic matter buildup led to an unforeseen high mortality of large longleaf pines. In areas long degraded by fire suppression, repeated burns may be necessary (Heuberger and Putz 2003). Another challenge for land managers is simulating natural disturbances on small parcels of land in a highly fragmented and human-dominated landscape—although one advantage of military installations may be that fragmentation and development are less of a problem than on surrounding, non-military lands. Incorporating disturbance regimes that approximate historic natural disturbances into management schemes should help to improve and maintain structure and function of the disturbance-dependent communities. Doing so, however, may be controversial and demands a great deal of planning and forethought.

**NOTES**

1. For more on ITAM, see http://www.sustainability.army.mil/function/training_itam.cfm.

2. For more on the Fall Line Sandhills ecoregion and the Department of Defense's interest in it, see http://www.serdp.org/research/CS/CS-1302.pdf.

## Literature Cited


Abrahamson, W. G. 1984. Post-fire recovery of Florida Lake Wales Ridge vegetation. *American Journal of Botany* 71:9–21.

Beatty, S. W. 1984. Influence of microtopography and canopy species on spatial patterns of forest understory plants. *Ecology* 65: 1406–1419.

Beckage, B. and W. J. Platt. 2003. Predicting severe wildfire years in the Florida Everglades. *Frontiers in Ecology and the Environment* 1:235–239.

Boice, L. P. 1997. Defending our nation and its biodiversity. *Endangered Species Bulletin* 22 (1):4–5.

Bratton, S. P. 1976. Resource division in an understory herb community: responses to temporal and microtopographic gradients. *American Naturalist* 110:679–693.

Brown, James H. and Mark V. Lomolino. *Biogeography* (2d ed.), Sunderland, Massachusetts: Sinauer Associates, 1988.

Clark, J. S. 1991. Disturbance and population structure on the shifting mosaic landscape. *Ecology* 72: 1119–1137.

Clements, F. E. 1937. Nature and structure of the climax. *Journal of Ecology* 24:252–284.

Collins, B. S. and S. T. A. Pickett. 1982. Vegetation composition and relation to environment in an Allegheny hardwoods forest. *American Midland Naturalist* 108:117–123.

Connell, J. H. 1978. Diversity in tropical rain forests and coral reefs. *Science* 199: 1302–1310.

Cowles, H. C. 1899. The ecological relations of vegetation on the sand dunes of Lake Michigan. I..Geographical relations of the dune floras. *Botanical Gazette* 27:95-117, 167–202, 281– 308, 361–391.

A serious disturbance. Strip mines (often called "surface mines" by their practitioners) are among the most visible of human-caused environmental disturbances. This one, in southern Maryland, formerly was devoted to pasture and row crops. (Photo: Fred Powledge)


Delany, M. F., P. B. Walsh, B. Pranty, and D. W. Perkins. 1999. A previously unknown population of Florida Grasshopper Sparrows on Avon Park Air Force Range. *Florida Field Naturalist* 27(2):52–56.

Demarais, S., D. J. Tasik, P. J. Guertin, and E. Jorgensen. 1999. Disturbances associated with military exercises. Pages 385–396. in L. R. Walker (eds.). *Ecosystems of the World 16: Ecosystems of Disturbed Ground*. (New York: Elsevier, 1999).

Dilustro, J. J., B. S. Collins, L. K. Duncan, and R. R. Scharitz. 2002. Soil texture, land-use intensity, and vegetation of Fort Benning upland forest sites. *Journal of the Torrey Botanical Society* 129(4):289–297.

Foster, D., D. H. Knight and J. F. Franklin. 1998. Landscape patterns and legacies resulting from large infrequent natural disturbances. *Ecosystems* 1:497–510.

Gilliam, F. S. and W. J. Platt. 2006. Conservation and restoration of the *Pinus palustris* ecosystem. *Applied Vegetation Science* 9:7–10.

Heuberger, K. A. and F. E. Putz. 2003. Fire in the suburbs: ecological impacts of prescribed fire in small remnants of longleaf pine (*Pinus palustris*) sandhill. *Restoration Ecology* 11:72–81.

Keeley, J. E., and P. H. Zedler. 1978. Reproduction of chaparral shrubs after fire: A comparison of sprouting and seeding strategies. *American Naturalist* 99:142–161.

Kercher, S.M., and J.B. Zedler, 2004. Multiple disturbances accelerate invasion of reed canary grass (*Phalaris arundinacea* L.) in a mesocosm study. *Oecologia* 138:455–464.

Kesler, T. R., L. C. Anderson, S. M. Herman. 2003. A taxonomic re-evaluation of Aristida stricta (Poaceae) using anatomy and morphology. *Southeastern Naturalist* 2:1–10.

Lathrop, E. 1982. Recovery of perennial vegetation in military areas. Pages 269–276 in R. H. Webb and H. G. Wilshire, (eds.). *Environmental effects of off-road vehicles: impacts and management in arid regions*. (New York: Springer-Verlag, 1982).

Lillie, T. H. and J. D. Ripley. 1998. A strategy for implementing ecosystem management in the United States Air Force. *Natural Areas Journal* 18(1): 73–80.

Menges, E. S. and P. F. Quintana-Ascencio 2003. Modeling the effects of disturbance, spatial variation, and environmental heterogeneity on population viability of plants. Pages 289–311. in C. A. Brigham and M. W. Schartz (eds.), *Population viability in Plants. Ecological Studies*, Vol 165. (Berlin: Springer-Verlag, 2003).

Milchunas, D. G., K. A. Schultz, and R. B. Shaw. 1999. Plant community response to disturbances by mechanized military maneuvers. *Journal of Environmental Quality* 28:1533–1547.

Mulligan, M.K., L. K. Kirkman, and R. J Mitchell. 2002. *Aristida beyrichiana* (wiregrass) establishment and recruitment: implications for restoration. *Restoration Ecology* 10:68–76.

Myers, R. L. 1985. Fire and the dynamic relationship between Florida sandhill and sandpine scrub vegetation. *Bulletin Torrey Botanical Club* 112:241–252.

Norden, A. H. and L. K. Kirkman. 2004. Factors controlling the fire-induced flowering response of the federally endangered *Schwalbea americana* L. (Scrophulariaceae). *Journal of the Torrey Botanical Society* 131:16–22.

Outcalt, K.W. 1994. Seed production of wiregrass in central Florida following growing-season prescribed burns. *International Journal of Wildland Fire* 4:123–125.

Orzell, S. L. 1997. Natural areas inventory of Avon Park Air Force Range, in Polk and Highlands counties, Florida. Unpublished report. Florida Natural Areas Inventory, Tallahassee, Florida.

Paine, R. T., M. J. Tegner, and E. A. Johnson. 1998. Compounded perturbations yield ecological surprises. Ecosystems 1:535–545.

Restoration work at the Warren Grove Air National Guard Range, New Jersey, where Drexel University has conducted numerous experiments to determine the most effective treatment to restore degraded vegetation on the range. (Photo: Douglas Ripley)

Peet, R. K. 1993. A taxonomic study of *Aristida stricta* and *A. beyrichiana*. *Rhodora* 95:34.

Peet, R. K. and D. J. Allard. 1993. Longleaf pine vegetation of the southern Atlantic and eastern Gulf coast regions: a preliminary classification. *Proceedings, Tall Timbers Fire Ecology Conference* 18: 4–81.

Pickett, S. T. A., and P. S. White. 1985. *The ecology of natural disturbance and patch dynamics.* (New York: Academic Press, 1985).

Platt, W. J. 1999. Southeastern pine savannas. Pages 23–51 in R. C. Anderson, J. S. Fralish, and J. M. Baskin, editors. *Savannas, barrens, and rock outcrop plant communities of North America.* (Cambridge, U.K.: Cambridge University Press, 1999).

Platt, W. J. and J. H. Connell. 20003. Natural disturbances and directional replacement of species. *Ecological Monographs* 73(4):507–522.

Platt, W. J., B. Beckage, R. F. Doren, and H.H. Slater. 2002. Interactions of large-scale disturbances: prior fire regimes and hurricane mortality of savanna pines. *Ecology* 83:1566–1572.

Prose, D. V. 1985. Persisting effects of armored military maneuvers on some soils in the Mojave Desert. *Environment, Geology, and Water Sciences* 7:163–170.

Quist, M. C., P. A Fay, C. S. Guy, A. K. Knapp and B. N. Rubenstein. 2003. Military training effects on terrestrial and aquatic communities on a grassland and military installation. *Ecological Applications* 13(2): 432–442.

Ripley, J. D. and M. Leslie. 1997a. Conserving biodiversity on military lands. *Federal Facilities Environmental Journal* 8(2): 93–105.

Ripley, J. D. and M. Leslie. 1997b. Defense Department's biodiversity initiative. *Endangered Species Bulletin* 22 (1):6–7.

Robertson, K.M. and W.J. Platt. 2001. Effects of multiple disturbances (fire, hurricane) on epiphyte-host tree associations in a subtropical forest, Florida, U.S.A. *Biotropica* 33:573–582.

Schroder, A., L. Persson, and A. M. De Roos. 2005. Direct experimental evidence for alternate stable states: A review. *Oikos* 110:3-19.

Schuyler, A. E. 1999. Defining nature and protecting rare plants. *Ecological Restoration* 17(1&2): 5–7.

Severinghaus, W. D. and W. D. Goran. 1981. Effects of tactical vehicle activity on the mammals, birds, and vegetation at Fort Lewis, Washington. U. S. Army Corps of Engineers Technical Report N-116. Champaign, Illinois.

Sheridan, P. M., S. L. Orzell, and E. L. Bridges. 1997. Powerline easements as refugia for state rare seepage and pineland plant taxa in *The Sixth International Symposium on Environmental Concerns in Rights-of-Way Management*. J. R. Williams, J. W. Goodrich-Mahoney, J. R. Wisniewski and J. Wisniewski, eds. (Oxford: Elsevier Science, 1997).

Slocum, M. G., W. J. Platt, B. Beckage, B. Panko, and J. B. Lushine. 2007. Decoupling natural and anthropogenic fire regimes; a case study in Everglades National Park, Florida. *Natural Areas Journal* 27:41–55.

Smith, M. A., M. G. Turner and D. H. Rusch. 2002. The effects of military training activity on eastern lupine and Karner blue butterfly at Fort McCoy, Wisconsin. *Environmental Management* 29:102–115.

Sorrie, B., B. V. Eerden, M. J. Russo 1997. Noteworthy plants of Fort Bragg and Camp Mackall, North Carolina. Castanea 64:239–259.

Sousa, W. P. 1984. The role of disturbance in natural communities. *Annual Review of Ecology and Systematics* 15: 353–391.

Sparks, R. E. 1998. Need for ecosystem management of large rivers and their floodplains. *BioScience* 45:168–182.

Suding, K.N., K.L. Gross, and G.R. Houseman. 2004. Alternative states and positive feedbacks in restoration ecology. *Trends in Ecology and Evolution* 19:46–53.

Sparks, R. E., P. B. Bayley, S. L. Kohler and L. L. Osborne. 1990. Disturbance and recovery of large floodplain rivers. *Environmental Management* 14:699–709.

Van Lear, D. H., W. D. Carroll, P. R. Kapeluck and R. Johnson. 2005. History and restoration of the longleaf pine grassland ecosystem: implications for species at risk. *Forest Ecology and Management* 211: 150–165.

Varner, J. M., J. S. Kush and R. S. Meldahl. 2000. Ecological restoration of an old-growth longleaf pine stand utilizing prescribed fire. Pages 216–219. in W. Keith Moser and Cynthia F. Moser (eds.). Fire and forest ecology: innovative silviculture and vegetation management. *Tall Timbers Fire Ecology Conference Proceedings,* No. 21. Tall Timbers Research Station, Tallahassee, Florida.

Vertegaal, P. J. M. 1989. Environmental impact of Dutch military activities. *Environmental Conservation* 16:54–64.

Wall, Diana H., Paul V.R. Snelgrove, and Alan P. Covich, Conservation Priorities for soil and sediment invertebrates in Michael E. Soulé and Gordon H. Orians 2001), eds., *Conservation biology: Research priorities for the next decade.* (Washington: Island Press, 2001).

Watt, A. S. 1947. Pattern and process in the plant community. *Journal of Ecology* 35:1–22.

Wilson, S. D. 1988. The effects of military tank traffic on prairie: a management model. *Environmental Management* 12:397–403.

Zedler, J.B. and S. Kercher. 2004. Causes and consequences of invasive plants in wetlands: Opportunities, opportunists, and outcomes. *Critical Reviews in Plant Sciences* 23:431–452.

CHAPTER NINE

# Show Me the Money

## Funding Sources for Biodiversity Conservation

By Fred Powledge, writer and editor

The United States spends lots of dollars on the environment at military installations—some $42 billion in the past ten years. Even considering that this sum is spread over almost 30 million acres, that's a lot of money. But the people who manage those acres are rarely heard to complain that their projects are overburdened with funding.

On the contrary: military land managers are always scrambling for more funds with which to conserve biodiversity. There's hardly ever enough in the budget to conduct the inventories, swat the invasive species, protect the threatened and endangered plants and animals, write, update, and implement the Integrated Natural Resources Management Plans, administer the Environmental Management System, keep up to date with (and execute) the growing number of rules, regulations, and executive orders that govern environmental protection on military bases—*and* keep pace with the latest findings and discoveries in environmental science, explain all they have learned to their base commanders, civil works engineers, and trainers, and, while they're doing all this, support the main mission of the military, which is to train people to win wars.

Interest in and understanding of the need to conserve biodiversity have grown in recent years as scientists, the public, and policymakers have probed deeper into the interconnectedness of nature and natural processes, as well as the growing public awareness of climate change and its influence on life. This has come at the same time that the military's main mission—fighting a war—has become even more all-important. Thomas Warren, chief of environmental programs at Fort Carson, Colorado, has a reputation for being one of the most innovative of dollar-finders. But, he recently commented, the coordinated suicide attacks on American targets on 11 September 2001 had changed all that: "Most innovative funding sources have virtually dried up since the implementation of the global war on terrorism over the last five years," he said. Many other installations' natural resources managers would agree with his assessment.

To supplement their conservation budgets, managers have found it necessary to come up with innovative ways of finding money, and some of them have become quite expert at it. Kyle Rambo, the director of the conservation division at Naval Air Station Patuxent River in Maryland, does a lot of his work in coordination with the community surrounding his base (Rambo's operation is discussed in greater detail in chapter 10, *Beyond the Fenceline*.) And much of the money for his conservation operations comes from organizations outside the base.

"Remember back to our smoking days?" Rambo asked. "What's the cheapest brand of cigarette out there? It's OP's—'other people's.' The best kind of money? Other people's money."

With that rule in mind, and with the knowledge that biodiversity conservation must proceed from a base of knowledge about what's out there to be conserved, Rambo has produced detailed inventories of species on his base. "We've invested a lot of money in inventory," he said. "So we know what we have." The database shows where endangered species are, where archaeological sites are, where water, sewer, and electricity lines run—all of which helps Pax River plan future expansion. But the inventory also serves as a magnet for scientific researchers, who will pay with in-kind expert research for having access to military installations to conduct their information gathering. And the researchers' findings go back into the database, so the inventory keeps growing.

"We don't ever pay a dime for research. There's plenty of people with research questions out there; we provide the laboratory, the space, and the opportunity.

We provide human-wildlife interactions that are interesting to study and have other people pay to come in and do our work for us.

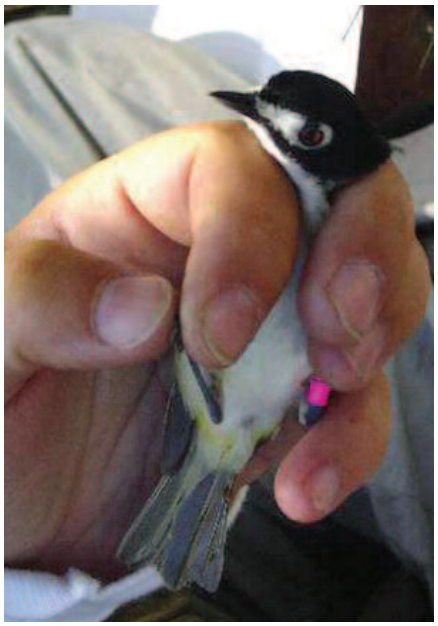
"We can offer access to the base, in a controlled environment and in an area with security—they can leave equipment out there. Cornell [University] is putting out automated listening devices, tracking big bird migrants and tracking migrations. We've got the land there; we've got controlled access. The researchers can then link what they find to on-the-ground bird researchers and say 'We know these species arrived on this day because we caught them in our nets this day.' They can add this information to the data from the listening devices, and it compounds the benefits of their research."

Pax River's own outlay for such services is small and consists mostly of staff time. "And the other people are bringing in money," says Rambo.

## Other People's Energy, Too

Rambo uses OPE (other people's energy) as well as their funds on a lot of his conservation work. Invasive species are a problem at Pax River, as elsewhere, but the base doesn't have a huge budget for controlling them. So the base invited Eagle Scouts to come to the base and pull up invasive foliage. The base and its native species obviously benefit, but so do the Scouts: they win points for their service projects. And the installation wins some friends. (Pax River also enjoys a steady stream of environmental help from sailors who are convicted of misdemeanors in the on-site federal magistrate's court and who prefer community service to, as Rambo puts it, "cleaning toilets.")

At Fort McCoy, Wisconsin, David Beckmann is the natural resources manager for an artillery and maneuvering range that spans some 60,000 acres. The base mobilized troops during Operation Desert Shield and Storm, Desert Fix, and most



Monitoring to assess the impacts of military training on the endangered Black capped vireo and Golden-cheeked warbler at Fort Hood, Texas, is accomplished through a cooperative agreement with The Nature Conservancy. (Photo: U.S. Army)

### What DoD spends on the environment

**According to its Fiscal Year 2006 report to Congress, the Department of Defense in that year obligated approximately $4.1 billion for environmental activities at more than 425 military installations. The breakdown for environmental expenditures:**

- **$1.5 billion for compliance with applicable federal, state, and local environmental rules**
- **$1.4 billion for environmental restoration at active and formerly active military sites**
- **$568.2 million for activities required by the Base Realignment and Closure Act**
- **$261.3 million for environmental technology**
- **$204.1 million for conservation (natural and cultural resources programs)**
- **$125.2 million for pollution prevention**

**Sources: Defense Environmental Programs: Annual Report to Congress: Fiscal Year 2006. https://www.denix.osd.mil; Environmental Compliance: Better DoD Guidance Needed to Ensure That the Most Important Activities Are Funded, GAO-03-639, June 17, 2003. http://www.gao.gov/docsearch/abstract.php?rptno=GAO-03-639.**

recently for the war in Iraq. The base's mission changed dramatically after 9/11; before, it was most active as a summertime training station for Army National Guard and Reserve troops, leaving the winter months for conservation efforts. "Now," says Beckmann, "it's pretty much constant."

Where does Beckmann look for funds? "We try to rely a lot on the DoD," he says. "Even before 9/11, we never were guaranteed any type of funds. And then, especially after 9/11, it got even tighter." But the fort's conservationists kept searching for money. "The DoD's Legacy Resource Management Program[1] is an important one that we had worked with," says Beckmann, "and also the National Fish and Wildlife Foundation[2]. We got grants from them... to really get our invasive species program off the ground. So that was a big source there." There are other sources: Beckmann does habitat restoration with funds obtained from the Wisconsin Department of Natural Resources' turkey stamp program; funds have come from Whitetail Unlimited and the Rough Grouse Society and are used to support the fort's hunting and fishing programs.[3]

## Friendly Organizations

As will be seen in chapter 10, successful military land managers are wizards at forging partnerships with local, regional, and national organizations both private and public. These partnerships almost always produce sources of funding—or at least in-kind assistance that reduces the base's burden for conservation financing. But the Department of Defense is a good supplier of conservation money itself. As David Beckmann pointed out, the Legacy program itself is a valued source of funding. In early 2007, DoD announced the release of more than $7 million in Legacy funding for 69 projects.

Partnerships of another kind produce savings that allow conservation managers to free up other funds for their projects. These are the product of the Cooperative Ecosystem Studies Units (CESU), which provide cooperative agreements with colleges and universities to conduct multidisciplinary research in partnership with federal and state agencies. Although the overall program is overseen by the Department of the Interior, one of the participating agencies is the Department of Defense.

"This is a valuable partnership for DoD," says Jane Mallory, natural resources specialist in the Legacy headquarters, "because there's an agreement [for the participating universities] to hold overhead cost 'way below what otherwise would be charged. Instead of 40 percent or so of a project's budget going to university overhead, CESU universities agree to keep overhead down to 17.5 percent. This works out great for DoD in that more of our project money actually goes to the study at hand."[4]

Another community resource that can help chase down funding is a "conservation partnering team," usually comprising representatives of the installation itself, the local U.S. Fish and Wildlife Service (USFWS) field office, and state fish and game field office. Steve Helfert, who is USFWS's liaison with DoD and who is based in Albuquerque, New Mexico, says participants in these teams frequently are able to suggest, and find, sources of additional funding for base biodiversity conservation projects.[5]

Helfert is a strong advocate of seeking funding outside DoD's usual channels, or even those of the military's favorite partners, and to tailor those searches to seeking grants for specific projects. "There's never enough funding from the mil-

### DoD Legacy Resource Management Program

**Congress established the Legacy Resource Management Program in 1990 "to provide financial assistance to DoD efforts to preserve our national and cultural heritage." A guide to the program states: "The program assists DoD in protecting and enhancing resources while supporting military readiness. A Legacy project may involve regional ecosystem management initiatives, habitat conservation management efforts, development of historic contexts, archaeological investigations, invasive species control, Native American consultations, archaeological collections management protocols, and/or monitoring and predicting migratory patterns of birds and animals."**

**When originally established in Fiscal Year 1991, the Legacy Program provided funding for specific projects on individual installations. Now, however, the guidelines prohibit such "installation-specific" projects unless they are part of a larger demonstration project that can be applied to many installations.**

**Three principles guide the Legacy Program: "stewardship, leadership, and partnership . . ." For details on the program, including information on how to submit proposals for project funding, see http://www.dodlegacy.org/Legacy/intro/guidelines.aspx.**

Left: Perimeter fence at Savannah Air National Guard Base, Georgia. Some natural resources projects can be justified also on the basis of security needs. For example, clearing of undesirable vegetation along the base perimeter is often funded using security funds, rather than environmental ones, because of the importance of maintaining an open roadway along perimeter fences for security purposes. (Photo: Douglas Ripley)

Below: Research on the Lower Keys Marsh Rabbit (*Sylvilagus palustris hefneri*) at Naval Air Station Key West, Florida, must surely be one of the more interesting cases of using "Other People's" money to finance research for endangered species on military lands. Mr. Hugh Hefner, of *Playboy* magazine fame, financed research on this endangered species provided that the university zoologist doing the research named the rabbit after him. (Photos: Douglas Ripley)


itary chain of command, or the Fish and Wildlife Service, or the states or anybody," he says. "But there are grants available—again, through the Fish and Wildlife Service, through [the U.S. Department of Agriculture], through other federal entities, through quasi-governmental organizations like the National Fish and Wildlife Foundation. The Nature Conservancy sometimes will contribute funds as well as in-kind help." The innovative military land manager, he said, will keep "a shopping list of those entities, and a record of their websites, and how to contact them—and how to apply to them for grants. There are all sorts of opportunities."

All the installation natural resources managers who were interviewed on the subject of funding agreed on two basic tenets: (1) There isn't enough of it, and there's not likely to be enough of it in the future; (2) There is money out there, waiting for an imaginative and resourceful manager to pursue and obtain it.

**NOTES**

1. See http://www.dodlegacy.org/Legacy/intro/about.aspx.
2. http://www.nfwf.org.
3. For more about hunting, fishing, and other multiple use programs, see chapter 5.
4. From 2001 to 2006, the Department of Defense funded 57 projects, totaling $6.3 million, through CESU. DOD estimates that this has provided "cost avoidance" of about $2 million over the four-year period. For more about CESU, see http://www.cesu.psu.edu.
5. There's more on Helfert's ideas about partnerships in chapter 10.

CHAPTER TEN

# Beyond the Fenceline
## Partnerships with Surrounding Communities

By Fred Powledge, writer and editor

Many of America's military installations sprung up in the middle of nowhere, surrounded by forests, scrublands, prairie, or desert. Musket balls and artillery shells could fall where they may; the assertive purr of propeller-driven airplane engines disturbed few humans. But then came population growth. Towns, cities, and suburbs grew up around the installations, typically to serve the needs of the military community itself. As development edged closer to the military fenceline, both base commanders and adjacent civilians started using the word "encroachment." The commanders realized that they needed partnerships with members of the civilian community, if for no other reason than a desire to keep the peace at home, as well as around the world.[1]

The need for partnerships became even more apparent as the modern environmental era blossomed. Civilians, scientists, elected politicians, and military commanders learned that the lands they controlled were treasuries of biological diversity, and that it was legally and ethically imperative that the diversity be protected. Some of that land even housed species that elsewhere had been trampled to the point of extinction. The commanders and civilians more fully appreciated, too, that a military installation's environmental obligations did not end at the fenceline—that whatever a base did to its air, water, foliage, and animals affected the larger ecosystem. Thus it became essential that an installation's land manager think beyond the fenceline, and that the manager seek out non-military partners to help perform what had become an increasingly complex mission.

Public involvement in an installation's environmental life is vital. A basic document on the subject, *Leader's Guide to Environmental Public Involvement*, published in February 2005 as part of the Army Public Involvement Toolbox[2], makes that clear. The guide dismissed any notions that "public involvement" is just a synonym for "public relations":

> In making use of public involvement, we are often trying to influence stakeholders so that they understand and accept an Army approach to an environmental concern or a decision based on Army-unique requirements. However, we must remember that the leader's definition of influence includes involvement. The objective of public involvement is not necessarily to convince others that we are right. Instead, public involvement should provide stakeholders with opportunities to provide input about issues that will improve our decisions. . . .
>
> By including stakeholders in our decision-making processes, and listening to their input, we give them a reason to become involved with us in a positive way. Over time, that involvement helps build relationships upon which trust is based, and trust is a basic bond of leadership.

And furthermore, says the guide, involving the community with regular two-way communication is a great way to head off conflicts and hard feelings. The 36-page publication sets forth detailed and useful suggestions for encouraging the community's participation. Some of them are:

- First, build a strategic planning team, made up of representatives of the commander; the public affairs department; a specialist in risk communications; environmental managers, and the medical department. This team will guide the public participation process.
- Assess the community's concerns and interests and determine how its members get their information.
- Identify the key stakeholders in community-military relations.
- Survey the community, through interviews, telephone surveys, and/or focus groups.

Public meetings at Fort Belknap Indian Reservation, Montana, sponsored by the Montana Air National Guard. Public meetings are an essential tool to improve military-community cooperation. (Photo: Douglas Ripley)

- Communicate with the public, through notices, comment periods, meetings, and a publicly available administrative record.
- Along the way, provide speakers to inform the public; deal with the media; operate websites.

## Plenty of Examples

There are abundant examples of effective military-community cooperation. Kyle Rambo, whose work at Naval Air Station Patuxent River[3] was described in chapter 9, has much experience with the subject; his installation has gone through three Base Realignment and Closure (BRAC) processes (and came out a winner each time) in a community that is highly economically dependent on the Navy. "We're responsible for 80 percent of the county's [St. Mary's County, Maryland] economy," he says. "The Navy pumps $2 billion a year into the local community." Furthermore, Pax River has become the leading agency in its home county for environmental information and activity. Other conservation agencies "call us with questions of a technical nature," he says.

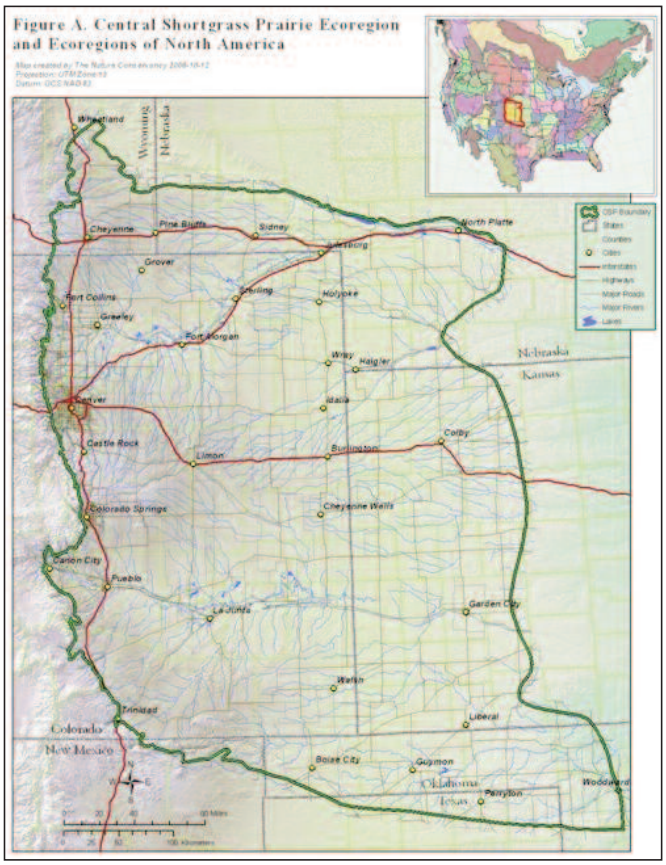
Still, when public hearings were held a few years ago on the base's future in the BRAC process, Rambo was understandably nervous, even though community leaders (many of them retired Pax River officers) had mounted an intense lobbying campaign to keep the base open. When county officials called for public comment at one of the meetings, a representative of the Sierra Club rose to his feet. Rambo listened apprehensively. "He said 'I'd just like to be on the record as saying if St. Mary's County, in terms of development and environment in this county, did outside the gate as well as Pax River does on this Navy base, we would be a lot better.'" (Rambo said his first thought was, "'Did anybody get that on film?' You can't buy that kind of support.")

Buffering has become an important buzzword in military-community relations. At most installations, civilian development and population growth make it highly unlikely that the base itself can be enlarged, even though modern weaponry and training techniques need expanded space. Thus was born the buffering idea.[4] The

### What are "risk communications"?

**The Army's guide to public participation recommends that a specialist in "risk communications" be part of the basic strategy team. The guide defines risk as "environmental harm or adverse health effects that could result from human activities or exposure to the environmental conditions at a site." The guide goes on to say that "Risk communication is at the heart of effective public involvement," and it's a factor in almost every decision that involves air, land, or water. Dealings with the community cannot avoid frank discussions of risk; the public's trust of the military installation is at stake.**

Military installations in Colorado, such as Fort Carson and the Air Force Academy, have been important participants in the Central Shortgrass Prairie Ecoregion Initiative. Such cooperative partnerships provide an excellent opportunity for contributing to conservation on an ecoregional scale while simultaneously enhancing the ability of the military to use its lands to accomplish its primary mission. (Photo: Central Shortgrass Prairie Ecoregional Initiative)




Army led this movement in the nineteen-nineties by acquiring conservation easements on lands around Fort Bragg, North Carolina, that were suitable habitat for the red-cockaded woodpecker.[5] The Army eventually expanded and formalized this strategy into the Army Compatible Use Buffer Program (ACUB).

The Marine Corps followed soon after by acquiring easements on land adjacent to its Marine Corps Base Camp Lejeune, also in North Carolina. In 2003, the Department of Defense broadened the buffering idea to allow military departments (in the words of a DOD document) to:

> enter into an agreement with a state or private entity to limit development or property use that is incompatible with the mission, to preserve habitat, or to relieve anticipated environmental restrictions that would restrict, impede, or interfere with military training, testing, or operations on the installation.[6]

Cooperative partnerships have grown in subsequent years to the point where they are everyday instruments in the military land manager's toolbox. The Fort Carson Regional Partnership is helping to protect what remains of Colorado's short-grass prairie and the flora and fauna that inhabit it. The Coastal Georgia Private Lands Initiative was established by Fort Stewart and Hunter Army Airfield and their partners to protect some 120,000 acres surrounding the base. And a well-known and celebrated conservation partnership is the Northwest Florida Greenway, a consortium of military, government, and nonprofit organizations that seeks to protect a hundred-mile-long protected corridor of valued biodiversity that connects Eglin Air Force Base and the Apalachicola National Forest. The area has been identified as one of the six most biologically diverse regions in the United States. Again, The Nature Conservancy is an active promoter of the partnership.[7]

## Partnerships

At their best, efforts at public participation, conservation easements, and memoranda of understanding are examples of effective partnerships between the military and that part of the public that worries about conserving biodiversity. In such cases, "the public" can mean a small but concerned group of citizens who live near an installation, or it can be a nationally known nonprofit organization that's interested in environmental protection—or it can be pretty much anything in between. There are many examples of partnerships currently in operation that both protect the environment and further the military mission.

Partnerships may have become almost commonplace in the military's treatment of biodiversity conservation today, but the services have not always embraced the idea of working with outside organizations focusing on environment—or they have agreed with the idea in theory but done less in practice. In a report on endangered species management to congressional requesters in 2003, the General Accountability Office found:

> DoD and other federal land managers have taken some steps to implement interagency cooperative efforts to manage endangered species on a regional basis, but the extent to which they are using this approach for military training ranges is limited. Federal land managers recognize that cooperative management of endangered species has several benefits, such as sharing land-use restrictions and resources and providing better protection for species in some cases. The Departments of the Interior and Agriculture have issued policies, and DoD has issued directives to promote cooperative management of natural resources. They have also outlined specific actions to be taken—such as identifying geographic regions for species management and forming working groups. However, follow-through on these actions has been limited, without many of the prescribed actions being implemented. A few cooperative management efforts have been taken but were generally in response to a crisis—such as a species' population declining.

Miles of strong fence keep military bases and surrounding neighbors separate (in this case NAS Patuxent River and St. Mary's County, Maryland). But for conservation efforts to succeed, partnerships and communications must link both sides. (Photo: Fred Powledge)

Botanists from the Smithsonian Institution observing the field research conducted by scientists from Drexel University of the federally-listed Knieskern's beaked-rush at the Warren Grove ANG Range, New Jersey. The DoD has obtained invaluable scientific data and advice through cooperative agreements with universities and other public and private scientific institutions. (Photo: Douglas Ripley)

> . . . A strategy that includes a systematic methodology to identify opportunities for cooperative management efforts, funding sources, science and technology sources, and goals and criteria to measure success would facilitate federal land managers sharing the burden of land-use restrictions and limited resources, and potentially help avoid exacerbating constraints on training at affected military installations.[8]

GAO said there were several reasons for this lack of cooperation: Federal agencies were not all that good at sharing information; there were lots of policies but not enough follow-through; land managers sometimes had different thoughts about priorities for endangered species.

Today there's a vastly changed attitude. Military commanders eagerly seek out the expertise of skilled partners, both within and outside of government. The agency that's probably at the top of everyone's list is the U.S. Fish and Wildlife Service (USFWS), a bureau in the Department of the Interior. USFWS is one of the two federal agencies responsible for managing the Endangered Species List, and so it is in constant demand for consultation by military land managers. Jane Mallory, the natural resource specialist at DOD's Legacy Resource Management Program, lists the Fish and Wildlife Service as a sterling example of a successful partnership. Asked to define such a collaboration, she said:

> There are several common themes that always come up with successful partnerships. One of them is to provide additional resources. It also enhances available expertise. It builds a network based on trust and teamwork. It facilitates sharing of information and nurture of natural resources.
>
> So with these goals in mind, of the successful partnerships we've had, the first one on my list is U.S. Fish and Wildlife Service. But we also have successful partnerships with other agencies—Bureau of Land Management, the Forest Service.

Among nongovernmental agencies, Mallory puts The Nature Conservancy at the top of a lengthy list that includes NatureServe.

Many partnerships stand out at the more local level:

**THE ONSLOW BIGHT CONSERVATION INITIATIVE,** a collaborative forum that seeks to protect environmentally sensitive terrain and wetlands around Marine Corps Base Camp Lejeune (**http://www.cooperativeconservationamerica.org/viewproject.asp?pid=727**);

**THE GULF COASTAL PLAIN ECOSYSTEM PARTNERSHIP,** which seeks to preserve one million acres in Alabama and Florida (**http://www.cooperativeconservationamerica.org/viewproject.asp?pid=544**); and,

**THE SONORAN DESERT ECOSYSTEM INITIATIVE,** which protects the desert ecosystem in a 55-million-acre area in Arizona, California, and the Mexican states of Sonora and Baja California Norte (**https://www.denix.osd.mil**).

The Sonoran initiative, writes DOD, is "landscape in scale and collaborative in nature," and focuses on three connected components:

- Monitoring the ecosystem and coordinating management,
- Biodiversity management that is tailored to specific sites "and yet provides model lessons to apply to other sites . . . across the region", and
- Management of invasive plants, which are a major threat to the desert ecosystems.

There are many other excellent examples of productive partnerships (see **https://www.denix.osd.mil**). These include collaborations between military land managers and Indian tribes. (For a document concerning environmental decision mak-

ing with Indian tribes, see http://www.epa.gov/Compliance/resources/publications/ej/ips_consultation_guide.pdf).

### EDUCATIONAL INSTITUTIONS

Educational institutions are important DOD partners in the effort to conserve biodiversity, as was detailed in the chapter 9 discussion of Cooperative Ecosystem Studies Units (CESU).

An example of the value of universities in partnerships may be seen at the Warren Grove Gunnery Range, a 9,416-acre Air National Guard facility situated in the New Jersey Pinelands. The Pinelands, which include the ecologically famous New Jersey Pine Barrens, form an ecosystem that historically has been characterized by periodic fires. When the gunnery range started compiling its Integrated Natural Resources Management Plan, it needed answers to the basic question: Were the range's activities (which cause a great deal of disturbance to the environment) compatible with the best biodiversity conservation methods?

Fortunately for the range, Drexel University was an eager research partner. It was a match made in heaven: Warren Grove needed conclusive scientific studies, and Drexel's Department of Bioscience and Biotechnology had dozens of students eager to do them. Drexel also had Walter F. Bien, the director of Pinelands research at the university and a native of the region.

"I guess we've done close to a dozen ecological studies since around 2000 or 2001," Bien said in an interview. "The military would tell you that they get a big bang for their buck . . ." A big part of that bang is the sheer number of Drexel students involved. "We probably have had easily close to two hundred different people and organizations in those years, so we bring a big network with us," said Bien. And the payoff is large for the students as well. "Our students will get a thesis out of some of the work they do. They contribute to the reports we give to the government in support of the INRMP. But along with that, they'll take their research a step further and do maybe a bit more comprehensive work than what was required for the military, and they present at scientific meetings, they publish—whereas a regular contractor might not be doing these kinds of things." Nor, he said, would an ordinary contractor be expected to put in the hours the students devote to their work. "For example, this young man working with me on snakes—he probably puts a lot of extra hundreds of hours in a month on his projects simply because he's trying to get a thesis out of it and he loves what he does. . . . And I learn a lot from my students, and they make me look good. The trick is having good personnel around you."

One of Bien's own specialties is the Knieskerrn's beaked-rush *(Rhynchospora knieskernii),* a federally listed threatened plant that was practically wiped out by development, but that grows happily near and within target zones at the gunnery range. Bien and his students discovered that the plant (its name means "beaked seed") actually thrives in areas that are periodically disturbed. Bien has written that "military operations, such as mechanical disturbance, ordnance delivery, and prescribed burning, appear to be providing the necessary disturbance regime required for maintaining established sites and colonizing newly disturbed sites."[9]

As a result of the Drexel group's findings on the beaked-rush and other plant and animal species, the Air National Guard and Fish and Wildlife Service are committed to long-term monitoring of biodiversity, and they plan continued research into the effects of prescribed burning on seeds and their germination.

Bien is understandably happy about Drexel's partnership with the Air National Guard. "We're very fortunate that we have evolved this relationship," he says. "We almost feel like we're family at this point. Because we practically live out there. They have been very receptive to what we have done. They work with us; we just have a very good working relationship. I guess that could work in most places, as long as the military would be receptive to that type of a partnership."

The productive partnership extends, he says, to the Fish and Wildlife Service. Because of the Drexel group's relationship with the federal agency, "we have gone on to do studies that are probably not even required by the military—like greenhouse experiments, germination experiments, survival experiments.... Again, this will help not only the military but maybe down the road will help to find out about life cycles and maybe aid in delisting a species. These are the kind of things that I'm not sure other people would be doing. That would be a very good example of the value of having a university involved."[10]

## Partnership Essentials

Military land managers who are seeking partnerships may not all enjoy the good fortune of having a Drexel University nearby. Jane Mallory feels that a successful partnership is one that brings with it additional resources—expertise, information, maybe even money—to a conservation plan. Partnerships may be established at many levels—between the installation and nongovernmental organization, or university, or other governmental agency. What's important is the collaboration that the partnerships foster. Such a collaboration produces "a network based on trust and teamwork," says Mallory, and it "facilitates sharing of information." Partnerships to avoid, she said, are those in which the potential partners "have an agenda already, or they have their minds made up [negatively] about the Department of Defense." Sometimes those mindsets can change, however: "It's exciting to people to find out that DoD does conservation and natural resources management."

It helps, say many natural resources managers, to set forth the rules of partnerships in writing. This is often done in a "cooperative agreement" or memorandum of understanding. A typical agreement would explain:

- why the agreement is necessary
- why the parties to the agreement have been selected (or have selected themselves)
- the purpose of the agreement
- the responsibilities of the agreeing parties
- financial understandings: Is any partner committing to the expenditure of funds?
- an understanding of how powers are delegated and administered, how the agreement may be modified and terminated.

An example of such an agreement, between the Department of Defense and The Nature Conservancy, may be found at **https://www.denix.osd.mil**.

Steve Helfert of the Fish and Wildlife Service (see chapter 9) is a huge fan of what he and others call "conservation partnering teams," which provide a framework for productive partnerships. A major benefit of such organizations is that its structure practically guarantees "very strong communication lines" among its members. "A typical partnering team," he said, "would be a group that would

agree to meet face-to-face, other than by telephone or e-mail. Meeting face-to-face could mean once a year, perhaps four times a year. An example would be the South Texas Natural Resource Partnership. They formally meet four times a year with a facilitator."

The South Texas group, which covers an area that contains three military installations, takes matters a step further by making sure that installation commanders are part of their process. "They say, 'We want to add an annual executive briefing to our three installation commanders, to brief them on results of the prior year: what have we been doing, what have we succeeded in, what do we continue to do, what issues there are, what solutions.'" The result, he said, is that the conservation planners remain linked "to that component of the military we call the 'operations training and range' part of the military command—the folks in uniform who basically are training our troops. It's very important to stay engaged and linked with that."

In addition to creating a more formal conservation planning process and keeping commanders involved and up to date, the teams sometimes are good sources of ideas about how to find more money for biodiversity conservation.

How inclusive should the conservation partnership teams be? Helfert thinks that's one of the first questions the team must tackle. "I would advocate that if indeed there is a conservation partnering team or one in the making, then those local folks look at their local needs. They should ask, Do we need to bring in the county, the local school district, other local governmental entities, that may want to be part of a new 'partnership'? It may still be that you have just a core group of the military, Fish and Wildlife Service, and the state natural resources agency. They may be the nucleus of that group to look at any and all particular issues and solutions. Or sometimes the solution is to bring in more local folks as stakeholders or part of the team."

Helfert said it would not be unusual for the partnering team to seek out local groups, saying "You've got something we want you to bring to the table." Such an invitation would be obvious if one of the problems facing an installation is encroachment. The partnership team needs members "who are willing to think outside the military fence line. They think, 'Aha, the answers to these issues, including encroachment, obviously are going to involve outside players; I need to put on my beyond-the-fence hat and think externally. I need to invite them in. I need to seek their wisdom, their input, if we're really going to tackle and solve this issue.'"

Who are the best potential partners (and those most likely to help financially)? Helfert is naturally biased toward his own organization, the U.S. Fish and Wildlife Service—and for good reason. USFWS devotes a great deal of its energy to holding conferences and workshops and publishing information of value to military land managers, and its name comes up constantly when military land managers are asked to name their friends. But USFWS is not a source of extensive funding. Helfert's list also includes the other large national land management agencies, such as the U.S. Forest Service. "They can bring in additional grant funds; they can bring in people on the ground. Say, they have a salamander that's endangered in the Atlantic coast area, and it's on Forest Service lands, military lands, state lands. They effectively can be a very positive partner."

The U.S. Department of Agriculture (USDA) can bring in funds under its Natural Resources Conservation Service (**www.nrcs.usda.gov/**), which formerly was known as the Soil Conservation Service. "Those USDA funds can go into helping conserve fish and wildlife, endangered species, species at risk, migratory birds;

the list is endless," says Helfert. Some of the large-scale regulatory programs of the Environmental Protection Agency can be helpful in planning and financing programs that concern water quality, watersheds, and air quality—all of which are as important on military installations as anyplace else. The Fisheries branch of the National Oceanic and Atmospheric Administration (NOAA), which is part of the U.S. Department of Commerce and co-guardian, with USFWS, of the Endangered Species Act, "is another group that we deal with, more so along the coastal areas, that can be a very good partner," said Helfert. The Bureau of Land Management is on his list, too. As for individual states: "I wish I could tell you all 50 states are equal in terms of funding and conservation. But some states are ahead of others in this respect." One way to judge state involvement is in the quality and detail of their wildlife action plans.[11]

The State of New Mexico has established partnerships with Kirtland AFB, the U.S. Army's White Sands Missile Range, and the Army National Guard's Camel Tracks Training Range to protect the threatened gray vireo. (Photo: Brian E. Small, Utah Division of Wildlife Resources)

Steve Helfert uses New Mexico as a good example of a state that has an effective partnership with the military in protecting the threatened gray vireo. Three military ranges—Kirtland Air Force Base, White Sands Missile Range, and the Army National Guard's Camel Tracks training range—now have protected areas set aside for the migratory species. "We promote this as an example of where a state has jumped out and said, 'We have the desire to conserve this bird,'" said the USFWS official. "`We need to seek input from the public, from the federal agencies, from the military, from the state agencies, from private landowners, ranchers, The Nature Conservancy, everyone out there on the landscape where this bird occurs.'"

There are good examples of effective partnerships, said Helfert, throughout the United States, and many of them are the product of conservation partnership teams. "The important thing is we all like to think it's led principally by the military because we're focusing on military land. But it also could go off the lands; it could go around the fenceline. And the leadership may change among the partners, depending on which initiative, which solution. But it's always going back to the tenet that it will benefit the military."

**NOTES**

1. For a detailed look at encroachment, see chapter 4.

2. The leader's guide may be found at http://www.asaie.army.mil/Public/IE/Toolbox/documents/final_leaders_guide_to_public_involvement.pdf. The Public Involvement Toolbox contains many links to guides, training opportunities, potential partnerships, and links to related websites. It is at http://www.asaie.army. mil/Public/IE/Toolbox/default.html.

3. See http://www.globalsecurity.org/military/facility/patuxent-river.htm.

4. For more on buffering, see chapter 4 and, at Fort Bragg, chapter 1.

5. The Nature Conservancy is a leader in securing conservation easements, which the organization defines as "a voluntary, legally binding agreement that limits certain types of uses or prevents development from taking place on a piece of property now and in the future, while protecting the property's ecological or open-space values." An agreement is signed by a landowner and an entity (unit of government, military base, or a land protection organization) that is known as a "land trust." Money may change hands, or the easement may be donated. For more on easements, see The Nature Conservancy website at http://www.nature.org/aboutus/howwework/conservationmethods/privatelands/conservationeasements/about/art14925.html.

6. https://www.denix.osd.mil.

7. http://www.nature.org/wherewework/northamerica/states/florida/preserves/art12820.html.

8. General Accountability Office, *Military Training: Implementation strategy needed to increase interagency management for endangered species affective training ranges.* September 2003 (GAO-03-976). The GAO conducted its work from September 2002 through September 2003. The report noted that written comments from DoD, Interior, and USDA "agreed on the need to improve interagency cooperation in managing for endangered species," and DoD's acting assistant deputy under secretary of defense for environment offered some "additional observations" in support of improvement. The report may be found at http://www.gao.gov/new.items/d03976.pdf.

9. Walter F. Bien, "What's the rush at Warren Grove Gunnery Range?" *Endangered Species Bulletin,* July 2006, Vol. XXXI No. 2.

10. For more on conservation at Warren Grove, see the case study that accompanies chapter 8 on disturbance regimes.

11. These relatively new plans, designed to head off declines in wildlife populations, were submitted to USFWS for approval in 2005. Implementation began the following year. Nationally, $68.5 million was appropriated in 2006 for the program. For more on the state programs, now termed "State Wildlife Action Plans," including links to individual states, see http://www.wildlifeactionplans.org.

CHAPTER ELEVEN

# Building a Strong INRMP

By Fred Powledge, writer and editor

At the basis of virtually every aspect of biodiversity conservation on military lands is The Plan—officially known as the Integrated Natural Resources Management Plan, or INRMP. It is, to the natural resources manager, the equivalent of the mariner's or flyer's chart, the foot-soldier's topographical map. The INRMP declares the installation's environmental intentions and offers a checklist of how to execute them.

Every natural resources manager interviewed for this guide spoke of the need to work from a realistic INRMP, and the willingness to correct the course if it becomes necessary.

Such a plan is necessary because of the sheer number and importance of conservation issues facing land managers today. These include, but certainly are not limited to, the evolving science of biodiversity conservation; endangered species; invasive and non-native species; funding sources; the need for reliable partnerships; the sustainable multipurpose use of resources; disturbance both natural and human-caused; the plethora of laws and regulations; encroachment by the outside world; public attitudes, and much more. A well-written INRMP takes all these components into consideration and fits them into a master plan that, in a perfect world, both protects the environment and furthers the military mission. The INRMP is more than just an organizing device: Without it, it's quite likely that everyone involved would be free to run off in separate and quite likely conflicting directions.

And there's another excellent reason for having an integrated natural resources plan: It's the law (or rather the laws, as J. Douglas Ripley points out in chapter 3). The Sikes Act of 1960, which is the premier of these laws, provides that the "Secretary of Defense shall carry out a program to provide for the conservation and rehabilitation of natural resources on military installations." The purpose of the act, named for a Florida congressman, is "the conservation and rehabilitation of natural resources on military installations; the sustainable multipurpose use of the resources, which shall include hunting, fishing, trapping, and non-consumptive uses; and, subject to safety requirements and military security, public access . . ." In 1997 the Sikes Act was amended to require that the military services write Integrated Natural Resources Management Plans in cooperation with the U.S. Fish and Wildlife Service and appropriate state agencies (usually fish and game departments). A key provision of the act was the establishment of chronologies by which components of the plans must be completed, and each plan had to be revisited and revised, if necessary, no less than every five years.[1]

## Military Mission, Conservation, and Tension

As important as it is for the conservation of biodiversity, the INRMP has another essential element. It must support the military mission. Interestingly enough, "the military mission" is rarely, if ever, defined in INRMP discussions, although for most people it is one of those concepts that one knows when one sees it.

At first glance, there would appear to be an inevitable tension between natural resources and the military mission; oftentimes it is the job of the military to bomb, burn, run tracked and wheeled vehicles over and otherwise destroy the trees, shrubs, wetlands, soils, and nesting areas that fall under the general category of "natural resources." Are nature lovers and military commanders natural enemies?

It can happen, says Mary Hassell, natural and cultural resources manager at the U.S. Marine Corps headquarters in Arlington, Virginia.

"I do believe, however, that we can serve both," she says. "I think the key word is 'compatible use,' and ensuring that natural resources conservation managers and military activities are integrated. It takes a lot of collaboration and cooperation with different groups that we have. It's part of our stewardship requirement as a federal agency.

"I'm a forester by training. My grandfather was a farmer. The idea of taking care of the land is nothing new. It's been around for hundreds and hundreds of years. And that's our goal: to be sustainable. And [to employ] multiple use. And integrate all that with the military mission. If you weren't practicing land management for sustainability you would soon destroy your land. So the concept isn't new. It's a good-management, best-management tool for keeping our activities ongoing."

Tim Beaty heads the fish and wildlife branch of the natural resources division at Fort Stewart and Hunter Army Airfield in Georgia, the home of the Army's 3rd Infantry Division. Beaty agrees that there can be a stereotypical gulf between environmental thinking and military mission. "Some folks don't see conservation as their number one priority," he says. "When you're a military commander in charge of ten thousand or fifteen thousand soldiers who are fixing to go in harm's way and put their lives on the line to defend the freedom we all enjoy, your number one priority is probably not worrying about salamanders. That's very understandable."

But, Beaty adds, that coin has two sides. "There may be a conservationist who you have to convince that not every tank commander is an evil guy. Once you can move past those preconceptions and prejudices and get folks to slow down and look at the facts and talk to one another, very often—I'd say in almost every case—you can find common ground. And begin to work from there and develop trust and develop working relationships. If we can do that one commander at the time, I think we're beginning to create a culture of understanding within DoD on both sides that the conservation mission has to be sensitive to the training mission. That's what comes first. That's what we have to do: meet both missions and not compromise training realism and effectiveness in pursuit of some unreasonable conservation goals.

"It's frustrating when you face these challenges, but it's very rewarding when you get there. I love it when the plan comes together."

But what tricks and techniques does Tim Beaty employ when he's putting together an INRMP that he hopes will contribute to that culture of understanding?

"It's going to sound like a cliché, but it's all about communication and team building. If you don't know your trainers or your testing community folks, if you don't understand their culture, and where they're coming from, then you've got to work on that. You've got to get to know those guys; take them to lunch; take them to the woods; show them what you know, and be open to learning what *they* know. Recognize that the reason the land is here is because the DoD needs to meet the military mission. And gradually you'll get an opportunity to help *them* understand that they do have a stewardship—that the Army does have a stewardship responsibility that has to be met. And that you can meet that responsibility by sticking your head in the sand and keeping people out and ignoring and arguing that that responsibility doesn't exist, or you can meet it by recognizing that that responsibility does exist and you can find a way to meet that responsibility in a way that doesn't compromise and in fact supports the training mission. One of the buzz phrases we have around here is that a disagreement doesn't equal disrespect."

### What is the military mission?

**The mission of the U.S. Army is defined in Title 10 of the U.S. Code, Section 3062(a):**

**It is the intent of Congress to provide an Army that is capable, in conjunction with the other armed forces, of**

**1. Preserving the peace and security, and providing for the defense, of the United States, the Territories, Commonwealths, and possessions, and any areas occupied by the United States;**

**2. Supporting the national policies;**

**3. Implementing the national objectives; and,**

**4. Overcoming any nations responsible for aggressive acts that imperil the peace and security of the United States.**

Kyle Rambo, the natural resources manager at the Navy's Patuxent River Air Station, also appreciates the importance of honoring the wisdom of those who carry out the military mission. "You've got to learn how to see things from the military guy's perspective," he says. Rambo recalls a story about a land manager from another base who complained about the difficulties of convincing flyers that they shouldn't drop bombs on woodpecker habitat. "Then somebody got the bright idea to take the woodpecker colonies and make them part of the training center. Make them 'missile sites'." Score aviators on how well they avoided the 'missile' installations. It became, he said, "a real training scenario."

Said Rambo: "The thing is to put on the guy's training hat and try to think like him. And all of a sudden these guys are getting scored on how well they *avoid* woodpecker colonies. At Fort Bragg, they do the same thing; they call them 'land mines' and 'mine fields.' And they get scored down on an exercise if they find themselves stumbling around in a 'mine field.'

"Learn the mission. Learn who you're working with and what they do. Learn to speak their language, and hone your people skills, because you're going to be working with people who maybe see the world differently than you do." Learning the mission was an important first step for Rambo when he started working at Pax River. "We were out there in the middle of an airfield putting up wood duck boxes. It never occurred to me that getting big ducks to fly along the runways was a problem. This was back in 1981. We were doing things that were counter to the military mission. We were not being supportive at all. It took me a while to figure it all out."

The Air Force and U.S. Marine Corps hosted numerous public meetings to obtain comment and input for the INRMP for the two million acre Barry M. Goldwater Range in Arizona. (Photo: Douglas Ripley)

(Rambo says more recent innovations have made it less likely that natural resources managers will make what in the future will be regarded as silly mistakes. "Nowadays, we have annual meetings of military biologists. We can share things with each other; use e-mail, the Internet. We can all share and contribute case studies and say, 'Here's how we did it.' We didn't have that back then. We were all going our own way and trying to figure out how to do it.")

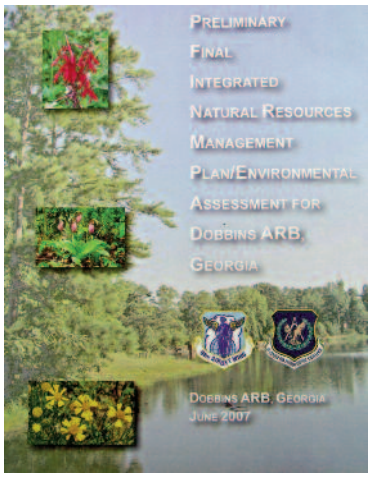
## The Mission and the INRMP

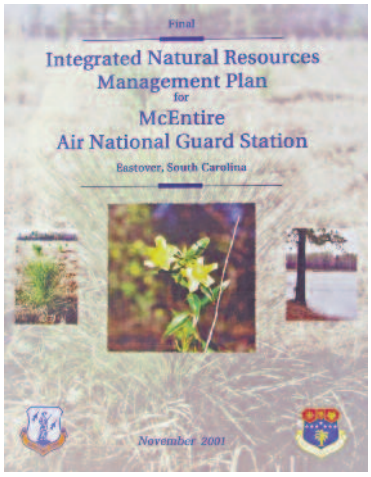
If the cardinal rule for writing a good Integrated Natural Resources Management Plan is to learn (and appreciate) the military mission, then a close runner-up is to assemble vast quantities of information. The INRMP is a living encyclopedia of the natural side of a military installation (several INRMPs refer to it as a "living document"), and also a handy list of what needs to be done and a chronology of how and when to do it. If it is well-written, it also is a valuable educational tool. Few military managers or even skilled biologists can stay current on all the aspects of environmental knowledge these days. A good INRMP is a storehouse of definitions, introducing the installation's caretakers to the most current thinking on environmental stewardship.[2]

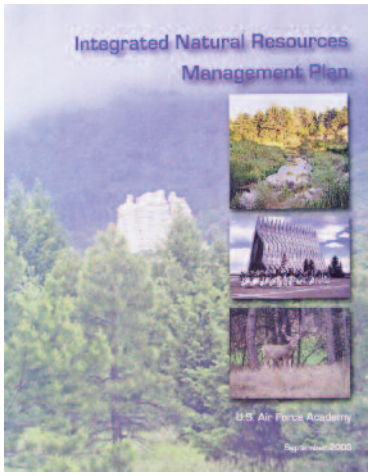
It helps to codify the basic facts and of an installation, sorting them into various management areas. One such compendium of information, examined in the INRMP of one air base, includes:

- a description of the installation—its size, environmental and demographic

The INRMP Task Force Working Group at the Warren Grove Air National Guard Range, New Jersey. The formation of an INRMP Task Force Working Group, composed of representatives from the U.S. Fish and Wildlife Service, state fish and game agency, other state and local environmental agencies, and interested nongovernmental and academic organizations, is an important first step in the preparation of a comprehensive INRMP. (Photo: Douglas Ripley)




characteristics. These include climate, topography, air and water quality, water resources, geology, soil characteristics, existing ecosystems

- fauna
- flora
- endangered, threatened, and rare species (including those included on state as well as federal lists)
- invasive and other exotic species
- facilities and other facets of development
- hazardous and toxic materials
- environmental justice issues

A well-built INRMP will state, up front, its purpose. A concise sample, taken from the document at Dobbins Air Reserve Base, near Atlanta, Georgia, says:

This INRMP is a practical guide for the management and stewardship of all natural resources present on Dobbins ARB, while ensuring the successful accomplishment of the military mission. The INRMP was developed using an interdisciplinary approach in which information was gathered from a variety of organizations. Guidance was also solicited from a variety of Federal, state, and local agencies and groups. A Task Force was formed, which included key base personnel and individuals from various agencies. Representatives from the following Federal and state regulatory agencies were members of the Task Force: the U.S. Fish and Wildlife Service (USFWS) and Georgia Department of Natural Resources (GADNR). These varying perspectives allowed for an accurate portrayal of the status and management needs of local ecosystems, balanced against the requirement for the base to accomplish its mission(s) at the highest possible level of efficiency. (From *Final Integrated Natural Resources Management Plan/Environmental Assessment for Dobbins ARB,* Georgia, June 2007. Compact disc.)

The sample quoted above succinctly makes the point that successful management of natural resources goes hand in hand with a successful military mission. Most skillfully-written INRMPs make this point, though some seem reluctant to grant conservation equal status: "...land management on a military installation must be consistent with the military purposes of the installation," warns the INRMP preliminary document for the Barry M. Goldwater Range, which at 1.7 million acres is the nation's third largest military reservation. (The document is also huge; its executive summary is 36 single-spaced pages long, and the complete INRMP runs to 1,500 pages. They are available at **http://www.luke.af.mil/shared/media/document/AFD-070119-100.pdf** and **http://www.luke.af.mil/library/factsheets/ factsheet.asp?id=6348**).

## Sources of Help

INRMPs are frequently, if not always, the product of working groups, assembled for the purpose of gathering material for the plan and, later, for monitoring its progress. Sometimes private consultancy groups or universities are contracted to do the information collection and actual writing of the document. The working groups almost certainly include persons from the base itself, the U.S. Fish and Wildlife Service (USFWS), the state department of natural resources (or fish and game department), and others. The Sikes Act requires that the plan be prepared by the installation, USFWS, and appropriate state agency. Since USFWS's active involvement was mandated by 1997 amendments to the Sikes Act, the agency has developed procedures to assist in producing the plans and in streamlining the

USFWS approval process once the plan is submitted. (Lewis Gorman, USFWS's liaison with the Department of Defense on endangered species matters, says some at DOD might refer to his agency as "*regulators*, but we consider ourselves the *cooperators*. We are excellent partners with each other.")

Anyone can have access to the expertise from a computer screen. USFWS maintains a website, "The Sikes Act—a Dynamic Partnership" at **http://www.fws.gov/habitatconservation/sikes_act.htm**, and within that site there are links to the important aspects of INRMPs—endangered species, fisheries, invasive species, migratory birds, law enforcement, wetlands, and environmental contaminants.

Another fountain of data is the Department of Defense itself, through its DENIX website (**https://www.denix.osd.mil**). The site contains links to INRMP guidance documents; the text of the agreement among the DOD and USFWS and the International Association of Fish and Wildlife Agencies (now called the Association of Fish and Wildlife Agencies); a document titled "Best Practices for Integrated Natural Resources Management Plan (INRMP) Implementation"; and many others.

The DENIX site also contains links to information on state wildlife action plans, which installation managers will find useful in assembling their INRMPs. Such plans now exist for all 56 states and territories. These are federal-state collaborations aimed at collecting information on, monitoring, and designing conservation plans for wildlife. There is more information at **http://www.wildlifeactionplans.org/**.

And the Legacy program itself is a great source of information. The Legacy Resource Management Program was created in 1990 by Congress to financially assist DOD efforts to preserve cultural and natural heritage, while supporting military readiness. (The Legacy Program also supported the development of the original DOD Biodiversity Conservation Handbook in 1996, as well as this updated version.) The program is explained at **http://www.dodlegacy.org/Legacy/intro/LegacyGuidebook_print_June07.pdf,** with additional information at **https://www.denix.osd.mil.**

Nongovernmental organizations (NGOs) are another useful supplier of wisdom. They include The Nature Conservancy (**http://www.nature.org**) and NatureServe (**http://www.natureserve.org/**). Of special interest at the NatureServe site are its reports on species at risk on DOD installations (see **http://www.natureserve.org/prodServices/speciesatRiskdod.jsp**).

Finding funding is a constant interest (and concern) of natural resources managers, as some of them explain in chapter 9. Although there are no Web-based ATM machines to cough up endless streams of money for species counting, wetlands monitoring, and the other components of INRMPs, the Legacy Program does provide a 235-page handbook, "Resources for INRMP Implementation," that explores the budgeting system (one chapter subtitle is "How to get funds.") The link is **https://www.denix.osd.mil**.

The U.S. Fish and Wildlife Service files reports with Congress on its activities and expenditures relating to INRMPs. The June 2006 report, covering the fiscal year 2005, is at **http://www.fws.gov/habitatconservation/FY%2005%20Sikes%20Report%20to%20Congress.pdf**.

## Tips from Experts

Any defense installation's natural resources manager who has been through the INRMP writing process probably deserves to be called an expert in the field. The process is akin to compiling the data for, and then writing, a comprehensive nonfiction book. As Kyle Rambo points out, land managers frequently meet with each other, and stay in touch by e-mail and the Internet, and so a great deal of expertise is available.

Mary Hassell, the Marine Corps's natural and cultural resources manager, believes a key need for the INRMP writer is to have a clear vision of the plan's goals, for most everything else flows from those. "What needs to be concentrated on," she says, "are the goals and objectives, and how well we're doing in implementing the projects that we are listing [in our INRMP]. So, for example, our goal would be compatible with integrated land management, and an objective would be that in order to support that goal would be minimizing soil erosion. And then the project would be a soil erosion control project. So what you're doing is, every year you're sitting down with your colleagues at the Fish and Wildlife Service and your colleagues with the state fish and game or wildlife agency, and you're going over the goals and objectives and projects and your work plan, and you ask 'How well are we doing here? Are the goals and objectives still valid? Do we need to drop some, add some? Is it supporting the recovery of any endangered species that we have? Is it supporting biodiversity; is it minimizing invasive species?'"

To aid in this process, the Navy has developed a Web-based tool, called the "Natural Resources Metrics Builder," that its installations are now required to use. The Metrics Builder is actually a database that lists all the Navy and Marine Corps INRMPs, with categories for seven focus areas. "We look at our partnership effectiveness; we look at opportunities for public recreation—hunting and fishing—and we go into all these focus areas and we actually require our installations that have INRMPs to fill this out in collaboration with our partners, and give a score, from zero to 100, how well they're doing," says Mary Hassell.[3]

Tim Beaty, at Fort Stewart and Hunter Army Airfield, says an INRMP effort must always keep the military mission at the top of its list. In addition to managing thousands of acres of forest to accommodate endangered, threatened, and rare species, and drawing up schedules for prescribed burning, as well as cooperating with nearby landowners and cleaning up toxic spills from the past, Beaty is aware of the need to involve the base's military trainers in his plans for conservation.

In Fort Stewart's case, as at Fort Benning (see chapter 1), the red-cockaded woodpecker was instrumental in joining the concepts of conservation and mission.

"For close to twenty years," recalls Beaty, "there was friction between the woodpecker and the mission." Finally, the base started getting "jeopardy opinions."[4] Similar warnings were received by Fort Benning and Fort Bragg, also "over the damage that was occurring as a result of training."

When land managers at Fort Stewart began more forcefully applying existing timber harvesting rules that left woodpecker habitat untouched, they got flak from another direction. "The Army said, 'Hey, this isn't going to work. This is impacting training'," said Beaty.

The solution would have thrilled the heart of any dedicated INRMP-writer. "We began to realize that one of the reasons we were having so much friction between

Wildlife Biologist Jim Ozier, (left), Georgia Department of Natural Resources, assisting natural resources managers at Dobbins Air Reserve Base, Georgia, with the development of the base Integrated Natural Resources Management Plan. (Photo: Douglas Ripley)

the mission needs and the woodpecker's needs was that we were fighting over the same ground," says Beaty. "What we thought was good woodpecker habitat, places that had woodpeckers in it, was the same place the Army thought was good training land—it was high and dry and open up so they could see and maneuver to it.

"We began to realize that there were a lot of parts of Fort Stewart that *didn't* look like that. This was about the same time the conservation community was starting to appreciate anew the importance of fire—natural fire—and particularly to recognize that the way we had prescribed fire in the past had been a little too timid—that what this ecosystem really needs is fire in the growing seasons, whereas our prescribed fires tended to be winter fires. As we started doing more proactive use of fire, particularly growing-season fire, we were really liking the results for the woodpeckers, and the Army was really liking the results for training.

"I think what's made our programs here successful, and supportive of the mission as well as the endangered species, is that the habitat needs are the same. As we focus on trying to make the habitat better, it's had positive effects on both the woodpecker and the Army.

One lesson Tim Beaty learned from all this is that to compose a solid INRMP, you must "Go back to the mission. Involve your trainers early on. If you don't already have a good understanding of the mission and what the trainers' needs and priorities are, get one. And then involve those folks; seek their input and constructive criticism.

"You always have to remember when you're working with the trainers, especially now, is that we are a nation at war, and these are awful busy folks. It's really hard for them to find time and drop what they're doing and read a 600-page, or 100-page, even, management plan. You want to always coordinate with those folks and get their input in a way that makes it easiest for them. You have to ask them what that way is. To send them a 100-page document to review and get their comments back in 10 days is not the best way to do it."

If a natural resources manager is working on a large installation, such as Fort Stewart, said Beaty, "you've got to realize that you can't eat that cow all at one time. You've got to eat it a bite at the time. What we did was come up with some overall objectives and goals and then pencil in the INRMP along with a plan to do more specific prescriptions, as we call them, training area by training area. There's 120 training areas that make up Fort Stewart—subdivisions of the whole post that can be used to schedule training activities and that kind of thing—to make sure that Company A is not shooting bazookas while Company B is learning how to raise an antenna. Develop a prescription for each one of those areas that identifies the current condition and what are the desired future conditions. Was there an old agricultural field that we want to restore longleaf pine in? Where's a stand that's too dense that we need to thin? Where's a wetland that we want to restore? Those kinds of things.

"Our INRMP is a five-year plan, so we can say, Okay, for the next five years we're going to do prescriptions on each of these 120 training areas. So we're trying to do about 25 training areas each year—about two prescriptions a month is what we're turning out."

Once the trainers have been consulted, the databases studied, and the prescriptions prescribed, the INRMP must be sold to the base commander. Tim Beaty advocates taking as many expert helpers along for such presentations as possible. "When you do go in to talk to the commander about the plan or anything else, if you talk about the mission and about how your plan supports the mission, and all the good things you're doing for the mission and what the mission means, be sure to take somebody along from your directorate of plans, mobilization and security, or whatever you call your training organization, and let *him* tell the commander that. If you're going to have to tell the commander about how this is the law and you need to be in compliance and you're going to go to jail if he doesn't do this, take your *lawyer* along. Let your staff judge advocate tell him that.

"You sell the other staff elements on the idea, and let the guy that the general's paying to be his expert on a particular subject tell him how your plan is going to help him do well in that area."

## Adaptive Management

And once the plan has been sold to the base commander and everyone else, the natural resources manager has the task of making it work.

What Tim Beaty, Mary Hassell, Kyle Rambo, and many others are advocating is part of what's often referred to as "adaptive management." The concept, which has been around for decades, has become a major part of assessing, planning for, and executing big, complicated projects such as those that are required in Integrated Natural Resources Management Plans. Using adaptive management, policies become flexible experiments. For example, a policy to preserve and protect habitat for a certain creature on a military installation (while not only not harming the military mission but actually supporting it) is not set in stone, but rather treated as an effort to be closely watched and modified if required. Formulating the policy and placing it into action during a specified time span (as an INRMP might require) is not enough; managers must calculate over time the responses of the ecosystem to the change. In simplest form, adaptive management might be defined as "learning from the outcome."

For Mary Hassell, adaptive management is a natural part of biodiversity con-

servation on military lands and waters, and one that is not all that difficult to execute. It's like an annual review, she says: "—the concept of really using the Integrated Natural Resources Management Plan as a tool, and actually using it. It's the concept where 'This is something we're planning to do; we'll take a look at what we're planning to do; we'll fund it and find a way to implement it; and then we'll look at it and see how well we implemented it and see if there's anything we need to change.'

"The military is pretty dynamic. Sometimes we have a new range or a new weapon system, and things are always moving. There are a lot of moving parts. So we have to constantly try to keep up; keep ahead of the game. So far as managing our natural resources is concerned, the projects in an INRMP give us a chance to practice that adaptive management."

In fact, says Hassell, the concept of adaptive management is useful in reminding managers that the INRMP is just a very useful tool, rather than a doctrine that's set in stone. "The big problem that I see with the INRMPs," she says, "is that a lot of money has been thrown at preparing the plans. It's really not the plans that are important; it's what we're doing on the ground that's important. People think they have to completely revise these documents every five years. But the law says the documents have to be *formally reviewed for operation and effect* every five years. That means if the plan is still good, you keep it. You might have some new projects, but there's no need to spend $100,000 to regurgitate another plan just to put a new date on it. That is something that DOD-wide people have realized. And we're trying to get the word out there that you don't have to redo the sucker every five years, but we really want you to take a look and ask, *How are we doing?*"

### A Solid INRMP

**The Integrated Natural Resources Management Plan for Marine Corps Base Camp Pendleton, in southern California, might be seen as a model of good, instructive reporting. The reasoning behind the lengthy document is expressed lucidly in the first paragraph of its executive summary:**

***The mission of the Marine Corps is to win battles and make Marines. The Marines need to train as they fight, which requires access to extensive acreages for training. Over time, military training activities pose the potential for adverse impacts to Marine Corps lands and resources. Unless properly managed, Camp Pendleton lands could be impacted to the point where both the quality of training and conservation value of the land could be diminished. Natural resources management supports the Marine Corps mission by ensuring the health of its lands for long-term use.***

For a look at the complete Pendleton INRMP, see http://www.pendleton.usmc.mil/base/environmental/inrmp.asp.

#### NOTES

1. As it was originally written, the Sikes Act was a far cry from the DOD environmental policy of today. According to one legislative history of the act, the purpose of the legislation as introduced in 1960 was to certify an informal, pre-1949 arrangement at Elgin Air Force Base in Florida in which base personnel collected fees for allowing hunting and fishing on the base and used the money for restocking. The Sikes Act has been amended several times since 1960, always in the direction of biodiversity conservation as well as wildlife management and recreation. (See http://search.yahoo.com/search?p=sikes+act+1960&ei=UTF-8&fr=moz2 [hollingsworthfx4.doc].)

2. The Dobbins ARB document is a fountain of useful definitions: For instance. noise, a necessary component of an airfield, "is considered to be unwanted sound that interferes with normal activities or otherwise diminishes the quality of the environment. It can be intermittent or continuous, steady or pulsating." Wildlife management is "manipulation of the environment and wildlife populations to produce desired objectives." There are dozens more.

3. The Metrics Builder scores installations on seven key areas of interest, arranged by the installation name in a spreadsheet-like database. The areas are "INRMP project implementation," "Listed species and critical habitat," "Partnership effectiveness," "Fish and wildlife management and public use," "Team adequacy," "Ecosystem integrity," and "INRMP impact on the installation mission." A 2005 description of the Metrics Builder may be found at http://www.enviro-navair.navy.mil/currents/fall2005/Fall05_New_ Conservation_ Metrics.pdf. The Metrics Builder site itself is at https://clients.emainc.com/dcs/navfac/metrics/MetricsAllSum_H.asp. Logon and password are required.

4. The "jeopardy opinions," issued by USFWS in its role as one of the managers of the Endangered Species Act, declared that Fort Stewart's actions would be expected to "reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species." The federal agency, as a consultative service on endangered species matters, also can issue declarations of "no jeopardy."

CASE STUDY
CHAPTER FOUR
ENCROACHMENT

MCB CAMP LEJEUNE

# MCB Camp Lejeune Addresses Encroachment Through the North Carolina Onslow Bight Conservation Forum

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Marine Corps Base (MCB) Camp Lejeune, North Carolina, is the Marine Corps' largest amphibious training base and is home to 47,000 Marines and sailors; the largest single concentration of Marines in the world. Its tenants include the II Marine Expeditionary Force, 2nd Marine Division, 2nd Marine Logistics Group, U.S. Coast Guard, and the U.S. Naval Hospital, Camp Lejeune. Camp Lejeune encompasses approximately 143,000 acres, including the onshore, near shore, and surf areas in and adjacent to the Atlantic Ocean and the New River.

## The Setting

Eastern North Carolina provides a diverse array of ecologically important habitat types and ecosystems. The Onslow Bight region, in which Camp Lejeune is situated, stretches from Cape Lookout to Cape Fear. It consists of a rich mosaic of saltwater marshes, wetlands, longleaf pine savannas, and other coastal ecosystems, and it supports several rare and endangered plant and animal species, including the red-cockaded woodpecker.

## Challenges

The Onslow Bight region is developing rapidly and is beginning to lose its rural character and ecological integrity. New commercial and residential development near Camp Lejeune's boundaries can restrict the type of activities that can be safely conducted on the camp's training ranges. Noise complaints from nearby residents can also restrict military training and serve as a serious and contentious subject of conflict between the Marine Corps and local communities.

## The Solution

The Marine Corps and The Nature Conservancy jointly established the Onslow Bight Conservation Forum in 2002 to address encroachment issues and protect the natural heritage of coastal North Carolina. Subsequently, many other partners joined the forum, representing land managers and conservation advocates who are working to identify areas that should remain in a natural state. In addition to MCB Camp Lejeune and The Nature Conservancy, the forum now includes Marine Corps Air Station (MCAS) Cherry Point, the North Carolina Coastal Land Trust, other non-governmental organizations, several North Carolina State agencies, the U.S. Fish and Wildlife Service, and the U.S. Forest Service.

HTTP://WWW.COOPERATIVECONSERVATIONAMERICA.ORG/VIEWPROJECT.ASP?PID=727

HTTP://WWW.FWS.GOV/SOUTHEAST/GRANTS/ONSLOWBIGHT.HTML

HTTP://WWW.NATURE.ORG/WHEREWEWORK/NORTHAMERICA/STATES/NORTHCAROLINA/PRESERVES/ART17462.HTML

## Accomplishments

In March 2003, MCB Camp Lejeune and MCAS Cherry Point entered into a memorandum of understanding (MOU) with the North Carolina chapter of The Nature Conservancy and other federal and state government agencies and non-governmental organizations to establish the Onslow Bight Conservation Forum. In January 2006 the MOU was updated to include new member organizations.

HTTP://WWW.LEJEUNE.USMC.MIL/EMD/INRMP%202007/FINAL%20INRMP%20INTERNET%20POSTING/NOV%202006%20FINAL%20INRMP%20APPENICES/APPENDIX%20Q%20FINAL.PDF

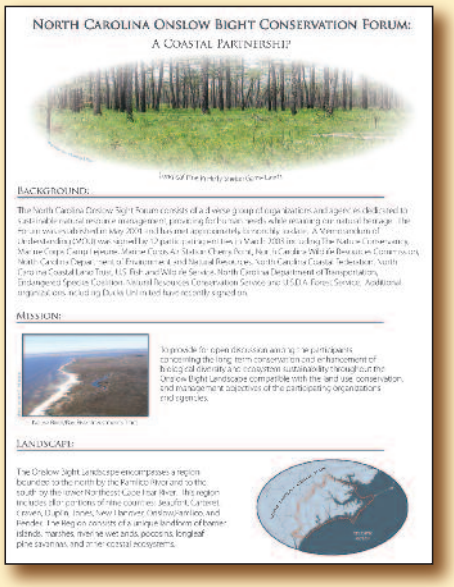
In 2003, some 2,500 acres adjacent to the Camp Lejeune tank and rifle ranges became available for purchase. The area excited the interest of a developer who hoped to construct 3,000 housing units. The land was purchased by The Nature Conservancy (with partial funding provided by the Marine Corps) and was transferred to the North Carolina Wildlife Resources Commission for inclusion into the state game lands system. The Marine Corps, in exchange for its funding contribution, received a restrictive use easement that prohibits any land use or development of the parcel that is incompatible with Marine Corps training requirements.

In 2005, Onslow Bight Conservation Forum partners assisted MCB Camp Lejeune and MCAS Cherry Point to acquire conservation interests on several other parcels in the vicinity of both installations. Known as the Camp Lejeune-Holly Shelter Corridor, the acquisitions will create an additional buffer to military activities that will allow for land management vital to the maintenance of ecological functions in the coastal plain.

In 2006 the Onslow Bight Conservation Forum made possible a project undertaken by the North Carolina Coastal Land Trust (NCCLT) and the North Carolina Wildlife Resources Commission (NCWRC) to acquire 1,378 acres in the vicinity of MCAS Cherry Point's Piney Island bombing range. The area will become public game lands.

There is also a potential that, with habitat enhancement, some parcels of land in the vicinity of MCB Camp Lejeune could be developed as habitat for the federally listed red-cockaded woodpecker.

As of 2007, over $60 million in state trust funds and over $15 million in federal dollars, including funds from DOD's Readiness and Environmental Protection Initiative (REPI), have been awarded to projects sponsored by the Onslow Bight Conservation Forum.


NORTH CAROLINA ONSLOW BIGHT CONSERVATION FORUM:
A COASTAL PARTNERSHIP

BACKGROUND:

MISSION:

LANDSCAPE:


ACCOMPLISHMENTS TO DATE

## Conclusion

MCB Camp Lejeune's outreach efforts, resulting in the establishment of the Onslow Bight Conservation Forum, have succeeded in reducing the impact of encroachment on the Marine Corps' mission in North Carolina. This has been accomplished while simultaneously enhancing environmental quality and biodiversity conservation on surrounding lands through the establishment of public parks and the restoration of wetlands. The process has also helped the U.S. Marine Corps establish very positive relationships with a wide range of governmental and non-governmental organizations and individuals.

CASE STUDY
CHAPTER FOUR
ENCROACHMENT

ACUB PROGRAM

# Army's Compatible Use Buffers Support Soldier Training and Protect Habitat

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Army training, private development, and federally protected species are competing for a limited, non-renewable resource: land. Military and private lands often contain valuable habitat for protected species. As rapid development occurs on private lands, habitat is fragmented and degraded, leaving the military increasing responsibilities to limit training, testing and operations to avoid species decline and ultimately provide for recovery. Species management on military lands often results in adverse impacts to assigned missions (i.e. encroachment) as the timing, type and location of training is adjusted to protect and conserve habitat. Recognizing the need to engage private landowners in the regional protection and conservation of red-cockaded woodpecker (RCW), the Army initiated a unique partnership with The Nature Conservancy in North Carolina, the Private Lands Initiative (RCI), either to purchase the outright fee to key parcels of RCW habitat or to work with landowners for the sale of conservation easements.

## Successes

Fort Bragg is home to many tenant organizations, but the most significant units it trains are the 82nd Airborne Division, XVIIIth Airborne Corps and U.S. Army Special Operations Command. Fort Bragg is the "Home of the Airborne," and its units are expected to rapidly deploy anywhere in the world and to fight and win upon arrival. The installation is the Army's most important power projection platform, is in constant use for soldier training, and requires constant use of its 140,000 acres of training lands. At the same time, it provides the largest block of contiguous long-leaf pine and wiregrass habitat for conservation of the red-cockaded woodpecker in the Sandhills East Recovery Unit for the RCW. In the 1990s the competition between military training and RCW management on Fort Bragg lead to serious conflicts between Fort Bragg and the U.S Fish and Wildlife Service (USFWS) with the shutdown of important training ranges and the prospect of increased training limitations.

The outcome was a major shift in thinking: Both the Army and the USFWS agreed to take serious steps to engage off-post landowners in the perpetual conservation of RCW habitat with the dual goals of restoring habitat across the recovery unit while easing Fort Bragg's burden. Known initially as the Private Lands Initiative (PLI), Fort Bragg turned to an unlikely partner to achieve these objectives—The Nature Conservancy (TNC), an organization with the primary purpose of protecting and restoring critical natural systems.

In 1995, the Army entered into a cooperative agreement with TNC, calling for TNC to purchase and protect in perpetuity fee interests or conservation easements in lands from willing landowners. The Army and TNC agreed to share resources in this endeavor. In addition to permanently protecting RCW habitat, the purchase or encumbrance of tracts along the installation border preclude incompatible land uses (sprawl) while furthering RCW recovery. Technical support and oversight to this protection initiative is provided by the North Carolina Sandhills Conservation Partnership, which includes Fort Bragg, the State of North Carolina, The Nature Conservancy, the U.S. Fish and Wildlife Service, Sandhills Ecological Institute, Sandhills Area Land Trust, and others.

As of April 2007, 24 tracts of land totaling 12,254 acres have been acquired or protected. The Army's cost was about $8 million, with partners contributing about $23 million. On June 7, 2006, the Department of the Interior, the U.S. Fish and Wildlife Service, and the U.S. Army partnered to celebrate and commemorate the recovery milestone of the RCW population in the Sandhills East Recovery unit, a primary core recovery population, five years earlier than anticipated. Further, the Army and USFWS recently revised management guidelines for RCW on Army installations, virtually eliminating restrictions on training at Fort Bragg. Though a highly professional on-post conservation program was the foundation, PLI played a significant role in these successes.

**HTTP://WWW.COOPERATIVECONSERVATIONAMERICA.ORG/VIEWPROJECT.ASP?PID=414**

## The Army Compatible Use Buffer (ACUB) Program

The Department of Defense (DOD) recognized the power of this approach to address encroachment by conserving habitat and reducing the effects of burgeoning urban and suburban sprawl. Using the Fort Bragg approach as a model, DOD worked with Congress to clarify and expand legislative authority. Congress (through the National Defense Authorization Act for Fiscal Year 2003 , Section 2811) enacted "Agreements to Limit Encroachment and Other Constraints on Military Training," now codified at 10 U.S.C. Section 2684Aa. The Army implemented this authority, formalizing the Army Compatible Use Buffer (ACUB) Program. In 2005, the Department of Defense established the Readiness and Environmental Protection Initiative (REPI) which endeavors to fund buffer protection programs throughout the Department of Defense modeled largely on the Army's ACUB program. Due to the Army's success with PLI at Fort Bragg and establishment of the ACUB program, many other Army installations across the United States (e.g. Ft. Huachuca, Arizona; Ft. Carson, Colorado; Ft. Stewart, Georgia; Camp Blanding, Florida, and others) quickly developed similar cooperative conservation partnerships. The other military services have followed suit on lands under their jurisdiction.

**HTTP://WWW.LAW.CORNELL.EDU/USCODE/**

**HTTPS://WWW.DENIX.OSD.MIL**

**HTTP://WWW.DEFENSELINK.MIL/RELEASES/RELEASE.ASPX?RELEASEID=10168**

Through the REPI, the DOD funded the ACUB program for the first time in FY05, granting $6.5 million to the Army. The Army supplemented the sum with an additional $12.9 million. Those funds were obligated towards cooperative agreements at Fort Bragg; Camp Blanding, Florida; Camp Ripley, Minnesota; Fort Carson, Colorado; Fort Stewart, Georgia; and the U.S. Army Garrison Hawai'i. As of 30 September 2006, ACUB has protected in perpetuity a total of 53 parcels covering approximately 63,370 acres in 15 states. Additionally, the value of partnership contributions is estimated at $91million. The number of Army installations with approved ACUB projects was set to expand from 16 to 21 by 1 October 2007.

The conservation benefit of this initiative is that large tracts of land with critical natural systems are being protected and managed forever. These are especially valuable in that most are adjacent to large core natural areas (e.g. impact areas, maneuver lands, etc.) and are therefore more stable platforms for biodiversity conservation than isolated tracts of comparable size owing to the exclusion of people and other potential disturbance factors. The ACUB program has allowed Army installations to move from singular focus on large blocks of isolated habitat on-post to working across the landscape on an ecosystem level, thus achieving long-term conservation goals.

## Challenges

The development of the pilot project and the expansion of off-post conservation efforts required a fundamental change in the Army's culture. Many senior military staff vigorously opposed expending human and financial resources on natural resources conservation on non-Army lands. Responsibility for management of resources historically ended at the "fenceline." In addition, many officials held deep seeded suspicions of the conservation community, based upon regulatory action under the Endangered Species Act to shut down Army ranges and threaten criminal enforcement. Similarly, many environmental organizations were suspicious of the Army's commitment to environmental conservation due to previous high profile environmental controversies involving historic environmental contamination that called into question the Army's stewardship ethic. Moreover private landowners, key to the success of the PLI, ACUB and REPI programs held deep-rooted concerns, based on the vast expansion of military lands to support WWI and WWII, that the military was engaging in yet another private property land grab. And local governments in rural and economically depressed areas had serious concerns for the loss of tax revenues. The building of trust between these four communities has taken over 12 years at Fort Bragg.

The longleaf-wiregrass communities on Fort Bragg are among the most important for the recovery of the federally-listed red-cockaded woodpecker. The establishment of conservation easements to protect RCW habitat and reduce encroachment at Fort Bragg served as a model for the Army's Compatible Use Buffer (ACUB) Program. (Photo: U.S. Army)

## Lessons Learned

Success in using cooperative conservation partnerships to limit encroachment, conserve natural habitat, and engage necessary participants is essentially a function of establishing trust and enduring relationships with diverse organizations that are willing to devote and leverage resources. Such partnerships are capable of achieving landscape goals that would be unattainable by individual participants. Cooperative conservation to achieve consensus on a common path forward is often a long-term and expensive process (in terms of human and financial resources) of inter-organizational bioregional conservation planning, landowner education and public outreach. The plan must be based upon comprehensive inventories, perpetual monitoring, and application of the principles of conservation biology. While such planning is critical, true success can only be achieved when cooperative agreements result in the acquisition of interests in real property necessary to restrict incompatible development and provide for the perpetual protection and conservation of habitat.

Most importantly, both the Army and the conservation community have recognized that while their primary missions may differ, they share a common goal of limiting or avoiding the unrestricted development of lands ecologically related to the valuable natural habitat occurring on Army lands. The potential to serve multiple public purposes (e.g. endangered species recovery, ecosystem conservation, reduced sprawl, increased soldier training, and outdoor recreation) must be served by protection of the same tracts of land.

## Conclusion

Military trainers and the conservation community are natural allies. Sensitive species and the natural habitat upon which they rely are often the Army's best neighbors.

CASE STUDY
CHAPTER FIVE
MULTIPLE USES

FORT STEWART AND
HUNTER ARMY AIRFIELD

# Cooperative Conservation Planning Helps Reduce Conflicts between Competing Natural Resources Programs

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Fort Stewart and Hunter Army Airfield are the home of the 3rd Infantry Division. Combined, they form the Army's Premier Power Projection Platform on the Atlantic Coast. It is the largest, most effective and efficient mechanized infantry training base east of the Mississippi, covering 280,000 acres in southeast Georgia. Hunter Army Airfield is home to the Army's longest runway on the East Coast (11,375 feet) and the Truscott Air Deployment Terminal. Together these assets are capable of deploying units such as the heavy, armored forces of the 3rd Infantry Division or the elite light fighters of the 1st Battalion, 75th Ranger Regiment.

The natural resources on Fort Stewart and Hunter Army Air Field are extensive and diverse. Fort Stewart has over 90,000 acres of wetlands, including 500 acres of ponds and lakes and 260 miles of streams and rivers. Fort Stewart is home to a number of wildlife species whose existence has been jeopardized for many reasons. These animals include the red-cockaded woodpecker (endangered), eastern indigo snake (threatened), wood stork (endangered), flatwoods salamander (threatened), and shortnose sturgeon (endangered).

Fort Stewart's forestry program is one of the largest in the Department of Defense. Fort Stewart is also home to the largest remaining acreage of longleaf pine-wiregrass ecosystem in Georgia. Recent notable accomplishments of the forestry program include: uninterrupted military training during the worst wildfire season on record in Georgia; reforestation of longleaf pine; endangered species habitat improvement, and a record timber harvest for the installation. Also, Fort Stewart has one of the largest prescribed burning programs in North America, having burned 1.52 million acres since 1992, with no injuries to soldiers or civilians. The success of Fort Stewart's forestry management can be measured by the installation's immensely valuable timber resources (approximately $5 million of revenue annually) and its role in developing and sustaining an excellent military training environment. **http://www.stewart.army.mil/dpw/fish/resource.htm**

Need for Cooperative Management: The Fort Stewart natural resources program is extensive and diverse and managed by an environmental division consisting of three branches: environmental compliance, fish and wildlife, and forestry. Although overall management of the program is prescribed by a detailed Integrated Natural Resources Management Plan (INRMP), the potential for conflicts among proposed activities of the individual environmental branches is always present.

## Internal Coordination Process

To reduce conflicts between competing INRMP goals and objectives, Fort Stewart developed an internal coordinating process, as outlined below:

The process starts with three levels of planning:

- INRMP (very broad)
- Integrated Management Prescriptions (IMP) (intermediate). The integrated management prescription team develops approximately 25 IMPs annually
- Specific management prescriptions (most specific and detailed of the three levels of plans)

The INRMP requires that IMPs will be prepared for each of the installation's 121 training areas by a team of coordination partners consisting of:

- Forestry
- Fish and wildlife
- Environmental branch (wetlands, cultural resources, borrow pit manager)
- Range division (ITAM)
- Resident forester (U.S. Army Corps of Engineers)

## Advantages of the Internal Coordination Process

- Allows for all involved agencies to have a say in specific actions (e.g., timber sales, prescribed burns, longleaf wiregrass restoration)
- Provides a forum for discussing the best approach and timing for specific INRMP projects
- Eliminates or significantly reduces potential conflicts (natural resources objectives vs. the military mission)
- Ensures "buy-in" and consensus to meet INRMP goals and objectives

## Conclusion

By focusing on cooperative management, and establishing a system of internal coordination, Fort Stewart has established a highly successful natural resources program that address a wide range of specific, and potentially conflicting, goals and objectives. See **www.dodbiodiversity.org** for examples of an Integrated Management Prescription and a specific Timber Harvest Prescription. Both illustrate the benefits of careful, detailed cooperative coordination in reducing conflicts between multiple natural resources uses.

Above: Helicopter used in prescribed burning operations.

Below, clockwise from top left: Use of prescribed fire at Fort Stewart; Longleaf habitat immediately after prescribed burn; Recovery of longleaf habitat after burn; Mature longleaf pine habitat. (Photos: U.S. Army)

CASE STUDY
CHAPTER FIVE
MULTIPLE USES

FORT HOOD

# Balancing Critical Species Protection and Armored Military Training

## Fort Hood, Texas

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Fort Hood is an 88,000 ha U.S. Army installation situated in central Texas. Mixed juniper-oak woodlands, shrublands, and grasslands characterize the vegetation. Military training includes brigade combat team (BCT) live fire and maneuvers with rotary-wing and combat service support. Tactical weapon systems training includes heavy armor (Abrams Main Battle Tank), artillery (Paladin and Multiple Launch Rocket Systems), light armor (Bradley Infantry Fighting Vehicles), rotary wing (Apache and Blackhawk helicopters), unmanned aerial vehicles, and small unit arms. BCT units train to maintain a high state of readiness for decisive victory on the battlefield.

Two federally listed migrant songbirds, the golden-cheeked warbler (*Dendroica chrysoparia*) and the black-capped vireo (*Vireo atricapilla*), nest on Fort Hood. The installation, which has the largest populations of both species under a single management authority, is considered a crucial site for species recovery. Recovery efforts, e.g. habitat and population protection, have the potential to conflict with the military mission at Fort Hood, but thanks to adaptive management techniques, diligence, patience, observation of military training/ecosystem response dynamics, and informed decisions, Fort Hood managed to greatly reduce training restrictions on the installation from 29 percent or ca 27,000 ha in 1993 to 4.3 percent or 3,846 ha in 2007. Restriction reduction does not indicate the habitat is nonexistent and no longer protected; birds still use the habitats and their populations are monitored. However, rather than being "off limits" to training, military units are allowed to conduct crucial battle skills training in the habitat all year long. The result: unit commanders have contiguous, realistic battlefields to plan and conduct BCT operations, and the birds have contiguous, managed habitats to maintain viable population growth.

Geologically, Fort Hood is a karst landscape characterized by roughly sculpted limestone hills and mesas dotted with caves, sinkholes, rock shelters, and springs. At least 19 endemic, troglobitic (adapted for cave life) invertebrates are found in karst ecosystems on Fort Hood. Additionally, 244 invertebrate species and 23 vertebrate species have been recorded from the 250+ caves, sinkholes, and springs on Fort Hood. None of the recorded species is federally endangered; however, one bat species is considered a species of concern. Fort Hood proactively protects and manages these unique ecosystems.

## Challenges

- Protect, manage, maintain, and monitor sensitive and unique fauna:
  - Populations and habitat of the federally listed black-capped vireo and golden-cheeked warbler
  - Cave-dwelling populations in 550+ karst ecosystems including 13 named and 6 unnamed endemic karst invertebrates
  - Populations of a possibly endemic, karst dependent sub-species of slimy salamander (*Plethodon albagula*)
  - Cave myotis bat (Myotis velifer incautus) maternal colony and bat caves.
  - Populations of a globally rare shrub, Texabama croton (*Croton alabamensis texensis*)
- Support and conduct leading, innovative scientific research
- Support and maintain the mission of the largest armored force in the U.S. Army by limiting natural resources encroachments and by providing quality, realistic training lands

Fort Hood is home to two federally listed birds, the black-capped vireo (far left) and the golden-cheeked warbler (left). (Photos: U.S. Army)

## Approach

### CONSULTATION WITH U.S. FISH AND WILDLIFE SERVICE (USFWS)

- Prepared biological assessment
- Biological opinion rendered by USFWS: Based on the direct and indirect impacts of military training on the vireo and warbler populations and the conservation measures undertaken by III Corps to maintain and enhance Fort Hood's populations, the USFWS issued a "no jeopardy" opinion.

### DEVELOPMENT OF AN ENDANGERED SPECIES MANAGEMENT PLAN (ESMP)

Fort Hood's ESMP is based on the concept of adaptive management. This approach recognizes that protection and management actions are implemented with imperfect knowledge. As research and monitoring progresses, the knowledge gaps are filled which allows improved management and decision making. Serves as primary guidance to protect, manage, inventory, monitor, and research threatened, endangered, and sensitive species and their habitats.

### HABITAT ASSESSMENT

Before protecting bird habitat, we needed to know the location, extent, and configuration (contiguous or not). This area in particular required flexibility on the part of the trainers and the natural resources land managers because it constantly evolved based on the data and survey effort. We used aerial photography and satellite imagery along with ground truthing; this method proved 100 percent accurate in identifying bird habitat. For karst features, we used Cultural Resources Branch archives, historic community karst accounts, and on-the-ground field searches to locate, map, inventory, study, and monitor features.

### POPULATION MONITORING

Once we established where habitat areas were situated, occupancy assessment and population monitoring became crucial parts of the inventory process.

- We capture, band, and monitor birds to obtain valuable demographic data that provide a detailed account of population parameters. We use these data to document and update population baseline and demographic trends over time; both of which we use to assess the impacts of military training on the warbler and vireo populations. Adaptive management and flexibility are very useful tools as data are gathered and analyzed.

- We manage populations of the brown-headed cowbird (*Molothrus ater*), an obligate nest brood parasite. Unmanaged cowbird populations are a serious threat to warbler and vireo reproductive success and population growth.
- We monitor and index cave myotis bat maternal population monthly to document population trends across time. All other bat caves are also monitored for bat activity and roosting.
- We sample karst invertebrates and monitor cave microclimate to obtain an index of occupancy and health of the ecosystem across time.

### ESTABLISHMENT OF ENDANGERED SPECIES SURVEY AREAS (ESSA)

We needed to know if training is having a negative impact on warbler and vireo populations. This is easy enough to accomplish in the maneuver areas via demographic study areas and point count routes, but in the impact area the investigation is more difficult. A conflict exists because it is crucial for units to maintain weapons systems proficiency and wildlife surveys ultimately result in range shutdown. To minimize training time loss and to gather valuable demographic data, we established ESSAs. Training managers schedule one day every two weeks (usually on weekends) for bird survey crews to gather demographic data on and near weapons firing ranges. This approach reduces training time loss by providing predictability in terms of access for both survey crews and for military units, plus it is scheduled on a day of the week when most ranges are not utilized.

### ESTABLISHMENT OF "CORE" AND "NON-CORE" HABITAT AREAS

Once we delineated habitat, established a population monitoring program, and assessed military training intensity/tactics; we needed to protect bird habitat. During the early nesting period, training restrictions in habitat were unnecessarily restrictive due to imperfect knowledge about how much habitat was needed for viable populations, how much habitat existed, population size and demographic

Population monitoring of golden-cheeked warblers at Fort Hood. (Photos: U.S. Army)

trends over time, and how the population responded to training. By adhering to adaptive management principles and collecting reliable data, we were able to reduce training restrictions in areas highly used by units for multiscale operations, areas we refer to as "non-core" habitat. The small percentage of habitat currently under restrictions are rarely used by units for large-scale operations, we refer to these areas as "core" habitat. By leveraging protection to rarely used habitat areas and by lifting restrictions in highly used areas, we were able to greatly reduce military training and endangered species protection conflicts.

- "Core" habitat areas are those areas needed for long-term population maintenance and in which training is highly restricted. We delineated these areas with highly visual signs for troops in the field. Most of these areas receive very low amounts of training, so there is little conflict with mission readiness.

- "Non-core" habitat areas are also needed for long-term population maintenance, but training is not restricted in these areas. "Non-core" areas receive the same amount of protection and monitoring as "core" areas, except that units are allowed to plan and execute operations with minimal damage to the habitat. Current doctrine of BCT battle drills usually result in ephemeral, temporally-spaced habitat occupation so bird populations are rarely exposed to long-term stressors. As contradictory as it seems, moderate amounts of BCT maneuver training help create and maintain vireo habitat. Similarly, wildfire ignited by weapon systems firing assists in maintaining and creating open shrubland, a crucial habitat component for vireos.

### SUPPORT AND CONDUCT LEADING, INNOVATIVE RESEARCH

Fort Hood is the leader in warbler and vireo research and the installation is often the reference location for such investigations. With respect to warbler and vireo management, Fort Hood has developed many innovative studies and monitoring techniques. Some examples include:

- **LIGHT DETECTION AND RANGING** (LiDAR), which is very useful for remotely determining shrubland vertical structure (an important component of vireo habitat) and mature forest canopy structure (an important component of warbler habitat).

- **REMOTE ACOUSTIC MONITORING.** Fixed Autonomous Recording Units (ARUs) are deployed in remote and inaccessible habitat areas (e.g. impact area); the units automatically record bird vocalizations over a period of many weeks, data reveal density and breeding activity. Airborne ARUs are deployed on an aerial platform (much like weather balloons) and are launched over target areas; data give a quick, limited time-frame indication of occupancy and density.

- **INFRARED (IR) NEST CAMERAS.** IR camera systems are used to identify and quantify predators at vireo and warbler nests. Data reveal that Texas rat snakes (*Elaphe obsoleta lindheimeri*) are the primary predators of both species. Data also reveal predator behavior at the nests, warbler and vireo response to predators, and predator activity shifts and timing as the breeding season progressed. IR camera studies revealed that red imported fire ants (*Solenopsis invicta*) are a major predator of vireos. Small, organic pellets and strips (sustained release devices) with internal micropores charged with volatile ant repellant compounds were deployed at vireo nest sites. The devices slowly allow a miniscule repellant vapor "curtain" to develop, thereby providing protection from ants during the vireo nest cycle.

- **STRESS HORMONE STUDY.** Vireos and similar shrubland nesting birds were subjected to various levels of stress which simulates military training. Hormone response analyses revealed that vireos tolerate moderate levels of simulated military stressors. An expanded hormone and heart telemetry study using warblers and vireos and various levels and types of simulated military stressors are currently under investigation.

- **TEXAS RAT SNAKE STUDY.** Using implanted transmitters and 24-hour, autonomous transmitter tracking arrays, analysis and study are currently conducted on snake habitat use, territory size, prey availability, seasonal movement patterns, and local life history traits. Ultimately, predator-prey dynamics, especially with relation to warbler and vireo habitat, will be better understood.

- **OFF-POST BUFFERS.** III Corps is working with several partners to establish conservation easements, safe harbor agreements, and wildlife management plans on private lands surrounding Fort Hood. The functions of this initiative are to relieve the warbler and vireo recovery burden placed onto Fort Hood and to preserve metapopulation dynamics between Fort Hood and the surrounding landscape.


Sign at Fort Hood denoting restricted area due to endangered species. (Photo: U.S. Army)

## Successes

Within the range of the warbler and vireo, Fort Hood is the only land manager with completely recovered populations. Fort Hood has greatly exceeded population and habitat goals.

- Fort Hood has located, surveyed, and mapped many karst features; installed specially designed gates on caves with endemic cave-dwelling species that are near commonly used areas, and established karst management areas and buffer zones.
- Currently studying population, distribution, and genetics of the karst dependent slimy salamander.
- Protected the cave myotis bat maternity colony site with a buffer zone delineated by rock barriers and installed two Bat Conservation International-approved bat gates on cave entrances.
- Karst ecosystems and croton populations are found in warbler and vireo habitat, so protection of bird habitat also provides protection for other rare and sensitive species.
- Helped maintain mission readiness by providing quality training lands and minimizing training time loss for several BCTs as they prepare for operations in the Middle East.

## Lessons learned

Potentially conflicting land uses, such as armored military training and ecosystem protection, can be attained with careful planning, observation, research, plan implementation, and most importantly, stakeholder collaboration. Difficult management decisions and decision analyses, as well as stakeholder compromises, must be made to accomplish the delicate balance of training the Armed Forces and preserving wildlife and their habitats.

CASE STUDY
CHAPTER FIVE
MULTIPLE USES

BEALE AFB

# Habitat Conservation Planning Provides an Ecosystem-Based Roadmap for Natural Resources Protection

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Beale Air Force Base, situated in the northern Sacramento Valley of California, is the home of numerous highly sensitive vernal pool wetlands. The airbase has a long history of addressing wetland regulatory requirements. Complying with those requirements can be burdensome and expensive, and it can complicate not only meeting the military mission but detract from larger base conservation efforts. The U.S. Army Corps of Engineers has outlined an ecosystem-based approach to addressing these requirements known as Special Area Management Planning (SAMP) that we successfully employed at Beale.

We addressed SAMP through the development of the Beale AFB Habitat Conservation and Management Plan (HCMP) that provides a multi-species approach to natural resources conservation by protecting large tracts of land that provide habitat for many species of plants and wildlife. The plan also provides mitigation plans for adverse effects on natural resources associated with implementation of the Beale AFB General Plan and provides guidelines for Endangered Species Act and Clean Water Act compliance for future projects.

## How it Supports Beale's Mission

The base's general plan identifies areas that are slated for future development. These areas are called "development areas." Sensitive natural resources on the base are mainly vernal pools (seasonal wetlands) and their associated wildlife species, and those that will be affected in the development areas have been identified. The HCMP defines what the base will do to mitigate for all wetlands that will be disturbed in these development areas in support of Beale's mission. At this point, all mitigation can be accommodated on the base's property. The mitigation consists of "conservation areas," where preservation, management, and restoration of wetlands and wildlife habitat will occur. Conservation areas comprise 5,300 total acres, which is roughly 23 percent of the base's property.

**PRESERVATION:** As a tradeoff for impacts in development areas, Beale has set aside existing high-quality wetlands in conservation areas throughout the base. These areas will only be used for future activities that are already in progress (such as drinking water well maintenance) and other activities that are compatible with grassland and seasonal wetland management (such as cattle grazing and prescribed burning).

- The main vernal pool preservation area is on the west side of the base to the north of North Beale Road. The vernal pools in this area are more likely to have federally listed crustaceans (vernal pool fairy shrimp and vernal pool tadpole shrimp) and a larger diversity of native plant species.
- The riparian preservation area along Dry Creek and Best Slough will also preserve approximately 720 acres of riparian (streamside) forest. This preservation will not serve as mitigation for wetlands, but instead will provide protection of the area of the base that has the highest biodiversity (i.e., many plant and wildlife species occur there), as well as providing habitat for a federally threatened species of fish.

**MANAGEMENT:** "Management areas" are those containing high-quality wetlands and threatened and endangered species habitat, but these wetlands are in areas identified for possible (but not likely) development in the future. Any development that would occur in those areas would be done as a last resort—meaning that there are no other areas that are appropriate for that type of specific activity. Therefore, these areas will be managed in the same way as the preservation areas, unless a special development project is identified for these areas.

**RESTORATION:** Also included in the HCMP are "restoration areas" where the construction of approximately forty acres of vernal pools and other aquatic areas will occur. These regions previously supported the vegetation types that will be restored there, but they had been degraded and destroyed by past agricultural and military practices before most environmental laws existed.

## The Future

The planning that occurred during the development of the Habitat Conservation and Management Plan now serves as a basis for obtaining large-scale permits from the appropriate regulatory agencies. Once these permits are completed, the development process at Beale will be expedited in support of the mission, while still assuring that Beale's precious natural resources are protected.

**HTTP://WWW.USACE.ARMY.MIL/CW/CECWO/REG/RGLS/RGL_05_09.PDF**


Kirsten Christopherson, Natural Resources Manager, uses a Special Area Management Planning process to address competing multiple uses at Beale AFB, Calif. (Photo: Douglas Ripley)

CASE STUDY
CHAPTER SIX
ENDANGERED SPECIES

DEFENSE FUEL
SUPPORT POINT

# Conservation of the Palos Verdes Blue Butterfly

## Defense Fuel Support Point, San Pedro, California

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The Palos Verdes blue butterfly (*Glaucopsyche lygdamus palosverdesensis*) (PVBB) is a postage stamp-sized butterfly that was described in 1977. It has only been found in a relatively small area in the Palos Verdes peninsula, in southern Los Angeles County, California. Due to its geographic isolation and declining abundance, it was listed as an endangered species in 1980. In spite of this, the City of Rancho Palos Verdes bulldozed the last known site for the butterfly in 1983 to establish a baseball diamond. When the U.S. Fish and Wildlife Service (USFWS) lost its case against the City of Rancho Palos Verdes for knowingly destroying the last known population, the U.S. Congress amended the Endangered Species Act to allow prosecution of not only individuals, but also municipalities and other entities. This is the butterfly that rewrote the Endangered Species Act.

In 1994, eleven years after it was thought extinct, a tiny relict population of approximately 65 individuals was discovered on the Defense Fuel Support Point, San Pedro, a Defense Logistics Agency (DLA) site which supplies aircraft and marine fuel to 28 military bases and activities in California, Arizona, and Nevada.

The butterfly's coastal scrub habitat on the Palos Verdes peninsula has been shrinking under pressure from urban development, and the DLA facility is surrounded by residential neighborhoods, businesses, schools, playgrounds, a golf course, a regional park, a cemetery, and an oil refinery. Other factors in the decline of the habitat include weed control, off-road vehicle use, and non-native plant invasion. **http://butterflyrecovery.org/species_profiles/palos_verdes_blue/**

## The DLA's Response to the Discovery

The rediscovery of the PVBB triggered one of the most successful recovery efforts for an endangered species in the history of the Department of Defense. **http://www.urbanwildlands.org/pvb.html**

The DLA quickly recognized that the protection of this species was not only a legal responsibility but that its recovery could potentially engender great public support for the DLA mission on the Palos Verdes peninsula and for the Department of Defense in general. Consequently, the DLA, U.S. Navy, and the Department of Defense began to work toward the recovery of the species, along with a team of partners including the U.S. Fish and Wildlife Service, University of California, Riverside, the Urban Wildlands Group, Palos Verdes Peninsula Land Conservancy, Moorpark College, America's Teaching Zoo, and the Soil Ecology Restoration Group at San Diego State University.

## Results

Restoration of habitat was an important first step in recovery, especially the reestablishment of healthy stands of the butterfly's host plants, locoweed and deerweed. These are cultivated in a special nursery run by the Palos Verdes Peninsula Land Conservancy. The Conservancy uses the plants and its open space as a medium for teaching local school children and as a place for volunteers from the local community to help with nursery operations and habitat restoration. This is a "good neighbor" situation that allows the Defense Fuel Support Point to assist with projects in its local community.

Surveys are another important component of the PVBB conservation. Annual surveys for adult butterflies have revealed that conservation efforts are being ef-

fective, as the population has grown and is relatively stable. Additionally, locating and mapping of PVBB host plants has allowed for identification of potentially important habitat and for more informed land management decisions.

Captive rearing soon became another important part of the recovery program. Through an agreement with UCLA, and in cooperation with the U.S. Fish and Wildlife Service, scientists from the University of California–Los Angeles Geography Department began overseeing a captive butterfly rearing program. The primary site is situated at Defense Fuel Support Point San Pedro, and a secondary captive rearing site is with the Butterfly Project of The Urban Wildlands Group at America's Teaching Zoo. Both sites are funded through the DLA and the U.S. Navy. **http://www.urbanwildlands.org/pvb.html**

A recent shift in the care and handling of the butterflies, involving hand feeding adults by volunteers and interns with specialty "deerweed" honey water artificial nectar, has resulted in an explosion of the captive rearing stock over the past two seasons from 186 to 4,700. This will allow for an unprecedented reintroduction to several areas over its original habitat on the Palos Verdes peninsula in the spring of 2008.

In addition, the restoration efforts have provided many learning and research opportunities for both the general public and university students and faculty. The DOD and DLA have also received an unprecedented amount of positive publicity for the work they have done to recover the PVBB.

Above: Jana Johnson working in the greenhouse with seedlings of the butterfly's host plants. (Photo: Alex Dunkel, Defense Logistics Agency)

Below: Palos Verdes blue butterfly (Photo: David Severin, Defense Logistics Agency)

## Keys to Success

- Early and conscientious attention to the issue once it was recognized
- Cooperative conservation: recruitment of a wide-ranging team of partners to work together for the recovery of the species
- Successful funding to support the recovery programs
- Cost-sharing initiatives, including in-kind services, from partners
- Positive and highly effective public affairs support throughout the project

**HTTP://WWW.FWS.GOV/ENDANGERED/BULLETIN/2000/11-12/18-19.PDF**

## Conclusion

The DLA achieved great success in conserving biological diversity in a highly degraded habitat and did so in a way that was completely compatible with its primary military mission of providing supply support, and technical and logistics services to the U.S. military services and several federal civilian agencies. The DLA has forged a model for government and private efforts to conserve endangered species.

CASE STUDY
CHAPTER SIX
ENDANGERED SPECIES

SAN CLEMENTE ISLAND

# Management of Threatened, Endangered, and At-Risk Species

## San Clemente Island, California

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San Clemente Island (SCI) is the southernmost of the eight California Channel islands. It lies 55 nautical miles (nm) south of Long Beach and 68 nm northwest of San Diego. The island is approximately 21 nm long and is 4.5 nm across at its widest point. Since 1934, the island has been owned and operated by various U.S. naval commands. A dozen range and operational areas are clustered within a 60-mile radius of the island as part of the Southern California Offshore Range Complex. The Commander, Naval Forces Pacific, is the major claimant for the island, and Naval Base Coronado is responsible for its administration. For additional information, see the following web sites:

HTTP://WWW.SCISLAND.ORG/ABOUTSCI/ABOUTSCI.PHP

HTTPS://WWW.CNIC.NAVY.MIL/CORONADO/INSTALLATIONS/SANCLEMENTEISLAND/INDEX.HTM

## Biological Significance

SCI possesses a remarkable biological diversity, including many endemic species and ten species that are federally listed as either endangered or threatened:

- SCI loggerhead shrike (*Lanius ludovicianus mearnsi*)
- Western snowy plover (*Charadrius alexandrinus nivosus*)
- Sage sparrow (*Amphispiza belli clementeae*)
- Island night lizard (*Xantusia riversiana*)
- SCI rock cress (*Sibara filifolia*)
- SCI bushmallow (*Malacothamnus clementinus*)
- SCI Indian paintbrush (*Castilleja grisea*)
- SCI broom (*Lotus dendroideus ssp. Traskiae*)
- SCI larkspur (*Delphinium kinkiense)*
- SCI woodland star (*Lithophragma maxima*)

Also, the island harbors the island fox, a species that occurs on five other Channel islands, but which is a species of concern on SCI.

## Management of Listed Species

- In the 1970s the Navy recognized that recovering listed species on the island would not be possible without the removal of feral goat and pig populations, which negatively impacted the entire native biota. By 1991, all feral goats and pigs had been removed from the island.
- There are currently five separate Biological Opinions (BO) rendered by the U.S. Fish and Wildlife Service (USFWS) under the authority of the Endangered Species Act.
- The terms and conditions from these BOs have been translated into conservation actions and/or goals in the SCI Integrated Natural Resources Management Plan (INRMP).
- The INRMP also identified areas on the island with high and low inherent military value, and high and low inherent natural resources values. Most conservation efforts are focused on those parts of the island where high military and high natural resources values overlap, such as at the extreme ends of the island, thereby reducing conflicts.


## Management of Species At Risk

- The island fox, which is experiencing declines on other Channel islands, could be listed at SCI.
- To obviate listing, the Navy has worked with the USFWS to eliminate major threats to the island fox population:
  - Development of non-lethal fox deterrents to protect the endangered loggerhead shrikes from predation
  - Reducing road kills
- In 2003, the Navy entered into a cooperative conservation agreement with the USFWS to develop an island fox management plan.
- Also in 2003, the Navy nominated the island fox to the DOD Legacy Species at Risk Program. Through the program, implemented by the conservation organization NatureServe, a management plan for the SCI fox was developed cooperatively among Navy biologists, the USFWS, and the State of California Natural Heritage Program. Visit the following web site for more details: **www. natureserve. org/prodServices/speciesatRiskdod.jsp.**

San Clemente Island loggerhead shrike (Photo: U.S. Navy)

## Successes

- The removal of feral animals has allowed for the recovery of native vegetation, which has significantly enhanced habitat for most other animal species, especially the SCI loggerhead shrike.
- A restoration program is enhancing habitats for endangered species by augmenting the distribution of native plants propagated in the island's nursery. To date, thousands of individuals have been planted, with a survival rate at about 90 percent.
- There have been no interruptions of the Navy's training and testing activities on SCI due to threatened, endangered, or sensitive species.
- The island night lizard population may soon be de-listed by the USFWS.
- Navy-sponsored population studies on the San Clemente sage sparrow have revealed valuable data for the development of recovery strategies for the species.

## Lessons Learned

- Fostering good working relationships with federal regulatory agencies, in this case the USFWS, increases management options for the conservation and recovery of endangered species.
- By openly sharing operational training requirements and an assessment of associated impacts with federal regulatory agencies, trust is enhanced. Over at least a decade of coordination between the Navy and USFWS, the latter has gained both an understanding and an appreciation for the military mission at SCI, and for the Navy's commitment to environmental stewardship.
- Environmental stewardship must be proactive, such as the identification of and the application of management strategies for species of concern prior to their list-

ing. The island fox candidate conservation agreement with the USFWS, implemented through the Legacy-funded Species at Risk Program sponsored by NatureServe, will both protect the population and obviate its listing.

## Summary

San Clemente Island supports some of the most important weapons research, development, test, and evaluation programs and essential military operational training within the Navy. Despite such activity, the island's biological community is being both preserved and enhanced through multiple natural resources conservation and management programs. The Navy, in cooperation with the USFWS and other governmental environmental agencies, and with the support and encouragement of nongovernmental environmental organizations, such as The Nature Conservancy and NatureServe, has been able to achieve to the maximum extent possible both the military mission and environmental stewardship in a setting unique to each.

Above left: Native plants, including endangered plants, are propagated in the on-site nursery.

Above right: A grassland plateau, now recovered, provides nesting habitat for loggerhead shrikes (Photos: U.S. Navy)

Island night lizard. (Photo: U.S. Navy)

# U.S. Marine Corps Training and "Sweat Equity" Overcome Foreign Plant Invaders

## Marine Corps Base Hawai'i, Kaneohe Bay, Hawai'i

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Pickleweed (*Batis maritima*) and mangroves (*Rhizophora mangle*) are aggressive plants, non-native to Hawai'i, that have spread rapidly through coastal wetlands, where they displace, and sometime eliminate, native vegetation and wildlife. Unlike in their native habitats in other tropical regions, the mangroves introduced into Hawai'i in the early 20th century are a serious pest and significant threat to native biological diversity. The Hawaiian stilt *(Himantopus mexicanus knudseni*), a federally listed endangered species, has declined for several reasons, including loss of mudflat foraging and nesting habitat overtaken by these invasive plants. If left uncontrolled, these aquatic invaders provide cover for predators, clog and stagnate waterways, obstruct floodwater drainage, increase algal production, lower water quality and oxygen available for indigenous aquatic life. These are some of the major challenges facing resources managers at Marine Corps Base Hawai'i's Mokapu peninsula, known as MCBH—Kaneohe Bay, on the island of O'ahu's windward side. Marine Corps Base Hawai'i (MCBH) wetland habitat here provides home to about 10 percent of the State's remaining Hawaiian stilt population. Three other endangered Hawaiian waterbird species are also found here, as well as over fifty species of shorebirds and seabirds counted over the past 50 years. In addition, dense mangrove thickets along the peninsula's border with Kaneohe Bay provide cover for illegal activity, such as fish poaching.

## An Innovative Solution

For the past twenty-five years, MCBH has deployed innovative approaches to address these serious threats to environmental health by combining combat training with habitat restoration and by uniting military and civilian volunteers in weed removal service projects that build sustained community support for the military as exemplary environmental stewards.

**"PICKLEWEED PATROLS."** Starting in the early 1980s, with partner agency input from U.S. Fish and Wildlife Service and Hawai'i's Department of Land and Natural Resources, MCBH resources managers have supervised training maneuvers by 27-ton amphibious assault vehicles (AAVs) of the Third Marine Regiment's Combat Assault Company in pickleweed-infested wetland mudflats on base. These maneuvers have become an annual event, just before onset of stilt breeding season. The plowing action creates a beneficial checkerboard "moat and island" pattern in the terrain which controls pickleweed infestation, discourages predator access, improves the ground surface for stilt nesting, and provides ready access by newly-hatched stilt to water-resident food sources (e.g., flies, larvae, crustaceans). This is critical as stilt chicks must forage for themselves at birth. These maneuvers also provide Marines valuable training which they have nicknamed their annual "Mud Ops" maneuvers. AAV drivers, whose training options are limited elsewhere in Hawai'i, gain valuable practice in this difficult, muddy terrain, by deliberately getting their AAVs stuck. They build teamwork skills while towing their vehicles in daisy-chain fashion to get them unstuck. Developing such skills is an established part of USMC training curriculum and have proven useful in situations, such as recently in Iraq, where a mechanized company got mired in the mud during an attack and had to extract itself quickly while under hostile fire.

Left: Marine Corps Base Hawai'i, Kaneohe Bay. Below: Natural resources monitoring at MCB Hawai'i. (Photo: U.S. Marine Corps)

**"MANGROVE BUSTER" TEAMWORK**. Also starting in the early 1980s, MBCH resources managers and Marines began teaming with civilian volunteers such as the Sierra Club, other environmental, youth, school, and civic organizations to host "ecology camps" and service projects to remove mangrove with hand tools and forge bonds with each other while working toward a shared goal of improved environmental health. Contractors with mechanized equipment also played a crucial role in areas where the infestation was too thick for hand-tools to tackle alone. A total of about twenty acres of mangrove forest have been removed by these efforts.

Above: Hawaiian *stilt forages in mudflats* (Photo: R. Shallenbarger)

Above: AAVs plowing pickelweed-infested mudflats to open up better habitat for endangered Hawaiian stilts to nest and forage.

Left: AAV crews gain valuable team-building skills while getting their 27-ton vehicles "unstuck" from difficult muddy terrain. (Photos: D. Drigot)

Right: Wetlands prior to (top) and after (bottom) removal of invasive non-native mangroves. (Photos: GeoSight International, Inc.)

## Accomplishments, Results, and Positive Publicity

During the time span of implementing these innovations, pickleweed has been kept in check, "Mud Ops" is featured annually in the popular media, and in 2004, a nationally-distributed poster celebrating this partnership between combat training and conservation was produced as part of a "Saving a Few Good Species" awareness campaign, co-sponsored by the Marine Corps and the U.S. Fish and Wildlife Service. **http://www.fws.gov/endangered/pubs/marines.html**

During the same period, almost all mangrove infestation in MCBH wetlands has been removed. Systematic counts of stilt on-base have documented a steady rise in their numbers, from about 60 to 160 birds, and other environmental improvements have been scientifically documented. MCBH is recognized as a proactive conservation leader in the State of Hawai'i's Aquatic Invasive Species Management Plan (2003) (see **http://www.hawaii.gov/dlnr/dar/pubs/ais_mgmt_plan_final.pdf**) and in the National Wildlife Federation's publication Under Siege: Invasive Species on Military Bases (2005). MCBH won the 2005 Natural Resources Conservation Award in the Secretary of Defense's interservice military competition. National and international publications further detail benefits of this novel partnership between combat training and conservation. See, for example, D. Drigot, 2001. "An Ecosystem-based Management Approach to Enhancing Endangered Waterbird Habitat on a Miltary Base," Cooper Ornithological Society's Studies in Avian Biology, No. 22, edited by J. M. Scott, S. Conant, and C. van Ripper, III ; and M.J. Rauzon & D. C. Drigot, 2002 "Red mangrove eradication and pickleweed control in a Hawaiian wetland, waterbird responses, and lessons learned," in Turning the Tide: The Eradication of Invasive Species, edited by C.R. Veitch and M.N. Clout, Occasional Paper of the IUCN Species Survival Commission No. 27, IUCN–The World Conservation Union, Gland, Switzerland.

Combined Marine and civilian volunteers and contractors conquer foreign plant invaders at MCBH wetlands, restore endangered species habitat, and build community bonds. (Photos: top and bottom, D. Drigot; center, M. Rauzon)

## Conclusion

It took unwavering vision, resources manager and military teamwork, about $2.5 million, the sweat of thousands of volunteers, contractor know-how and combat military might in a persistent push over 25 years to bring pickleweed and mangrove infestations under control at MCBH, but it was well worth the effort. Twenty acres of "saved" habitat may not seem like a lot, but in a small island state hosting about 25 percent of the United States' listed endangered species, it represents a significant achievement in providing a "proving ground" of what can be done when partners work effectively together, often "outside the box" and with a shared vision of possibilities. This story also shows that while Marines are limited in funding and numbers, they are unsurpassed in motivation and creativity and willingness to work with other groups. Other branches of the military and community groups elsewhere across the state have also joined forces, battling invasive species in other irreplaceable Hawaiian habitats. Through determined, innovative teamwork, together we will curb the onslaught of invasive species. We will do it because we have no other choice but to protect our military's ability to train, preserve Hawai'i's ecosystems—a unique part of our nation's heritage—and to help sustain a healthy economy. We hope to inspire similar efforts elsewhere. Remember, however, it takes years of persistence to win this battle and the effort should be immune from partisan politics.

CASE STUDY
CHAPTER SEVEN
INVASIVE SPECIES

FAIRCHILD AFB

# Biological Control of Noxious Weeds

## Fairchild AFB, Washington

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Everywhere you go, there are weeds to deal with. Whether it's the dandelions in the commander's yard or an obnoxious thistle on the back forty, we all have weeds. In the past it presented little problem to attack these invaders. Call the base entomologist or a local contractor to come and spray the area. That has all changed now. Using 1993 as a base year, the Air Force mandated a fifty percent reduction in pesticide use by the year 2000. Fairchild AFB used that requirement to seek new ways to reduce pesticide use while at the same time controlling weeds and enhancing native biodiversity.

## Location and Land Condition

Situated 10 miles west of Spokane, Washington, Fairchild Air Force Base occupies approximately 4,500 acres in eastern Washington State. Much of the undeveloped portions of the base are dominated by pasture grasses and associated agriculture weeds.

## Impact On the Military Mission

Noxious weeds were degrading the natural habitat of Fairchild AFB, especially in unimproved areas, including over 300 acres of wetlands. Fairchild was in a predicament as weeds continued to spread in spite of spraying, wetlands posed a problem when using herbicides so buffer strips were set aside to assure the spray didn't reach the water, and the off-base neighbors criticized the base's continuing noxious weed problem.

## The Solution Using Biological Controls

The 92nd Civil Engineering Squadron, which is responsible for the maintenance of grounds and infrastructure on the base, brought together a group of experts on the base to attack the problem. The environmental flight and the base entomologist decided to try an innovative solution: "Biological Controls." A biological control can involve intentionally using living organisms to reduce the population of a pest species. These may include microscopic plant pathogens, insects, nematodes, mites, and vertebrates. Often more than one agent is introduced to control a specific weed. The effect of the biological control agent may be obvious, such as when the plant is defoliated, or it may be subtle, such as when slight damage caused by the biological agent allows secondary organisms to inflict greater damage.

The U.S. Department of Agriculture, through the Agricultural Research Service (ARS) **http://www.ars.usda.gov/main/main.htm** and the Cooperative State Research, Education, and Extension Service (CSREES) **http://www.csrees.usda.gov/**, conducts a complex procedure for locating, screening, releasing and monitoring biological control agents of weeds. Every effort is taken to ensure that introduced biological weed control agents are limited to specific hosts and do not threaten other plants. Precautions are also taken to ensure that the introduced agents are not diseased. After testing, various petitions and permits are required before field releases of bio-controls can be made. Every step of the process is closely monitored to ensure that the bio-controls are host-specific, pathogen free, disease free and that the agent to be released is the exact specimen that has been tested.

## Implementation

Fairchild AFB identified seven major noxious weeds for biological control: Russian Knapweed, Spotted Knapweed, Diffuse Knapweed, Canada Thistle, Musk Thistle, Plumeless Thistle, and Rush Skeletonweed. Working closely with Dr. Gary Piper, Washington State University, several specific agents were identified which would work on the identified weeds. These controls included Seed Head Gall Flies (*Urophora affinis and quadrifasciata*), Stem Gall Flies (*Urophora cardui*), Seed Eating Weevils (*Rhinocyllus conicus*) and Leaf and Stem Gall Flies (*Cystiphora schmidti*). HTTP://WWW.AENEWS.WSU.EDU/JUNE02AENEWS/KNAPWEED/KNAPWEED.PDF

| Noxious Weeds | Biocontrol Agent |
|---|---|
| Russian Knapweed | *Urophora affinis and U. quadrifasciata* |
| Spotted Knapweed | *Urophora affinis and U. quadrifasciata* |
| Diffuse Knapweed | *Urophora affinis and U. quadrifasciata* |
| Canada Thistle | *Urophora cardui* |
| Musk Thistle | *Rhinocyllus conicus* |
| Plumeless Thistle | *Rhinocyllus conicus* |
| Rush Skeletonweed | *Cystiphora schmidti* |

In preparation for this project, Fairchild AFB conducted an Environmental Assessment as required by the National Environmental Policy Act (NEPA). More than one hundred neighboring landowners were notified of the proposed effort and invited to participate in a public meeting to review the proposed action. The response was overwhelmingly positive and many of the landowners attending expressed an interest in implementing biological controls on their property. The public review yielded no negative comments or opposition.

The thistle head weevil (left) , a biocontrol agent, and the Musk thistle (right), an invasive weed. (Photos: Fairchild AFB)

## Results

Dr. Piper implemented the program in May 1996 by collecting various insects from sites where they had previously been released. During the following two months he delivered the insects to Fairchild AFB and immediately released them at predetermined sites within the unimproved area of the base. Each of the sites was identified and marked both on the ground and on maps to ensure accurate monitoring of the progress and success of the program.

We achieved early and dramatic results. Many of the thistles quickly developed stem galls, flowering seed heads were full of larvae, and leaves on the plants showed evidence of insect damage. Approximately 300,000 insects were released at a cost of $30,000, an amount about equal to treating the same acreage with traditional chemical pesticides. The big cost savings will come during the ensuing years when the insects reproduce naturally. They will continue to attack the weeds and no spraying will be required. And, the elimination of pesticides contributed significantly to meeting the Air Force pesticide reduction goals.

In all, Fairchild treated over 710 acres of unimproved ground with biological controls. We eliminated spraying near 300 acres of high-quality wetlands. Approximately 1,200 acres of ground was eliminated from our spraying program; that will result in a 40 percent decrease in pesticide sprayed to control noxious weeds.

The main disadvantage of biological weed control is that it often takes many years for the populations of the introduced agents to increase to levels that permanently decrease the pest plant populations. A limited number of eggs are laid by insects and initial population build-up appears slow. However, insect numbers increase exponentially. As biocontrol populations increase, the weed population will gradually decrease and may be unnoticed by the land manager. Biological controls usually do not eradicate weed populations. Rather, they will mainly reduce the population and thus the spread of the weed.

## Conclusion

Use of biological agents is only one tool in the fight against noxious weeds. Multiple control methods are important when implementing any management system. Each installation needs to take an integrated approach when attacking noxious weeds and other pests. An integrated pest management plan (**http://www.epa.gov/pesticides/factsheets/ipm.htm**) should be prepared in order to ensure a coordinated approach is taken.

### REFERENCES


Biological Control of Weeds in the West, February 19 (Western Society of Weed Science, P.O. Box 10342, Helena, Montana, 59604)
**http://www.weedcenter.org/management/bioweed-credit.pdf**

Dr. Gary Piper, Washington State University, Pullman, Washington, 99164
**http://www.aenews.wsu.edu/June02AENews/Knapweed/Knapweed.pdf**

Biological Control of Weeds (Noah Poritz, 1418 Maple Drive, Bozeman, Montana, 59715)
**http://wsare.usu.edu/pro/pr2003/FW01-032.pdf**

# Ho'ola I Ka Aina: Restoring Health to the Land

## MCB Hawai'i Helps Restore Watershed Health While Strengthening Military-Community Bonds

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Marine Corps Base Hawai'i (MCBH) is situated on the island of O'ahu in the Hawaiian islands—the most isolated land mass in the world, with a unique natural and cultural resources heritage and over 25 percent of US endangered species. MCBH itself is a place of uncommon beauty, rich biological diversity, numerous Native Hawaiian sites and military structures of national historic significance. The Marine Corps in Hawai'i controls about four thousand acres on O'ahu, with three primary properties on the island's windward side, within the Ko'olaupoko District. This district comprises an almost idealized tropical landscape of mountain peaks, coastal wetlands, three bays, offshore fringing reefs, and eleven catchments or watersheds. At the time of European contact (1770s), Hawai'i's original Polynesian settlers had transformed this region into one of the most biologically rich and productive in the islands. It was well populated and a favored gathering place for local chiefs. The Hawaiians channeled and recycled water as it flowed down mountain streams, through agricultural fields and fishponds, to support a large human population.

By contrast, today this region is populated by diverse urban to rural, ethnically mixed to Native Hawaiian, relatively affluent to low income communities. Flooding, nonpoint pollution, invasive alien vegetation encroachment, and urban development have divorced people from the land, contributed to loss of wetlands and wildlife habitat, and increased non-point pollution. Many coastal fishponds and wetlands here, whose "goods and services" once included their sponge-like capacity to absorb water and filter pollutants are now filled in, clogged with excess nutrients, alien vegetation, and sediment. This degrades their natural capacity to absorb floodwaters and filter nonpoint pollution from surface runoff. MCBH properties in this region are affected by these trends as much as their civilian neighbors. Public concern about the environment here is strong and focuses on a regional scale to restore watershed health.

This reflects a nationwide enhanced public awareness that watersheds are useful units of analysis for approaching solutions to many environmental problems. Many watershed-scale solutions are supported through plans, regulations, and cooperative agreements. The State of Hawai'i has ranked the Ko'olaupoko region as "priority one" for watershed restoration attention under the National Clean Water Action Plan.

Of primary concern to this region is how nonpoint pollution, increased sedimentation, and excess freshwater in stormwater runoff from impervious urban surfaces often flows unimpeded through straightened stream corridors and concrete-lined channels into the sea, closing beaches, causing sediment plumes, and threatening health of human communities and marine life. In Ko'olaupoko's offshore environment, where Marines train, aquatic wildlife are the "canary in the mine" with respect to showing symptoms of the problem. We see increased numbers of seabirds and marine mammals and reptiles ingesting plastics or tangled in marine debris. We see tumors on our turtles (Hawaiian green sea turtle, *Chelonia mydas,* a listed threatened species). While the exact cause still eludes scientists, evidence implicates polluted stormwater runoff as a key contributor to algal and bacterial blooms in our coastal waters, releasing biotoxins that suppress marine animal immune systems, thus promoting the growth of abnormal tissue such as the debilitating tumors. Hawai'i's freshwater aquatic species are increasingly at risk due to nonpoint pollution impacts concentrated in offshore coastal areas. Of the nine migratory aquatic fauna in Hawai'i that use whole stream chan-

nels (endemic species of snails and gobies), only one is currently listed as threatened (Newcomb's snail, *Erina newcombi*), but the others are listed as species of concern and are believed to be largely extirpated from the island of O'ahu due to habitat modifications such as hardened stream channels and increased temperature of water in largely urbanized stream corridors. All four species of Hawai'i's listed endangered waterbirds also depend upon healthy coastal riparian stream and wetland habitats for foraging and nesting opportunities. Fortunately, the Ko'olaupoko District contains 1,656 acres, or 82 percent of the island's remaining protected wetland habitat (with MCBH being a primary host of suitable healthy wetland waterbird habitat, used extensively by waterbirds and other protected species of shorebirds and seabirds in this region).

## An Innovative Solution

Community volunteers planted native plant gardens along streamsides. (Photo: MCB Hawai'i)

In this biologically rich but stressed Ko'olaupoko watershed region, our MCBH natural resources management program has made considerable investment in watershed health restoration projects involving civilian-military cooperation to improve prospects for delisting endangered waterbirds and protecting other native species at risk, while also enhancing military training opportunities. We measure success not so much by numbers of species recovered or by numbers of environmental restrictions removed from military training operations, but by such criteria as number of successful collaborative management actions undertaken that result in a "win-win" benefit to military training, endangered species recovery, and improved quality of life.

Another MCBH case study in this guide details how over twenty-five years, MCBH has combined combat training with waterbird habitat restoration and has united military and civilian volunteers in countless weed removal service projects to restore MCBH wetlands and build sustained community support. In addition to those actions, MCBH has played a leadership role in working collaboratively with the community to help solve stormwater management problems described above on a watershed scale. Examples follow:

### ACCOMPLISHMENTS, RESULTS, AND POSITIVE PUBLICITY

■ In 2001, MCBH completed a $400,000 demonstration watershed restoration project which engaged over one thousand community volunteers to create three native plant riparian (streamside) gardens along channelized storm drain corridors on MCBH properties. We hosted multiple "walk the watershed" events to demonstrate nonpoint source pollution best management practices and develop a regional vision of improved watershed health. University of Hawai'i credits and tuition waivers were granted to 16 local elementary school teachers who, with their students, assisted MCBH natural resources staff in planning, installing, and maintaining demonstration garden plots as part of a graduate-level watershed health course they completed. (The course was funded by the Marine Corps and designed and taught by this author, who is a pro-bono affiliate faculty member of the University). Investing in Hawai'i's teachers (who pass on this knowledge to countless children) results in a more sustained, collective community awareness of watershed restoration possibilities. One participating teacher from MCBH's on-base Mokapu elementary school composed a song celebrating MCBH's Mokapu watershed. A hula was choreographed to dance with the song and performed by

all the students in a school-wide assembly. Since then, hundreds of students, military families, retirees, civic and business groups have used these gardens for watershed education, cultural awareness, academic credit, and environmental service activities. A community-based web site hosts news about MCBH activities as part of a region-wide emphasis on watershed health restoration (**http://koolau.net**).

■ Another part of MCBH's watershed project was to produce displays, maps, and technical reports assessing watershed conditions and possibilities in the region based on inputs from some of the nation's foremost watershed scientists (e.g., the late Luna Leopold and colleagues) as well as indigenous and local knowledge from the surrounding community. This built upon information already compiled in our 1998 MCBH Mokapu Watershed Health Manual (**https://www.denix.osd.mil**), which is still accessed by teachers and community groups.

■ In 2004, a $300,000 project was completed that resulted in successful renovation of three half-acre stormwater retention basins/wetlands/endangered bird habitats on MCBH's Klipper Golf Course. It included sediment/weed removal, installation of native plants, solar-powered aerators, an interpretive sign, and construction monitoring (before, during, and after construction) of endangered bird activity and native plant reestablishment in these improved wetland basins. Delightfully unexpected increased waterbird use was noted right away. Reduced pond flooding and maintenance were noted by the golf course greens managers. Lessons learned were documented in a University of Hawai'i natural resources student master's thesis and shared on a 2005 Navy calendar distributed nationwide by *Currents,* the Navy's environmental magazine.

New construction projects at MCB Hawai'i have incorporated sustainable design principles that support watershed health. (Photo: MCB Hawai'i)

■ In 2006, a $900,000 project replaced a dysfunctional, weed-choked drainage ditch/wetland (about one acre in size) with a deepened and expanded wetland, about twice the size, and lined it with native plants, following the U.S. Environmental Protection Agency's best management practices guidelines for storm water management. This improved stormwater retention basin was developed in an area draining surface stormwater runoff from a combat vehicle maintenance compound that previously had been plagued with chronic flooding due to the clogged ditch that it replaced. The project proved its value right away during a heavy rain period shortly after excavation was completed when the adjacent compound did not flood. Also, systematic observations since then have documented expanded endangered waterbird and migratory waterfowl use of the area.

■ In 2007, excavation is under way for a $900,000 construction project to realign part of the MCBH Kaneohe Bay's central stream corridor (Mokapu Central Drainage Channel) which is connected to the sensitive Nu'upia Ponds endangered species wetland habitat and coral-rich Kane'ohe Bay. This project will replace three acres of weed-choked "fill" land along the stream corridor with a meandering, terraced, native plant-lined "pocket wetland" to better contain floodwaters, filter stormwater runoff, restore historic habitat for native avian and aquatic life, enhance scenery, and produce recreational benefits (scenic view, jogging paths), and an early Hawaiian "sense of place." A similar project is being designed for the Marine Corps Training Area–Bellows along a weed-clogged portion of Waimanalo stream. This project will help restore watershed health to a stream designated as "significantly impaired" by the State of Hawai'i, while also designing opportunities for more realistic military training in the area.

■ An overarching goal in all of these watershed improvement efforts has been for people to re-attach to the landscape and each other, and positively view these straightened stream corridors as living, breathing resources needing care and attention, instead of as mere drainage ditches. It was one of 30 national watershed success stories posted on US Environmental Protection Agency (EPA)'s website: **http://water.usgs.gov/owq/cleanwater/success/ko.html**.

## Conclusion

While these wetland and watershed improvement projects are being completed on a relatively small, island scale, their demonstration value far exceeds their size, mainly due to the collaborative involvement of the public—both military and civilian—in their execution. Building a collaborative vision of restored ecosystem health possibilities through educational projects, demonstration native plant riparian gardens, and volunteer military/civilian weed pulling projects has been an essential ingredient in the success of these efforts, contributing not only to improved environmental quality, but also to public support for the Marines' continuing presence in host communities. As a Society for Ecological Restoration board chair once said:

"Ecological restoration is as much about people as it is about nature. For many, the most exciting thing about restoration is its potential to radically alter our ability to restore a healthy sense of community . . . A healthy human community helps us to restore both people and nature. An unhealthy human community hinders our efforts to improve our ecological and social lives" (George Gann, cited in *SER Newsletter* [Vol. 12, No. 1, February 1999]).

### FURTHER READING


Drigot, Diane. C. "Restoring Watershed Health: Peacetime Military Contributions and Federal-wide Agency Implications," *Federal Facilities Environmental Journal,* Autumn 2000, pp. 71–86. On line at: **http://www3.interscience.wiley.com/search/allsearch?mode=quicksearch&WISindexid1=WISall&WISsearch1=drigot**

Kamehameha Schools Bernice Pauahi Bishop Estate, *Life in Early Hawai'i: The Ahupua'a* (Honolulu: Kamehamea School Press, 1994 ISBN 0-87336-016-8).

Wilcox, B., E. Guinther, et al., *Mokapu: Manual for Watershed Health and Water Quality* (Prepared for MCBH under contract to Geo InSight Int'l., Inc., 1998). Also available online at **http://www.denix.osd.mil/.**

City/County of Honolulu, *Ko'olaupoko Sustainable Communities Plan* (Honolulu: Dept. of Planning and Permitting, August 2000) **http://www.honolulu.gov/refs/roh/klaupoko/.**

National Research Council, *New Strategies for America's Watersheds* (Washington D.C.: National Academy Press, 1999), ISBN 0-309-06417-1.

Davidson, Osha Gray. *Fire in the Turtle House, the Green Sea Turtle and the Fate of the Ocean* (New York: Public Affairs, Perseus Books Group, 2001), ISBN 1-58648-000-6.

# Oak Savanna Restoration

## Multiple Programs to Meet Military Needs and Enhance Biodiversity

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Fort McCoy Military Installation encompasses approximately 60,000 acres of diverse and relatively rare ecosystems in west central Wisconsin. The installation is situated within the unglaciated area, also known as the Driftless Area, of Wisconsin. The Driftless Area is considered an ancient landscape, eroding into an intricate system of ridges and coulees for millions of years.

Fort McCoy lies at the intersection of two major ecotones, giving it a unique place on the landscape. On the east to west continuum, the transitions from eastern forest to western prairie influence the vegetation types of Fort McCoy. This mix of forest and prairie results in the savanna ecosystem that dominates the installation. On the north to south continuum Fort McCoy lies just south of the band termed the tension zone by John Curtis, author of *The Vegetation of Wisconsin*. This is a relatively narrow band that separates the northern coniferous forests from the central deciduous forests. Within the tension zone there is gradation between these two plant provinces. Many plants reach their northern or southern limits within this zone. Fort McCoy lies within this zone and the mix of vegetation on post is indicative of both the northern and southern forests.

## Savanna/Barrens Community

Drier soils and greater frequency of fires (historically) resulted in a system dominated by oak forest, savanna/barrens and brushlands. Frequent fires maintained the oak forest, preventing the natural succession to white pine, considered the climax forest in the region. In areas where fire has been suppressed, considerable amount of red maple, black cherry, and white pine are found in the understory.

Savanna/barrens plant communities are dependent on fire and disturbance to maintain the typical open structure. With fire suppression, the vegetation in the savanna communities quickly succeeded to a more closed forest condition. Oak grubs existed for decades in the presence of fire, slowly growing deep, established root systems, while the vegetation would be repeatedly burned. These oak grubs took advantage of the fire suppression and grew profusely for several seasons. In pre-settlement times a few oaks would attain a thick corky bark during periods without fire and then be able to survive later fires. This process established the open structure of the savanna communities. With twenty years of fire suppression the canopy of the former oak barrens closed and caused a change in the ground layer. The typical mix of prairie and woodland plants slowly degraded to a low diversity woodland ground layer. The seed bank will exist for many decades in a degraded ecosystem. Prescribed fire and thinning the oaks can release this remnant seed bank.

The oak savanna/barrens community is considered one of the rarest plant communities in Wisconsin. In pre-settlement times it is estimated there was between 7 and 10 million acres of Wisconsin savanna; presently, only 2,000 acres of high quality savanna remain, with about 300 acres at Fort McCoy. The Karner blue butterfly, a federally endangered species, along with a whole host of federal and state concern species, are dependent on a diverse savanna community. With up to 20,000 acres of low quality oak forest on Fort McCoy, there is great potential for oak savanna restoration activities. Prescribed fires, timber cuts, shredding and selective herbicide use have been instrumental in the management and restoration of these areas.

Invasive plants such as leafy spurge and spotted knapweed have been found

within many of the savanna remnants and along the peripheries of low quality oak forests. Exotic invasive plant species have a very strong impact on native plant communities and may replace the majority of native species if left unchecked. One consideration with restoring low quality oak forest to savanna is the potential to increase such invasive plant species populations. Many of the invasive species associated with savanna cannot survive in more closed canopy forests, but if the forest canopies are thinned out or removed, suitable environment for these species will result.

Igniting a prescribed burn at Fort McCoy, April 2005. (Photo: Jim Kerkman)

Opposite page: Prescribed burn crew members observing smoke column. Inset: Typical closed canopy oak forest prior to savanna restoration. (Photos: Jim Kerkman)

## The Military Mission

Savannas provide excellent areas for military training and maneuvers. And likewise, disturbance from military training has helped to maintain the diversity of the savanna ecosystem. Fires resulting from military training and the lack of intensive agricultural practices have kept areas of Fort McCoy in a quality savanna/barrens complex. Moderate soil disturbance has reduced the rate of canopy closure and helped propagate the spread of some beneficial plant species, in particular wild lupine, the host plant of the endangered Karner blue butterfly.

However, disturbance can also degrade training lands and ecosystems. Overuse of areas can result in the loss of native vegetation, causing soil erosion and spread of invasive plants. Close coordination with military trainers and Integrated Training Area Management (ITAM) can minimize the impacts due to over use of the landscape.

## Working Together

So how are the military and ecosystem needs met? The concept is simple—communication and cooperation. The work, however, is not always so simple. To be truly successful, there needs to be a bridge of communication and support. The ITAM Program is this bridge. Its job is to maintain the quality of training lands that allow the successful completion of the military mission. Coordination between ITAM and natural resources managers allows military training without disruption while managing healthy and productive native ecosystems.

HTTP://AEC.ARMY.MIL/USAEC/RANGE/SUSTAINMENT01.HTML

HTTP://WWW.FORTPICKETT.NET/HTML/ITAM.HTML

Above: Hazel Dell savanna restoration project, December 2002, showing big bluestem growing. The area was harvested of smaller trees in March 2000, slash piles burned in 2001, and prescribed Integrated Training Area Management (ITAM) Program burned in April 2002. (Photo: Jim Kerkman)

## Specific Strategies for Oak/Savanna Restoration

The Integrated Wildland Fire Management Plan (IWFMP), identifies forested areas that should be harvested and managed as savanna/prairie systems as a way to keep wildfires limited to the ground and easier to contain. Timber sales have thinned approximately 850 acres near ranges and the installation boundary to remove most of the pine and thin oaks to reduce the chances of severe wildfires. This has increased the amount of savanna/prairie habitat.

The Land Rehabilitation and Maintenance Program (LRAM), a component of ITAM, reduces the amount of slash after a timber sale with a severe duty shredder. This reduces the intensity of the first prescribed burn and may even take the place of prescribed burns in areas near the boundary where private homes may be adversely affected by smoke.

LRAM also uses native grasses and forbs for the restoration (reseeding) of disturbed locations. The species selection is based on those found in the area. Seed collection is done on the installation whenever possible. Planners will also incorporate annual cover crops, such as rye, to reduce erosion while the natives get a foothold. Soil enrichment is also being incorporated when needed using nitrogen fixers (legumes). The key is to avoid planting of non-native and/or invasive species.

Other savanna management strategies include 5-10 year prescribed burns (based on The Nature Conservancy and other savanna management recommendation developed through examination of historical/natural frequency).

Rotation burns are also done within larger blocks of grasslands and savanna—primarily those greater than 100 acres and dependent on overall management goals (i.e., grassland bird nesting requirements, Karner blue butterfly habitat, and other rare species in the area, etc). This reduces the impacts to the biological community by leaving residual vegetation for nesting, and reduces impacts in insect populations required for brood rearing and wildflower pollination.

## Conclusion

Working closely with military trainers, and using the tools available from the ITAM program, the Ft. McCoy Biological and Cultural Resources Team has developed effective strategies for restoring and maintaining one of the rarest and most biologically diverse ecosystems in Wisconsin. And, this has been accomplished in a way that enhances the military mission by providing additional oak savanna/ barrens lands for military training.

CASE STUDY
CHAPTER EIGHT
LANDSCAPE DISTURBANCE

WARREN GROVE
GUNNERY RANGE

# Disturbance Regimes and Landscape Process

## Fire Management at Warren Grove Gunnery Range

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The Warren Grove Gunnery Range (WGR) is a 9,416-acre federal facility situated in the East Pine Plains, Burlington County, New Jersey. The WGR is operated by the New Jersey Air National Guard's 177th Fighter Wing and used for tactical and conventional air-to-ground gunnery training. About 550 acres are used for targets, with the remaining 8,864 acres maintained in a natural state that act as a safety buffer to protect the surrounding communities from wildfires and dangers associated with military operations. The WGR is surrounded by state forested lands and undeveloped private lands. Mission-started fires have the potential to escape from WGR and threaten surrounding lands and nearby developed communities.

The East Pine Plains is a rare and protected forest community (G2S1)[1] situated within the Pinelands National Reserve, a fire-maintained ecosystem. The Pine Plains forest type (dwarf pine trees less than 3 meters tall) results from an increased fire frequency compared to other regions of the Pinelands. The dwarf pine plains communities are dominated by fire-tolerant species, namely pitch pine (*Pinus rigida*), shrub oaks (*Quercus marilandica, Q. ilicifolia*) and several ericaceous shrubs. A 5-to-10 year prescribed burning cycle is believed to promote dwarfing traits in pitch pine and shrub oaks, reduce fuel load buildup, and maintain a characteristic dwarf pine plains landscape. A long fire history and pattern of frequent intense burning has shaped this fire-prone ecosystem.

How do you protect this rare fire-prone ecosystem, deal with potential wildfire and public concerns, and maintain the military mission? The New Jersey Air National Guard (NJANG) approached these issues through an adaptive resource management program outlined in the Integrated Natural Resources Management Plan for WGR: an aggressive prescribed burning program to reduce hazardous fuel loads around target areas, and assistance from outside partners, including development of the Warren Grove Range Community Council, which addresses military issues and local concerns.

Integrated Natural Resources Management Plan: In 2006 the New Jersey Air National Guard implemented its second five-year Integrated Natural Resources Management Plan (INRMP) for WGR. (The first began in 2001.) The INRMP is a guide for the management and stewardship of all natural resources present on WGR; it employs a multiple-use approach that assures the New Jersey Air National Guard mission while effectively managing natural resources to conserve biodiversity and environmental quality. The INRMP was developed by a task force from several federal, state, and local agencies, including representatives from the U.S. Fish and Wildlife Service, U.S. Department of Agriculture, U.S. Environmental Protection Agency, Natural Resources Conservation Services, New Jersey Pinelands Commission, New Jersey Forest Fire Service (NJFFS), and New Jersey Bureau of Forest Management. The INRMP identified natural resource management practices needed to maintain and enhance biological diversity.

The overriding goals included:

- Manage for no net loss in WGR's capability to support the military mission.
- Minimize habitat fragmentation and promote natural connectivity of habitats.
- Protect native species and discourage non-native, exotic species.
- Protect rare and ecologically important species and unique and sensitive environments.
- Maintain or mimic natural processes.
- Protect genetic diversity.

Aerial view of extensive prescribed burn in dwarf pine plains at Warren Grove. (All photos in this case study: courtesy Warren Grove Gunnery Range)

- Restore ecosystems, communities, and species.
- Monitor biodiversity impacts.

Several fire-related issues were identified that required resolution to comply with the INRMP goals. Specifically, these included:

- A lack of knowledge of the occurrence and distribution of state and federally listed species that inadvertently could be impacted by mission activities, including prescribed burning.
- A need for road improvements to increase better access to fire and decrease response time.
- A lack of fuel breaks between fire management blocks.
- A lack of a coordinated regional fireshed management that encompasses off-range lands.

Since the implementation of the 2001 INRMP, the NJANG has been proactive in addressing all four of these concerns. Drexel University recently completed a comprehensive floral inventory (2002–04) that identified 28 rare plant species and 7 rare habitat types occurring at WGR. These data were entered into a GIS database to be used for planning range operations (e.g., prescribed burning). In addition, Drexel University has ongoing research associated with a herpetological survey, small mammal survey, non-native plant survey, avian survey, habitat restoration assessment and fire management assessment. These studies will help natural resources managers at WGR to protect habitat, conserve listed species, and maintain ecosystem function concomitant with the military mission.

## Fire Management at WGR

The NJANG has a long history of fire management and forest stewardship at WGR. The NJANG in 1985, along with the U.S. Park Service, New Jersey Pinelands Commission, and New Jersey Department of Environmental Protection, developed a fire management plan that was designed to mitigate wildfire danger and employ prescribed burning that uses intense crowning and scorching surface fires to maintain pine plains habitat. Starting in 1985, several thousand acres of dwarf pine plains have undergone prescribed burns by the New Jersey Forest Fire Service to reduce the risk of wildfires. Although these prescribed burns serve to reduce the buildup of forest fuels near target areas, their frequency and intensity serve an important ecological function by mimicking the natural fire regime required to maintain the dwarf pine plains forest type.

Several key ecological goals of the fire management plan are to:

- Maintain a landscape and community-scale fire regime which perpetuates pine plains and associated forest communities
- Maintain a fire regime mosaic within the pine plains that provides open areas for rare species such as Conrad's crowberry (*Corema conradii*) and closed canopies for other species
- Maintain the diversity of spatial and temporal fire regime patterns
- Maintain a fire regime that maximizes diversity and abundance of rare and common species
- Take precautions to avoid ecological damage when doing restoration burning in long unburned communities
- Minimize the effect that smoke has on air quality and human communities.


A recent study by Drexel University evaluated the effects of the fire management program on species richness and community structure in the pine plains forest type. The results of this study indicated that the current fire management strategy employed by WGR maintains a pine plains community, does not impact rare species, and does not encourage non-native species. The study determined that the fire management plan encourages diversity and maintains ideal habitat for several fire-dependent species such as pine barren reed grass (*Calamovilfa brevipilis*).

Starting in 1999, a more aggressive prescribed burn program was initiated around target areas. Range personnel have actively improved and widened 12 miles of primary roads to increase larger fuel breaks between fire management blocks. Another 30 miles of interior roads that dissect fire blocks and eight miles of plowlines have also been improved. The WGR is divided into 30 fire blocks that receive prescribed burning at different intervals and at different intensities so that the burn mimics the natural fire regime for that forest type. For example, the seven fire blocks that encircle the target zone are pine plains and pine plains transitional forest habitat types that are burned on a rotational basis every five to seven years. In contrast, fire blocks in buffer zones dominated by more arborescent trees have longer prescribed burned intervals. This fire management strategy promotes a fire regime that more closely mimics natural fire patterns. Some fire blocks in the target zone are burned more regularly than a five-to-seven-year frequency if they pose a potential wildfire risk. The NJANG works with a trained fire ecologist to develop a prescribed burn plan for each fire block. The fire ecologist and range personnel survey each fire block for rare species, sensitive habitat, and wetlands before improving or putting in plowlines and fire access roads. If necessary, a conservation plan is put into place to protect rare species and sensitive habitats. In some cases, prescribed burning is recommended to improve or restore sensitive habitat. Seed banks, dispersal corridors, and metapopulation dynamics are considered for species with limited distribution at WGR. Ecological burns are typically scheduled in February or early March, at a time when rare snake species and still in hibernation and will not be impacted by the burn. The prescribed burn plan is evaluated by the NJFFS. The fire ecologist monitors the prescribed burn and prepares a post-burn fire analysis to evaluate ecological effects and success of fire management goals.

Above: Various stages of a prescribed burn underway at Warren Grove. Minimizing the effects of smoke on surrounding communities is an important management objective.

Below: Fire ignition using drip torch.

Above: The author, Walt Bien, conducting a botanical survey at Warren Grove.

Below left: Early stages of revegetation in the dwarf pine plains.

Below right: Grass-pink, (*Calopogon tuberosus*), a beautiful orchid found in the WGR's bogs.

## Outside Partners and Warren Grove Community Council

The New Jersey Forest Service is currently coordinating an effort with United States Air Force, NJANG, NJ Pinelands Commission, NJDEP, and the NJ Division of Fish and Wildlife, along with Stafford, Little Egg Harbor, and Bass River municipalities to develop an East Plains Fire Shed Management Plan. The New Jersey Conservation Foundation (NJCF) has initiated a program to acquire and manage lands adjacent to the WGR. The NJANG and NJCF have agreed to work together to preserve the plants, animals and natural communities. In addition, the NJANG organized the Warren Grove Range Community Council (WGRCC) to provide a forum for discussion of interests and issues associated with WGR. This is especially important because of increased encroachment and development in nearby townships. Members of the WGRCC include local government representatives, environmental groups, educators, research scientists, and NJFFS. The WGRCC meets twice a year at a different municipality to discuss citizen concerns about mission related activities including wildland-urban fire risks. The WGR fire management plan, role of fire in the Pinelands, and potential risks to communities are key topics of discussion addressed by the NJANG and NJFFS.

1. NatureServe uses a specialized ranking system to denote conservation status and level of biodiversity threat. "G2" means "Imperiled on a global level—At high risk of extinction..." and "S1" means "Critically imperiled on a state scale." For an explanation of the NatureServe conservation ranking system, see **http://www.natureserve.org/explorer/ranking.htm**.

CASE STUDY
CHAPTER NINE
FUNDING

CAPE CANAVERAL
AIR FORCE STATION

# Creative Assessment of Mission Requirements Supports Threatened and Endangered Species

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There is rarely enough money to meet natural resources program requirements on military installations. One way to address that problem is to constantly be on the lookout for ways to combine mission-related and natural resources requirements. Opportunities to combine the two requirements will obviously vary widely throughout the Department of Defense, but clearly understanding mission requirements is the first step to assessing the potential of this funding strategy. Described here is one successful example from Cape Canaveral AFS.

## Background

Cape Canaveral Air Force Station (CCAFS) is situated on a barrier island paralleling the central east coast of Florida. This 15,800-acre installation is not only America's premier gateway to space, but also one of the few long sections of Atlantic Ocean coastline (21.5 km) that remains relatively undeveloped. Due to the extremely hazardous nature of the Air Force's mission on CCAFS, large tracts of land remain as naturally vegetated explosive safety buffers.

## Natural Setting

In 1997, the Florida Natural Areas Inventory (FNAI) surveyed CCAFS and documented eleven specific native plant communities. Some of these communities occur only as thin ribbons adjacent to the coastline, such as beach dune, coastal grassland and coastal strand; however, the vast majority of undeveloped land is scrub. The scrub plant community on CCAFS is dominated by various oak species, Florida hickory, palmetto, rosemary, wax myrtle, and numerous herb species. The coastal oak scrub plant community and other scrub plant associations were once prevalent in much of central Florida prior to the last fifty years of development and subsequent wildfire suppression. Consequently, government-owned land such as CCAFS and the adjacent Kennedy Space Center constitute the majority of viable scrub oak habitat remaining in Florida. Directly related to loss of habitat is the decline of faunal populations and subsequent designation of the more vulnerable species on state and federal threatened and endangered species lists.

## Critical Species

The "flagship" species for scrub oak habitat is the Florida scrub-jay (*Aphelocoma coerulescens*). This robin-sized bird is territorial and monogamous and the young become helpers with subsequent offspring. The scrub-jay lives in a family group and is not often seen outside its 25-acre territory unless it's a second year bird pursuing a mate or recruiting into a new territory. Due to the declining numbers resulting from habitat loss and fragmentation, the U. S. Fish and Wildlife Service (USFWS) listed the Florida scrub-jay as a threatened species in 1987. The USFWS has identified CCAFS as an integral component of the effort to recover this threatened species.

Wetlands at Cape Canaveral AFS. Rockets and wildlife coexist happily at Cape Canaveral. (Photo: U.S. Air Force)

## Accommodating Mission Requirements

One mission-critical launch support operation on CCAFS that affects scrub vegetation is the creation and periodic maintenance of instrumentation and optical lines of sight. Technicians operate instruments and cameras trained on launch vehicles (rockets) and their payloads (satellites) prior to and immediately following launch. Instrumentation vans and mobile cameras are positioned on earthen mounds situated at various distances from the launch pads. Lines of sight may cover miles of previously undisturbed habitat, and maintaining their visual integrity has historically been a challenge, with the potential to disrupt launch schedules. Previously, the lines were created by pushing down vegetation with a bulldozer, allowing plants to regenerate. This made possible invasion by exotic species. Natural resources managers realized the plight of the range instrumentation squadron while similarly grappling with the dilemma of restoring scrub to optimal scrub-jay habitat.

## New Management Strategy

Two unique characteristics of scrub habitat that are critical to supporting scrub-jays are oaks in the one- to two-meter height range for nesting and a significant ratio of open, sandy areas for caching acorns and identifying predators. Typically, this mosaic is maintained by natural, lightning-induced wildfires. A prescribed burning program implemented by the Air Force has improved habitat and reduced

critical fuel loads, but has not successfully mimicked natural fire intensity necessary for creating openings and a scrub mosaic. It seemed that natural resources managers were trying to create open, sandy areas immediately adjacent to low growing scrub while the instrumentation folks were at the same time desperately trying to keep their lines of sight open and operational. With limited funding available to manage threatened and endangered species, and operations and maintenance budgets cut to support the war in the Middle East, it became clear that a multi-office effort could meet mission and natural resources goals while providing additional benefits to fire safety, security, infrastructure, and grounds maintenance.

## Combining Mission and Environmental Funding Objectives

To achieve these multiple use goals, the 45th Space Wing Environmental Flight developed a policy, entitled "Land Clearing for Mission Support" that describes methods for conducting all types of routine land clearing requirements while simultaneously creating optimal scrub habitat. These clearing requirements include the lines of sight, security clear zones, firebreaks, utility corridors, road shoulders, facility set-backs, and others. In addition, previous land clearing that involved the loss of potential scrub-jay habitat required consultation with the USFWS. However, by creating openings, optimal scrub oak height and additional "edge" habitat with the new clearing policy, consultation, and more importantly, compensation for scrub loss is no longer necessary. Further, by incorporating the policy into all new requirements and contracts, the 45th Space Wing will ensure adequate funding is provided to guarantee long-term maintenance of the newly created habitats and furtherance of scrub and barrier island biodiversity.

The Florida scrub-jay, federally listed as threatened, is found only in the scrublands of central Florida. (Photo: Arlene Ripley)

## Conclusion

As this example demonstrates, natural resources managers may significantly increase their funding by understanding mission requirements and, where feasible, integrating mission requirements with those for specific natural resources projects.

CASE STUDY
CHAPTER NINE
FUNDING

NAS PATUXENT RIVER

# Innovative Funding for Natural Resources

## NAS Patuxent River, Maryland

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Situated on the western shore of Southern Maryland at the confluence of the Patuxent River and the Chesapeake Bay, NAS Patuxent River is a rich island of biological diversity in a rapidly growing Saint Mary's County. The base is the premier Naval aviation test and evaluation facility and includes the Navy's Test Pilot School.

## Management Challenges

As with many military installations, there are constant challenges in managing the installation natural resources program. At NAS Patuxent River these include:

- Overall funding and manpower
- Development pressures (inside and outside the fence), exacerbated by being a receiving activity in several successive Base Realignment and Closure rounds
- Regionalization of naval installations and creation of a new claimancy (Commander, Naval Installations, CNI) for naval shore stations, resulting in more bureaucracy and fewer resources
- Securing reliable funding for multi-year projects or long-term efforts
- Lack of resources for routine monitoring (to follow-up inventory phase)
- Major reduction of centralized Geographic Information Systems (GIS) support services
- No legal requirement or lack of sufficient drivers for protection of state-listed threatened and endangered species
- Misguided or misinformed "multiple use" advocates and "healthy forest" proponents, as well as pressure to increase consumptive uses for generation of revenue

## Successes

Notwithstanding these challenges, NAS Patuxent has been successful in implementing much of its Integrated Natural Resources Management Plan, some highlights of which include:

- Completion of a comprehensive floral and rare species inventory on approximately 15,000 acres on three parcels of land, including invertebrates
- Development of rare species management strategies
- Completion of comprehensive inventory of invasive plant species and development of control strategies
- Development of a very robust Geographic Information System with over 200 NR/CR data layers
- Effective use of modern technology for natural resources management
- Narrowing of utility rights of way for buried utilities (sewer, water, electric) through forested areas, allowing forest canopy closure and reduction of forest fragmentation impact to area-sensitive, interior-dwelling species.

Harper's Creek at NAS Patuxent River, one of many important on-base wetlands that provide outstanding recreational opportunities. (Photo: Doug Ripley)

## Strategies for Funding Success

- Be completely open to any help you can get, traditional or not. This may include the use of volunteers, interns, temporary hires, co-ops, etc. Actively search out opportunities for such help. At NAS Patuxent River we have successfully used Boy Scouts and other civilian volunteers for on base projects. On-base military members ordered by the federal court to community service are used in our invasive species control/eradication program.

- Constantly seek OP funding (OP = Other People!). Examples include using mitigation funds for on-base construction projects (e.g., wetlands mitigation, biological surveys, etc.). Local colleges are interested in pursuing on-base natural resources research projects either for free or for a very small fee.

Traditional utility right of way and fire break (top). The narrower right of way (bottom), with regrown vegetation, reduces maintenance costs and enhances biodiversity. (Photo: Douglas Ripley)

- Actively pursue Sikes Act cooperative agreements (typically established with private non-profit environmental organizations or universities). These agreements usually provide for work at a fraction of the cost of commercial contracts.

- Keep looking for partnership opportunities that will allow for leveraging available resources.

- Always be willing to share your data. With the exception of the exact location of protected species, all biological data should be made available to interested parties. For example, all biological inventory data should be shared with the state natural heritage office for inclusion in its natural heritage data base. This willingness to share data can lead to new opportunities for partnerships.

- Integrate/coordinate your INRMP with as many other plans as possible (e.g. base master plan, training/testing/operations plans, etc.).

- Get to know your installation's military mission and try to link everything to it.

- Be open to new natural resources management approaches that save money while enhancing biodiversity. At NAS Patuxent River, the plan to narrow utility rights of way (ROW) for buried utilities through forested areas is an excellent example of this approach:

  - Historically, 150-foot-wide fire breaks were been established along ROWs for buried sewer, water, and electric utilities.

  - Considerable costly maintenance was required for these corridors (mowing and other vegetation control)

  - Excessively wide corridors served to fragment the larger forest block on the station, thus reducing wildlife habitat, especially for migratory birds.

  - NAS Patuxent River is situated in an ecosystem where forest wildfire is virtually unknown. Thus the wide firebreaks were not needed.

  - The base began a program to reduce the size of the fire breaks from 150 to 50 feet, thus eliminating the need to mow and otherwise maintain hundreds of acres of former fire breaks. No impact to the military mission occurred as a result of this decision, great maintenance cost savings were achieved, and a significant improvement of the habitat for biodiversity conservation was realized.

## Conclusion

The successful natural resources manager must constantly be on the alert for new, innovative sources of funding. In some cases, partnering with other organizations can be a source of funding. In others, simply finding a cheaper and more effective way of accomplishing long-established practices may yield substantial cost savings.

CASE STUDY
CHAPTER TEN
PARTNERSHIPS

FORT BRAGG, POPE AFB, CAMP MACKALL

# Invasive Weed Management

## The Fort Bragg Non-Native Invasive Plant Managment Plan and North Carolina Sandhills Weed Management Area

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Together, Fort Bragg, Pope AFB, and Camp Mackall encompass more than 160,000 acres, and compose the largest tract of longleaf pine-wiregrass ecosystem in the Sandhills physiographic region of southeastern North Carolina. With less than 3 percent of the historic longleaf pine-wiregrass ecosystem remaining today, these Department of Defense (DOD) facilities and their neighboring federal, state and private landowners play an important role in conserving rare species diversity in the Sandhills. More than 1,500 documented occurrences of 58 federal and/or state listed threatened, endangered and at-risk plant species have been made on the installations alone.

Most of these rare plants are vulnerable to direct and indirect impacts of non-native invasive plant species (NIS). In 2003, proactive NIS management was initiated on these installations not only for its many environmental, monetary, and mission-related benefits, but also to meet numerous applicable compliance requirements and policy guidance (e.g., Executive Order 13112—Invasive Species; Army Policy Guidance for Management and Control of Invasive Species; North Carolina Noxious Weed Regulations; Endangered Species Act; the Army Strategy for the Environment). This case study describes the approaches that have been used to advance NIS management on the installations and with partners in the region, including; development of an exhaustive baseline survey, drafting of an installation Integrated Non-native Invasive Plant Management Plan (INISMP), and the implementation of strategic management actions to respond rapidly to new invasive species. Finally, it describes an effort in 2006 to establish a regional cooperative Weed Management Area (WMA) involving the North Carolina Sandhills Conservation Partnership, thereby greatly expanding the effectiveness of NIS control and management in the entire North Carolina Sandhills.

## NIS Survey

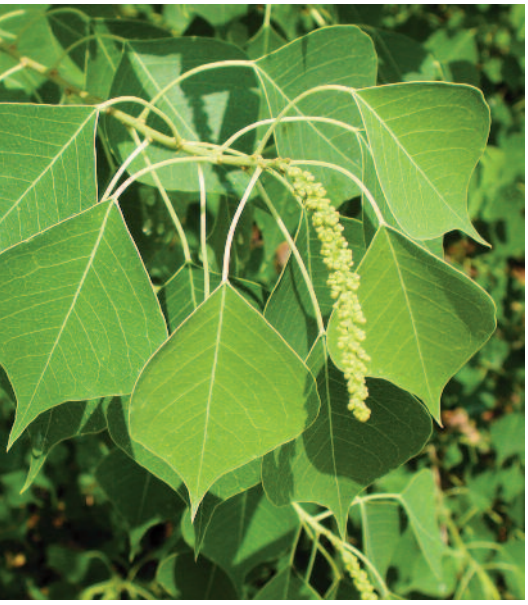
Knowledge of NIS distribution and abundance on the installations had previously been limited to roadside observations, sparse land condition trend analysis data, and anecdotal observations. After establishing the scope of the problem, the installations then launched a ground-based survey in 2004, targeting 96 NIS known or likely to occur within the region and directly or indirectly impacting the installation's military mission, land use sustainability, and threatened, endangered, and at-risk species. NIS presence and percent cover were recorded at more than five thousand plots. The design not only ensured a somewhat equal coverage of data across the installations, it also provided detailed information where it was most important; both of these results were critical for developing accurate maps of NIS distribution. The survey identified 39 different NIS within approximately 45 percent of the plots. Of the areas estimated to have NIS present most (~99 percent) were estimated to have a combined percent cover less than 25 percent. Dense NIS infestations (cover estimates >50 percent) were present on less than one percent of the surveyed areas. The distribution and abundance maps generated from the survey data formed the basis for making informed management decisions and developing the Integrated Non-native Invasive Plant Species Management Plan (INISMP).

## Integrated NIS Management Plan Development

The overall approach to NIS management adopted in the INISMP was based on a strategy of prevention, early detection, prioritized management, monitoring, and assessment. Once NIS become well established, management is increasingly difficult and cost prohibitive. The most effective and economical approach to managing NIS is through proactive prevention, early detection, and control of new invasions. The methods of control recommended in the INISMP were based on the concept of integrated weed management, which promotes using a suite of different control methods (biological, cultural, chemical, or mechanical) in a mutually supportive manner to achieve the most economically and ecologically effective combination that meets management goals. Evaluating the success of management actions is important to determine how management should be adapted in the future. Adaptive management is made possible by continuously monitoring NIS, and changing management actions in light of observations and new information. The development of the Fort Bragg INISMP included the following steps:

- Documenting installation land management areas
- Inventorying these land management areas to assess NIS abundance and distribution
- Identifying management goals for land management areas based on use and stakeholder input
- Developing NIS management goals based on land management area goals and NIS distribution and abundance
- Identifying NIS management actions necessary to meet NIS management goals
- Prioritizing NIS management actions
- Identifying methods for monitoring NIS and evaluating the success of management actions

This approach ensured that the management goals and recommendations within the INISMP were consistent with the installations' missions, as well as relevant laws and regulations. Furthermore, it satisfied the Army requirement to prioritize management objectives and actions, as well as integrate NIS management within the context of the goals and objectives of installation Integrated Natural Resources Management Plans (INRMPs). The INISMP has been an invaluable resource for communicating varied stakeholder concerns about NIS issues, identifying parties responsible for NIS management in different areas, justifying budget requests, and determining what management actions should occur where and when.



Above: The highly invasive Chinese tallow-tree (Photo: Peter Frank, Invasive Species Management, Inc.)

Below: Beaver pond, Fort Bragg. Three different plant communities converge here. (Photo: Peter Frank, Invasive Species Management, Inc.)

## Prioritization of NIS Management Actions

Because the NIS management needs invariably exceed available funds, NIS management requires difficult decisions be made about land use and management. These decisions are made easier by objectively assessing potential impacts of NIS at particular sites and prioritizing Management Actions accordingly. Prioritized actions are also beneficial in that they direct limited management funds to areas in most critical need of management. To determine which sites were in greatest need of management, all relevant NIS management criteria were incorporated in a multi-criteria prioritization model. Prioritization criteria included:

- Potential impact on threatened, endangered and at-risk species or their habitats

- Potential impact on military mission
- Potential impact on established land management goals and land use sustainability
- Cost of management action, consequences of delay in initiating management action, feasibility
- Availability of effective control methods

This approach ensured that near- and long-term management actions identified in the INISMP will be implemented in the most ecologically and economically effective manner (Figure 1).

## Monitoring

Monitoring was identified as a necessary part of overall NIS management, as it would allow the installations to quantitatively assess changes in NIS populations and evaluate the effectiveness of control measures. Consequently, the INISMP calls for collection and analysis of monitoring data to determine whether NIS management goals have been met. If goals have not been met, changes to NIS Management Actions will be considered and implemented as part of an adaptive management strategy.

## Early Detection/Rapid Response Program

Effective and cost-efficient NIS management requires the immediate eradication of small populations before they can spread. The exhaustive survey data showed that local eradication of certain NIS was feasible on Fort Bragg, Camp Mackall, and Pope AFB at relatively little expense. Consequently, ten highly invasive NIS occurring in few locations (<50 infestations) and/or low abundances were targeted for eradication via an early detection/rapid response program. Species not currently known to occur in the Sandhills ecoregion but having the potential to become established are also included in the Early Detection/Rapid Response Program. This species-specific approach complements the otherwise site-specific approach adopted in the INISMP.

Below: Kudzu infestation near rare plant populations, before removal (top) and after (below). (Photos: Peter Frank, Invasive Species Management, Inc.)

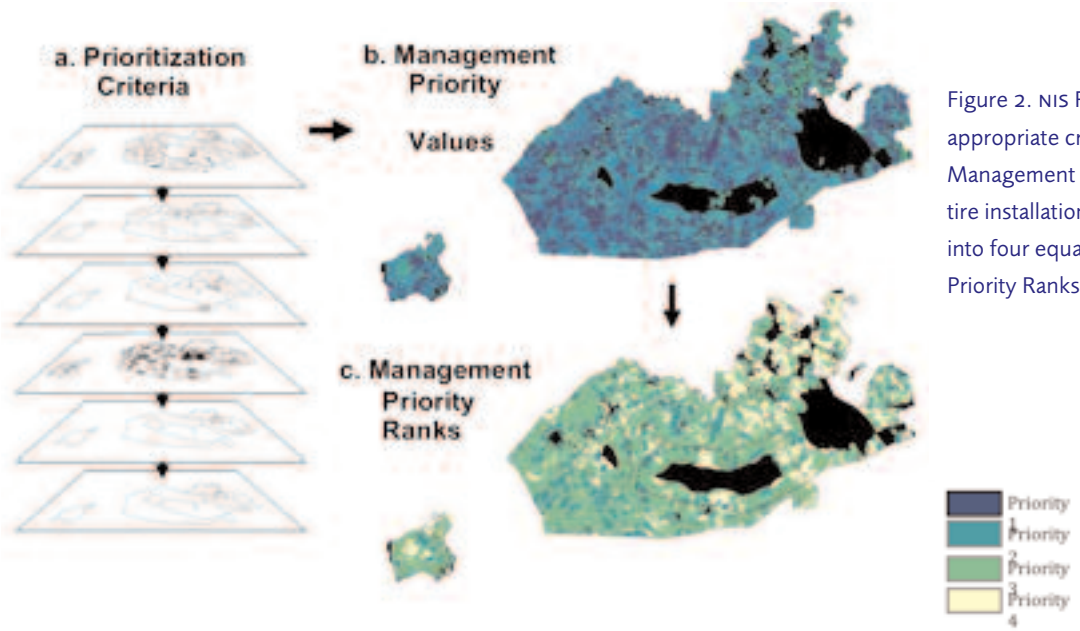



Figure 2. NIS Prioritization Model, combining appropriate criteria (a) to make (b) a map of Management Priority Values across the entire installation, which was then (c) divided into four equal ranks, creating Management Priority Ranks.

## NIS Management Partnerships Among DoD and Neighboring Land Stewards

While staff members were preparing the INISMP, it became apparent that DOD NIS management efforts need to reach beyond the installation boundaries to reduce the long-term magnitude and cost of NIS impacts. Otherwise, a constant influx of propagules from outside the installations' borders jeopardizes the success of on-post control efforts. In response the U.S. Army Corps of Engineers, Engineering Research and Development Center (ERDC-CERL), with funding from the DOD Legacy Program, worked with the North Carolina Sandhills Conservation Partnership to establish the North Carolina Sandhills Weed Management Area ( NCSWMA) in 2006. The NCSWMA represents a diverse group of land managers who can provide the partnerships, shared responsibilities, increased efficiency, and collective stakeholder vision necessary for successful regional NIS management. Members of the NCSWMA share expertise in invasive plant management and work together to develop regional strategies for budgeting, investigating, managing, and restoring areas with NIS infestations. The NCSWMA may well serve as a model for other military installations seeking to promote the long-term sustainability of training lands. More details on the NCSWMA may be found at:

**HTTPS://EKO.USACE.ARMY.MIL/PROJECTS/NCSWMA/INDEX.CFM**

**HTTPS://WWW.DENIX.OSD.MIL**

CASE STUDY
CHAPTER TEN
PARTNERSHIPS

FORT LEWIS

# Army's Compatible Use Buffer Program Partners Produce Conservation Plan to Ensure Continued Military Readiness Through Recovery of Candidate Species

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Like many in the nation, the Fort Lewis Military Installation has become a habitat island within a sea of development. Situated in the southern Puget Lowlands of western Washington State, Fort Lewis provides some of the largest expanses of remaining grassland habitat in the region. The region's grasslands are threatened by incompatible human uses of the land and the absence of fire across the landscape, resulting in encroachment of conifers and non-native vegetation. Four species that occur on these rare grasslands are federal candidates for listing under the Endangered Species Act (ESA): the streaked horned lark, Mazama pocket gopher, Taylor's checkerspot, and mardon skipper. If any of these species was to become listed, significant military training restrictions could be imposed by the U.S. Fish and Wildlife Service.

## Proactive Efforts: Supporting the Mission

Working proactively to ensure uninterrupted military training and readiness, Fort Lewis has partnered with The Nature Conservancy, the Washington State Department of Natural Resources, and the Washington State Department of Fish and Wildlife to enact an Army Compatible Use Buffer (ACUB) program aimed at recovery of the candidate species. Traditionally, ACUB program funding has been used to purchase lands surrounding military installations to act as lifeboats for rare species. At Fort Lewis, Army funds are being used instead for on-site land management and habitat restoration. The non-military partners have provided funds for land purchase and some management of off-post grassland sites. By initiating restoration and reintroduction actions around Fort Lewis, the burden of recovery is shared among the Army and other regional grassland land owners. ACUB, along with other cooperative, regional conservation efforts, decreases the likelihood that the candidate species will become listed under the ESA.

## How We Work

The Fort Lewis ACUB Partners have cooperatively produced a five-year implementation plan with conservation actions aimed at achieving the goal of continued military readiness through recovery of candidate species. Projects are selected by consensus of all partners and follow logical, temporally and spatially explicit, species-specific strategies to achieve recovery. The conservation actions funded through the Fort Lewis ACUB include land acquisition, habitat maintenance and restoration, increasing the size and numbers of candidate species' populations, monitoring, planning, and research.

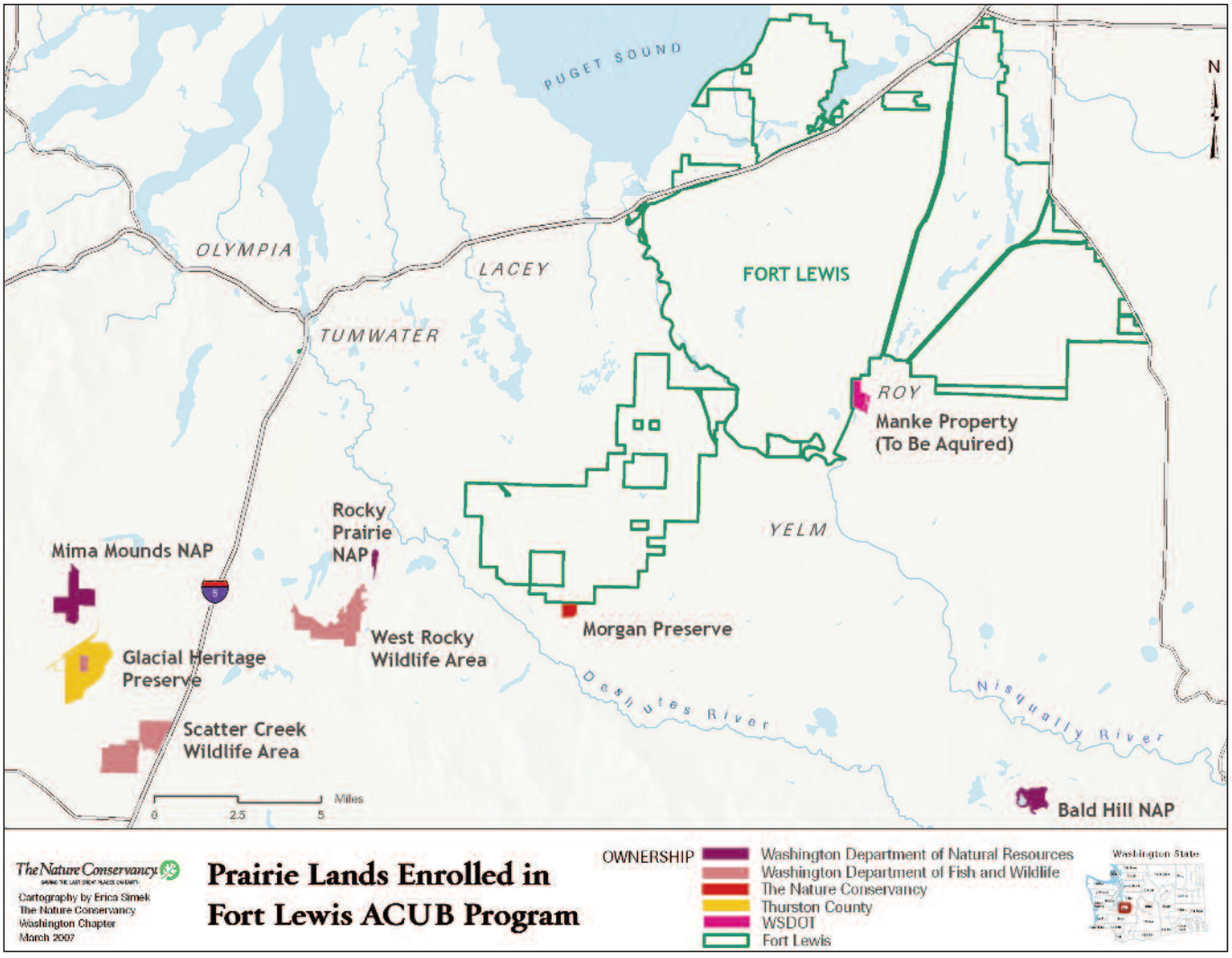
**LAND ACQUISITION.** The program has acquired privately-owned parcels containing native prairie at various locations in the southern Puget Sound lowlands outside Fort Lewis. The ACUB program and cooperators will continue to pursue additional acquisitions of important habitat.

**HABITAT RESTORATION AND MAINTENANCE.** To provide habitat for reintroduction of candidate grassland species on ACUB lands, the land must be in suitable condition to sustain those animals. Several first- and second-year projects focus on controlling the invasive vegetation that prohibits occupation by the candidate species.

Two of the biggest non-native threats are Scotch broom, a nitrogen-fixing shrub that modifies the structure of the prairie, creating unsuitable conditions for native plants and animals, and turf-forming grasses, such as tall oatgrass and colo-

Left: Fort Lewis Grassland (Photo: Hannah Anderson)

Below: Prairie lands enrolled in the Fort Lewis ACUB program. Map produced by The Nature Conservancy.



Clockwise from top left: Mardon skipper (Photo: The Nature Conservancy); Streaked horned lark (Photo: Rod Gilbert); Mazama pocket gopher (Photo: Bill Leonard); Taylor's checkerspot (Photo: The Nature Conservancy).

nial bentgrass, that outcompete the native prairie bunchgrasses and forbs.

The partners are also working to enhance native vegetation on ACUB sites by growing and outplanting native grasses and forbs that are important to the overall structure and diversity of the grasslands and/or that fulfill specific requirements of the candidate species (e.g., butterfly nectar sources).

**INCREASING THE SIZE AND NUMBERS OF CANDIDATE SPECIES' POPULATIONS.** The ACUB program is funding captive rearing efforts for both candidate butterflies: the Taylor's checkerspot and the mardon skipper. By developing methods to collect, rear, and release these animals, we are moving toward the goal of reintroduction of these species on currently unoccupied lands outside Fort Lewis. On those grasslands where the candidate species occur, the above-described habitat restoration activities are expected to increase the sizes of the populations.

**MONITORING.** Standardized, long-term monitoring is an integral aspect of the ACUB program. The tracking of both habitat quality and species status is essential to judge the effectiveness of land management activities, reintroductions, and species status trends. To date, the program has funded work to assess habitat quality ACUB lands, predict occurrence of the Mazama pocket gopher, and track population size of Taylor's checkerspot and mardon skipper.

**PLANNING AND RESEARCH.** Action plans are in development to direct conservation and restoration activities on each ACUB property. The plans are essential to ensure that funds are spent wisely, that conservation actions are targeted to specific sites, and that conservation actions are implemented in a consistent and coordinated manner across all ACUB lands.

Several important research projects have been initiated under the Fort Lewis ACUB that will help inform and direct recovery actions. For instance, existing research has shown that the streaked horned lark is subject to very high nest predation rates, resulting in low reproductive success. However, the primary predators are unknown. An ACUB-funded project is using remote sensing cameras on streaked horned lark nests to identify predators and provide recommendations to reduce nest predation rates.

Other research projects include habitat selection studies for both the Taylor's checkerspot and mardon skipper. By identifying which habitat components these animals are selecting for as egg-laying sites, as well as important life-history traits, such as in which life-stage they spend the winter, we will better know how to create and enhance their habitat.

A technical review panel comprised of scientists and biologists from the ACUB partners and independent (non-ACUB) organizations reviews all project proposals to ensure that a high standard of scientific integrity is maintained.

Grassland invaded by Scotch broom
(Photo: The Nature Conservancy)

**ECO-REGIONAL EFFORTS:** The ACUB program and its associated management and restoration projects are just one piece of a broad-scale, multi-partner effort to restore and recover these candidate species on the grasslands throughout their historic range. Efforts extend from the Georgia Basin in British Columbia, south through the Puget Trough in Washington to the Willamette Valley in Oregon.

Partners in the south Puget Sound area, including the Washington Departments of Fish and Wildlife and Natural Resources, Fort Lewis, The Nature Conservancy, Thruston County, and private landowners, have come together to sign a Candidate Conservation Agreement (CCA). The CCA is a formal agreement among participating partners and the U.S. Fish and Wildlife Service. The participants voluntarily commit to implementing specific actions that will remove or reduce the threats to these species, thereby contributing to stabilizing or restoring the species so that listing is no longer necessary.

In addition to the formal agreements such as the CCA, partners are engaged in local working groups throughout the eco-region, informal statements of unity that link partners together through common goals, active participation in species-specific workshops, as well as on-the-ground restoration and protection work across the ecoregion. This cooperative approach boosts chances of regional recovery of the species while assuring that Fort Lewis maintains its soldier training capacity.

Milan Army Ammunition Plant (MLAAP) is situated in the central part of western Tennessee in Gibson and Carroll Counties. Established in 1940-1941 from land purchased from 387 individual landowners, the installation today occupies some 22,357 acres. MLAAP is a government-owned, contractor-operated (GOCO) military industrial installation under the jurisdiction of the U.S. Army Joint Munitions Command. An Army commanding officer is typically the only active duty individual assigned to MLAAP. American Ordnance Systems, LLC, the current contractor, with a staff of approximately 560 employees, operates the installation under the oversight of the commanding officer and an 18-member civil service staff. Most of MLAAP's boundary neighbors are private citizens in a rural setting. The city of Milan and the University of Tennessee Agricultural Experiment Station share the northwestern MLAAP boundary, and the Tennessee National Guard shares approximately 70 percent of the eastern boundary and a small portion of the northern, southern, and western boundaries. Safety and quantity distance requirements are the only current land uses that affect neighbors' land use. Groundwater contamination affects neighbors on the western and northwestern boundaries (water use only).

## Scope of Conservation Program

MLAAP is in the Gulf Coastal Plain Physiographic Province in Western Tennessee. Upland hardwood forest, interspersed with agricultural crop and pasture fields, occupy 97 percent of land not utilized for industrial facilities. Bottomland hardwood forest and wetlands occupy the remaining three percent. One historic property and approximately 1,500 acres of other sites judged potentially eligible for nomination to the National Register of Historic Places have significant impact on land and forest management programs. MLAAP's natural resources program includes extensive agricultural outleases, commercial forestry operations, and outdoor recreation, including hunting and fishing programs. Although no federally listed threatened or endangered species occur at MLAAP, the conservation of biological diversity is an important component of the overall natural resources management program.

## INRMP History

In the mid 1990s MLAAP began exploring an ecosystem-based approach to its natural resources program. As part of that process, it established its first Integrated Planning Team (IPT), as described below, for the preparation of its Integrated Natural Resources Management Plan (INRMP). It completed its first comprehensive INRMP conforming to the requirements of the Sikes Act Improvement Act (1997) in 1998.

The current INRMP was reviewed and updated in 2004 using an expanded Integrated Planning Team. It is now undergoing its next five-year review and revision. The INRMP process developed at MLAAP has proven especially effective in addressing the wide range of natural resources issues and ensuring the maximum support for the installation's military mission.

**CASE STUDY**
**CHAPTER ELEVEN**
**INRMPS**

**MILAN ARMY AMMUNITION PLANT**

# A Successful INRMP Process

## Milan Army Ammunition Plant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## The Integrated Planning Team Process

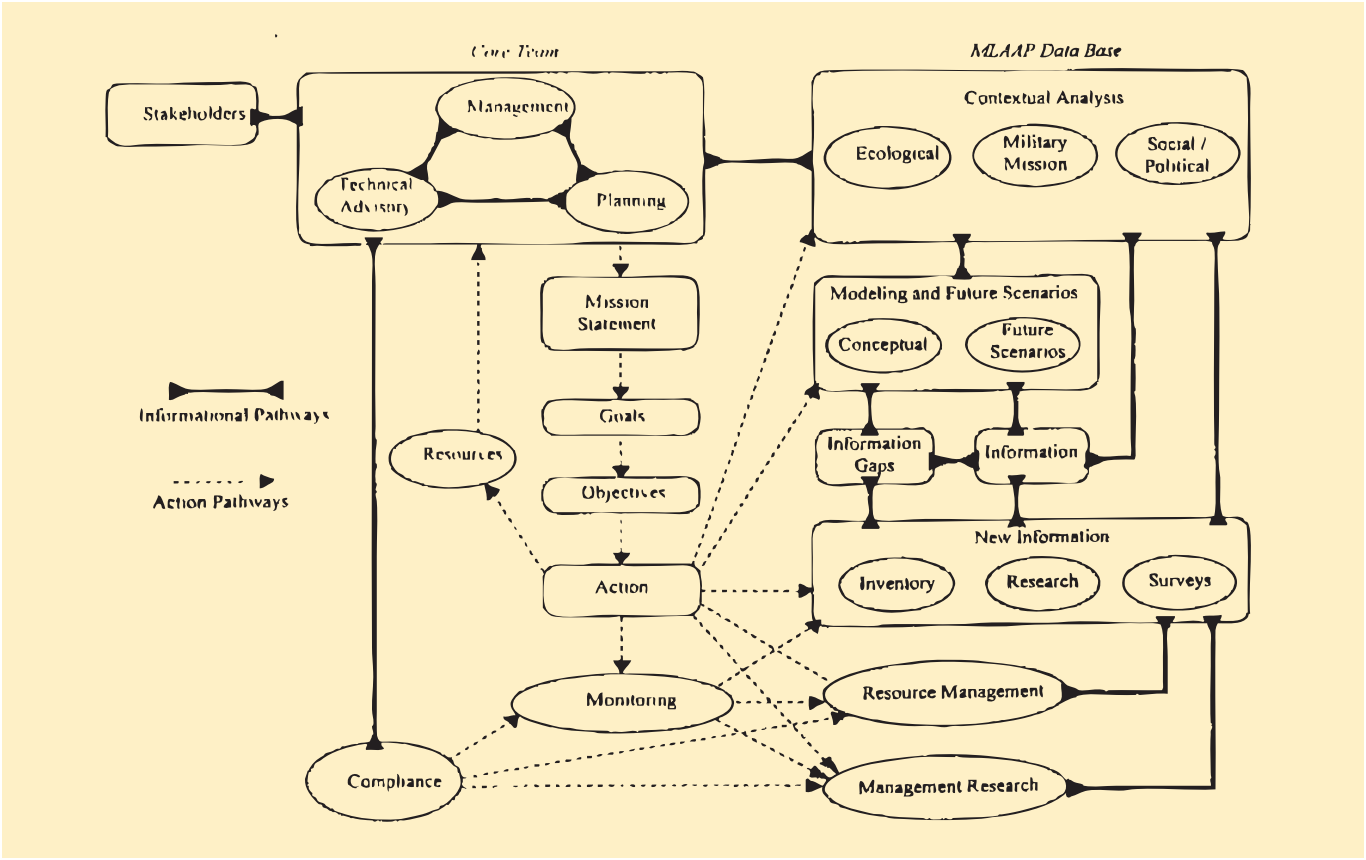
Responsible stewardship requires a proactive management philosophy that recognizes the underlying complexities of functioning ecosystems. Formation of an Integrated Planning Team from a broad spectrum of natural resources and professional fields has been critical for assembling the necessary knowledge base required for preparation of the INRMP.

The flow chart below (Figure 1) illustrates the complex, dynamic process utilized by the team in plan preparation and serves as the planning model for future management of MLAAP's natural resources program. Processes for monitoring and deriving research needs for future management are presented in the left column. This dynamic process (action-monitor-action-monitor) allows continuous refinement of ecosystem management strategies and permits the establishment of long-term databases critical for successful management programs.

Research has become an integral component for decision making in relation to the management of natural resources at MLAAP. Work initiated and conducted during 1995–98 provided the first structured research efforts and contributed valuable information concerning the status and distribution of selected biota (e.g., breeding birds, nongame mammals, amphibians and reptiles, fish, invertebrates, and plants). Additionally, this work raised questions that denoted needs for future research and, thus, provided the bases for research priorities planned during 1998-2003. From the start, an understanding of natural resources and detecting changes in natural resources was viewed by the planning team as a two-stage process (assessment of the status of resources, periodic monitoring) requiring long-term information.

**FIGURE 1:**
**MLAAP INRMP Planning Process**

**BASED ON MODEL DEVELOPED BY THE NATURE CONSERVANCY**



Milan AAP occupies over 22,000 acres, most of which serve as safety buffer zones. It has extensive forests, grasslands, and agricultural lands. (Photo: U.S. Army)

### MILAN ARMY AMMUNITION PLANT INTEGRATED PLANNING TEAM MEMBERSHIP

| Name | Organization |
|---|---|
| Dr. Mike Kennedy | The University of Memphis, Department of Biology |
| Steve Stephenson | Army Staff, Milan Army Ammunition Plant (MLAAP) |
| Jacqueline Arnold | American Ordnance LLC, MLAAP |
| Dr. Blake Brown | University of Tennessee Milan Experiment Station |
| Dr. Brian Butterfield | Freed-Hardeman University, Department of Biology |
| Geoff Call | U.S. Fish and Wildlife Service |
| Brian Carver | Freed-Hardeman University, Department of Biology |
| Jim Hamlington | TWRA, Region I Office |
| Paul Higgs | Army Staff, MLAAP |
| Britt Locke | Army Staff, MLAAP |
| Dr. Andrew Madison | Union University, Department of Biology |
| David Withers | Tennessee Department of Environment and Conservation, Natural Heritage |

In 1998–2003, research focused on filling gaps in the understanding of selected species (especially, mammals and birds) at MLAAP, developing standardized techniques for assessing biota, adding new and supplemental data to be used in monitoring species, and initiating monitoring programs. Studies relating to bird point counts (bird data gathered from a fixed point), monitoring selected groups of mammals, surveys and management assessment of white-tailed deer, and forest inventory were conducted. The goal was to put the status and distribution of the biota at MLAAP on a sound bases and initiate long-term monitoring programs to provide data to be used in future management planning.

The proposed (2004–08) Integrated Natural Resources Management Plan draws from a well- established database representing the state of natural resources at MLAAP. It presents a means of continuing to build to this database in a manner that yields a strong source of information from which to construct management plans. A major part of the proposed plan focuses on long-term monitoring. Proposed projects will provide new and important information on the status and distribution of amphibians, reptiles, fish, invertebrates, and plants as well as establish protocols for monitoring these taxa. Additionally, the plan provides for establishing long-term databases (ten years) for mammals and birds at MLAAP through continued monitoring of these animals. It calls for continued assessment of white-tailed deer, an important component of the installation's fauna as well as the principal game species hunted at MLAAP.), which should result in a strong understanding of population dynamics of the species on the site. Overall, the plan fosters long-term sustainable and environmentally sound management of the natural resources on MLAAP.

Clockwise from top left: Wildlife on Milan AAP includes box turtles, wild turkey, copperhead snake. (Photos: U.S. Army)