



U.S. Fish & Wildlife Service

ENDANGERED

# Species

BULLETIN

Spring 2011

Volume 36, No.1

**Wildlife Stewardship  
and National Defense**

## In This Edition

The Department of Defense and the military services work hard to ensure that soldiers have high-quality natural environments in which to train. They also work to sustain our nation's natural resources for future generations. Achieving these dual missions requires commitment and perseverance. A few of the many projects dedicated managers have undertaken in the past 10 years are featured in this edition of the Endangered Species Bulletin. These projects not only enable the military mission, but also help to defend and sustain endangered species and their habitats.

To learn more about DoD's stewardship efforts and successes, take time to read the stories in this edition of the Bulletin. You can also learn more at its website, [www.DoDNaturalResources.net](http://www.DoDNaturalResources.net).

## Send Us Your Comments

We are very interested in your comments and suggestions about the Endangered Species Bulletin. Please send them to [esb@fws.gov](mailto:esb@fws.gov) or mail them to Endangered Species Bulletin, U.S. Fish and Wildlife Service, Suite 420, 4401 North Fairfax Drive, Arlington, VA 22203-1610.

You can also call us at 703-358-2171.

# ENDANGERED Species BULLETIN

Spring 2011

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The Bulletin welcomes manuscripts on a wide range of topics related to endangered species. Please send an inquiry before drafting the article.

We invite you to visit the Endangered Species Program web site ([www.fws.gov/endangered](http://www.fws.gov/endangered)), where you can download podcasts and find links to follow us on Twitter and Facebook.

◀ **On the cover:** 2011 has been designated "The Year of the Turtle" by Partners in Amphibian and Reptile Conservation ([parcplace.org](http://parcplace.org)), an organization that counts the Department of Defense as a member. Last summer, personnel with the Air National Guard participated in a green sea turtle nesting beach clean-up on the Hawaiian island of O'ahu in cooperation with "Malama nu Honu," a non-profit group that works to protect the species through education, public awareness and conservation. Photo by © Martin Strmiska / Alamy.



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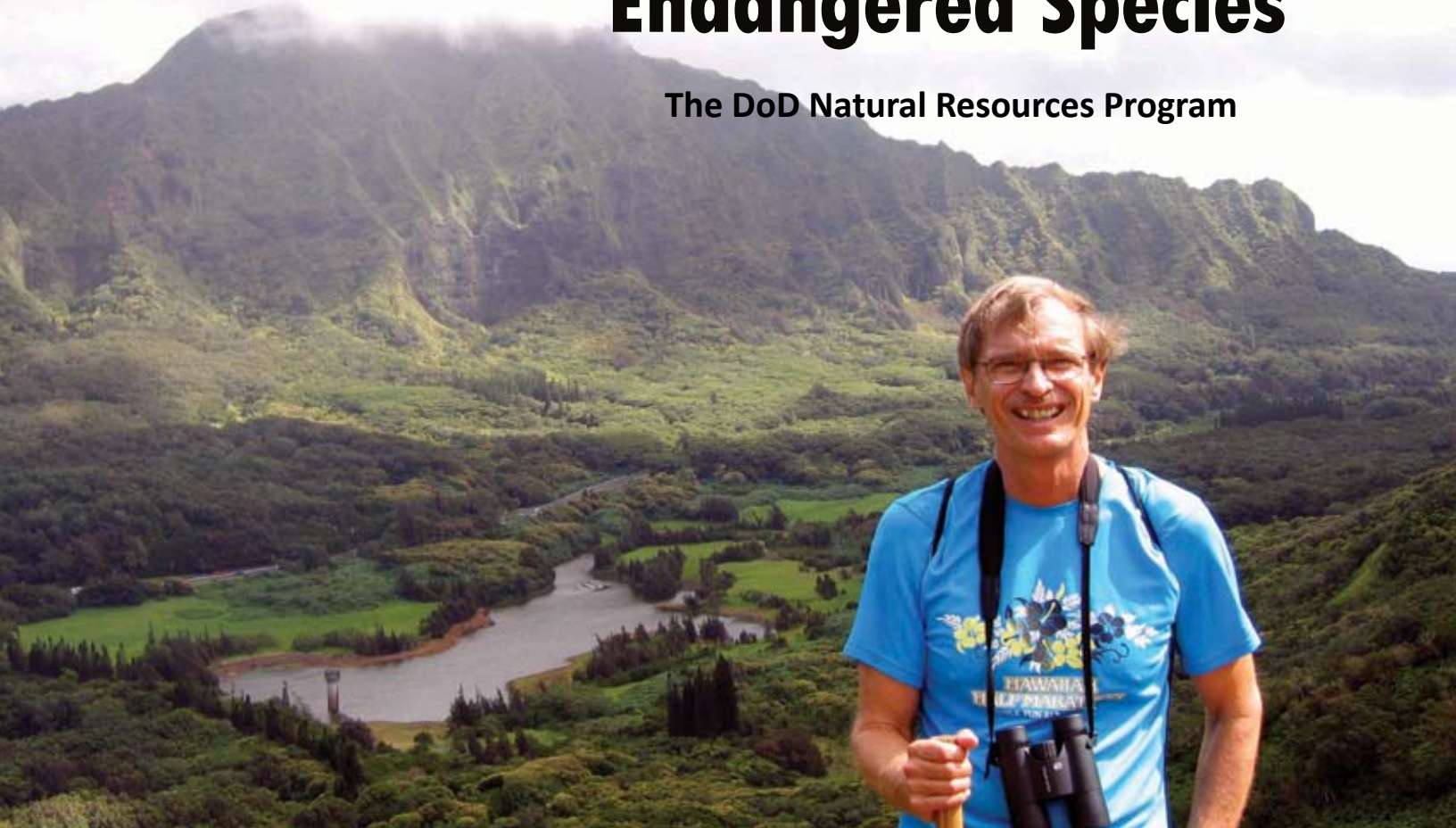
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# Why We Care About Endangered Species

## The DoD Natural Resources Program



**T**he Department of Defense (DoD) mission is to defend our nation, train our troops, and test equipment needed for national defense, peacekeeping, and emergency response. It requires air, land, and sea space for training and testing activities. Such activities may not immediately conjure thoughts of environmental stewardship. However, L. Peter Boice, Deputy Director of Natural Resources for the Office of the Secretary of Defense, offers 20 years of experience and a different perspective on this subject. During a short interview near his office in Arlington, Virginia, Peter spoke with me about DoD's commitment to natural resources conservation, and he discussed some of the natural resource policies and partnerships that have

driven DoD's successes during his career. Our conversation provides a glimpse into the extensive conservation efforts underway within the United States military, and reveals that the link between our military services and environmental stewardship is clear.

### **KS: What is DoD's natural resources mission?**

LPB: DoD's core mission is to enable our military service men and women, soldiers, sailors, airmen, and marines to train as they would fight. DoD pursues its natural resource goals to provide realistic training lands while at the same time meeting legal requirements to provide habitat for a wide variety of threatened, endangered, and at-risk species.

### **KS: Why does DoD care about endangered species?**

LPB: DoD protects endangered species to comply with the Endangered Species Act and to avoid the need for critical habitat designations, which could restrict training. To achieve this wildlife protection goal, the military services must also comply with the requirements of another law, the Sikes Act. Congress passed this law in 1960, requiring DoD to assess natural resources on installations, complete Integrated Natural Resources Management Plans (INRMPs), and coordinate with the U.S. Fish and Wildlife Service (FWS) and state fish and wildlife agencies to manage natural resources with no net loss to the military mission. However, legislative compliance is not the sole reason for

protecting endangered species on military lands. DoD manages over 29 million acres of land and more listed, threatened, endangered, and at-risk species per acre than any other federal agency. As development increases in areas surrounding military installations, some installations have become islands of biodiversity that provide habitat for certain species. In fact, more than 40 species occur only on DoD lands. DoD recognizes that part of defending our nation involves defending these natural resources for future generations.

**KS: Which DoD programs are involved with threatened, endangered, and at-risk species conservation efforts?**

LPB: There are four main programs involved with conservation efforts within DoD. I head the Natural Resources Office, which is part of DoD's Environmental Management Office. We implement the Secretary of Defense's priorities; conduct program oversight, advocacy, and outreach; and develop policy. The DoD Legacy Resource Management Program is the funding arm for the Natural Resources Office, and it provides money for national and regional projects in support of stewardship needs. The

Readiness and Environmental Protection Initiative Program works with communities that surround military installations and training areas to create buffer zones of protected habitats. This allows our soldiers to have more training space while the species that depend on those habitats can better flourish. The Strategic and Environmental Research and Development Program (SERDP) and the Environmental Security Technology Certification Program (ESTCP) fulfill DoD-specific needs for all DoD environmental programs, including munitions, restoration, weapons platforms, and natural resources. SERDP focuses specifically on research and development, while ESTCP funds technology demonstration and validation.

**KS: What are some key conservation successes that have resulted from DoD partnerships?**

LPB: DoD conservation successes not only prevent critical habitat designation and loss of training, but also create realistic training grounds for soldiers. During my career, many accomplishments have resulted from DoD partnerships with programs such as Partners in Flight and The Nature Conservancy. DoD Partners

in Flight, a public/private conservation partnership, is celebrating its 20th year by working with airfield operators to promote better habitat for species and reduce bird/animal aircraft strike hazards, resulting in potential cost savings. The Nature Conservancy works with DoD to identify lands on or surrounding bases that are prime for protection. Together, DoD and The Nature Conservancy populated a database for future land management decisions aimed at preventing the need to list at-risk species in places such as Fort Lewis, Washington, in the Puget Sound area.

**KS: What do you hope readers will take away from this issue of the Endangered Species Bulletin?**

LPB: I hope that our readers will understand that DoD's mission is to defend our nation and its resources. Our natural resource managers care about and protect threatened, endangered, and at-risk species, and I hope readers will appreciate the range of habitats and species under DoD stewardship. Most importantly, I hope that our readers leave with the knowledge that defending these species and other natural resources truly enables the military's testing and training mission.



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*L. Peter Boice, Deputy Director of Natural Resources at the Department of Defense, can be reached at peter.boice@osd.mil.*

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**(Opposite page): L. Peter Boice visiting O'ahu, Hawaii.**

**(This page): Capt. Aaron Cudnohufsky, Commanding Officer, Pacific Missile Range Facility (PMRF), along with Dennis Rowley, Tom Clements, Don Heacock, and Bobby Ragassa, carry an injured green sea turtle (*Chelonia mydas*) to an all-terrain vehicle at Nohili Ditch on PMRF. The turtle was later transported to O'ahu for medical treatment and released back into the wild. Photo by MC2 Jay C. Pugh, U.S. Navy.**

# Defense Secretary Announces Environmental Awards

by Erica Evans and Kathryn Sabella

The Secretary of Defense recognizes the importance of defending our nation's natural resources to support the military training and testing mission. Each year since 1962, the Secretary has honored military installations, teams, and individuals for their outstanding achievements to sustain the natural and cultural resources entrusted to the Department of Defense (DoD). For 2010, DoD's Environment, Safety and Occupational Health Policy Board approved 17 awards within the categories of natural resources conservation, cultural resources management, environmental quality, pollution prevention, environmental restoration, and environmental excellence in weapon system acquisition.

The DoD environmental awards recognize small and large military installations, teams, and individuals that:

- promote natural resources conservation, including the identification, protection, and restoration of biological resources and habitats; the sound management and use of the land and its resources; and the promotion of the conservation ethic;
  - promote cultural resources management, including the identification, protection, and restoration of historical buildings and structures; archaeological sites; Native American tribes and Native Hawaiian sacred objects and sites;
  - and the promotion of the cultural resources ethic;
  - prevent or eliminate pollution at the source, including practices that increase efficiency and sustainability in the use of raw materials, energy, water, or other resources;
  - protect human health and the environment by cleaning up identified DoD sites in a timely, cost-efficient, and responsive manner; and
  - incorporate environmental, safety, and occupational health requirements into the weapon system acquisition program's decision-making process.
- The 2010 Environmental Award winners are:
- Fort Custer Training Center, Michigan Army National Guard: Natural Resources Conservation – Small Installation
  - Camp Guernsey, Wyoming Army National Guard: Cultural Resources Management – Installation
  - Marine Corps Base Hawaii: Environmental Quality – Non-industrial Installation
  - Fleet Readiness Center Southwest, California: Sustainability – Industrial Installation
  - Hill Air Force Base, Utah: Environmental Restoration – Installation
  - Mr. Stephen M. Seiber, Eglin Air Force Base, Florida: Natural Resources Conservation – Individual/Team
  - Mr. Awni M. Almasri, Naval Facilities Engineering Command Europe Africa Southwest Asia: Environmental Quality – Individual/Team
  - Ms. Regina Dixon Butler, Patrick Air Force Base, Florida: Environmental Restoration – Individual/Team
  - Aeronautical Systems Center Environmental and Occupational Health Team, Wright-Patterson Air Force Base, Ohio: Environmental Excellence in Weapons Systems Acquisition – Team

Each year, a growing number of outstanding nominees present their work for consideration. These awards acknowledge some of the premier environmental projects that DoD supports. For more information on DoD's award winning environmental efforts, visit <http://www.denix.osd.mil/awards/>.

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# National Public Lands Day

## Engaging Volunteers in Natural Resources Conservation

by Jane Mallory

Since 1991, the Department of Defense (DoD) has participated in National Public Lands Day (NPLD), an annual event that brings volunteers and public land managers together to work for the restoration, conservation, and protection of essential natural resources. With the help of thousands of on- and off-post volunteers since 1999, and with funding from the DoD Legacy Resource Management Program, more than 320 individual projects throughout the country, and on Kwajalein Atoll and Guam in the Pacific, have benefitted military base environments.

The DoD Legacy Resource Management Program provides supplies for NPLD

projects, and teams of volunteers provide the labor. Throughout the years, they have worked together on a variety of projects: building bat boxes, bee condos, and bird houses; pulling invasive plants; planting native species; creating pollinator gardens; and clearing trash. Whether it is work that benefits a specific sensitive species (such as clearing debris from desert tortoise habitat on the Marine Corps Logistics Base in Barstow, California) or improving landscapes to benefit multiple species (such as planting healthy native trees, shrubs, and forbs on Greenbury Point at the Naval Academy in Annapolis, Maryland), the annual NPLD events prove that a little hard work from volunteers can go a

long way toward conserving species and habitat under DoD stewardship.

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**Volunteers installing native plants and weeding invasive species to improve coastal marsh habitat on Naval Weapons Station, Seal Beach, CA.**

*Photo by Robert Schallmann.*



# Cooperative Conservation on the Puget Sound Prairies

## The Joint Base Lewis-McChord Army Compatible Use Buffer Program

by Hannah E. Anderson

Native prairie habitat once occupied 150,000 acres (60,000 hectares) in the southern Puget Lowland of western Washington State. Ninety percent of this habitat has disappeared or been ecologically degraded. Human uses incompatible with conservation, along with the suppression of fire across the landscape, threaten the remaining prairies. Conifers and non-native vegetation are encroaching on the once open ecosystem.

A variety of rare species rely on prairie habitat for survival. Among them are four that are candidates for listing under the Endangered Species Act (ESA): two rare butterflies - Taylor's checkerspot (*Euphydryas editha taylori*) and the Mardon skipper (*Polites mardon*) - the streaked horned lark (*Eremophila alpestris strigata*), and the Mazama pocket gopher (*Thomomys mazama*). The largest expanse and the highest quality prairie habitat in the region occurs on Joint Base Lewis-McChord (JBLM), a 91,000-acre (37,000-ha) military installation 40 miles (65 kilometers) south of Seattle, Washington. If any of these species were to become listed, the U.S. Fish and Wildlife Service could impose significant military training restrictions. A group of concerned partners in the south Puget Sound are working together to recover these

species and preclude the need to list them under the ESA.

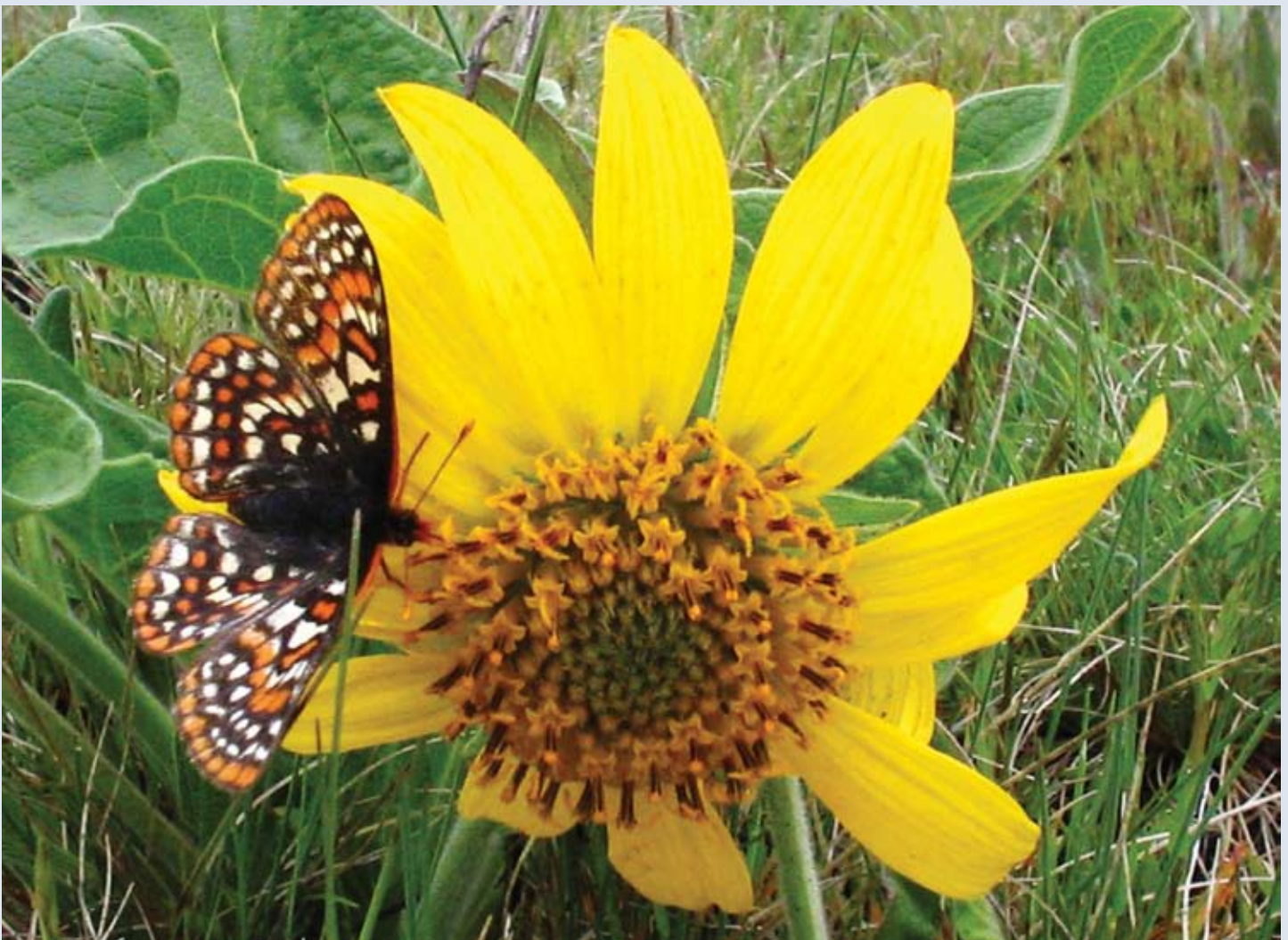
One significant conservation program in the region is the JBLM Army Compatible Use Buffer (ACUB) program. Most ACUB programs throughout the nation are geared towards acquiring and protecting land around military installations to serve as a buffer, which reduces the threat of "encroachment" (constraints on military training) due to incompatible development. The JBLM ACUB is different. In 2006, a team began using a cooperative approach to help sustain military readiness by implementing conservation actions for the four listing

candidates. The overall goal is to preclude the need to list or, if listing does occur, minimize the consequences.

The team does this through acquiring important prairie lands, restoring degraded habitats, and increasing the numbers and sizes of candidate species populations on the acquired lands. By supporting conservation actions on lands outside the base, the military shares the burden of recovery with the other ACUB partners: The Nature Conservancy, the Washington Departments of Fish & Wildlife and Natural Resources, and Wolf Haven International. The partners have acquired the prairie preserves and the







Department of Defense has provided essential funding support (\$3.3 million to date) for on-the-ground conservation actions.

The team is overcoming a common problem in conservation: insufficient resources for managing protected lands. In this case, management includes activities such as controlling invasive plants; using prescribed fire to restore historic natural ecological processes; growing, planting, and seeding native plants; breeding and reintroducing butterflies; reintroducing pocket gophers to ACUB properties; and planning, monitoring, and research.

Since the program's inception, the JBLM ACUB has acquired 1,025 acres (415 ha) of new conservation land, conducted ongoing restoration of these lands and 3,222 acres (1,303

ha) that were already in conservation status, and reintroduced Taylor's checkerspots and Mazama pocket gophers onto several ACUB properties. The team has answered significant questions about the target species, such as specific habitat requirements and predator identification. It has also conducted wall-to-wall vegetation mapping of all protected sites, information that has already been extremely useful for identifying new non-native species infestations and targeting areas for intensive habitat restoration. The JBLM ACUB projects have contributed significantly to the regional recovery of these rare native species.

The collaborative nature of the JBLM ACUB is one of the main strengths of the program. The partners agree that they accomplish much more

when working together rather than individually. Each entity is able to learn from the others, exchange information, and integrate its expertise into the collaborative effort. Most of the projects involve multiple years, sites, and partners. The goal is to promote continued military training, species recovery, open space protection, and the mutual respect and trust that come with cooperating toward a common purpose.

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**(Opposite page top): Streaked horned lark (*Eremophila alpestris strigata*).** Rod Gilbert.

**(Opposite page bottom): Managers prepare for a prescribed burn.** Photo by DoD.

**(This page): Taylor's checkerspot butterfly.**

Photo by Aaron Barna.

# Sustaining the Mission at Joint Base Lewis McChord

by David Clouse and Todd Zuchowski



At the Joint Base Lewis McChord (JBLM) in western Washington State, each of its major ecosystems -- late-successional forests, wetlands, and prairies -- provide unique opportunities to support both conservation and the military mission. In fact, projects to improve wildlife habitat frequently enhance military training opportunities. This makes it possible for managers to maintain viable populations of native flora and fauna, including listed species.

Natural resource personnel manage sites on military lands for the recovery of listed and federal candidate species, but they focus on areas of the installation that are compatible with

current and future uses of the area for training purposes. Compatibility is based on the requirements of the species targeted for augmentation and reintroduction. The following are examples from each of our ecosystems in which this process has been successful for both military training and species recovery.

Managing for late-successional forests on the military installation maintains overhead cover for training and a relatively open understory. This allows trainers to maneuver through the area and potentially enhances the site for the western gray squirrel (*Sciurus griseus*), a species of concern and a state threatened species. It also

creates habitat for nesting bald eagles. Since 1982, eagle nesting territories have increased from two to 10.

In addition to managing forests, natural resource managers at JBLM work to protect wetland habitats for various plant and fish species. Wetlands management focuses on controlling non-native plant species and protecting Chinook salmon (*Oncorhynchus tshawytscha*), steelhead (*Oncorhynchus mykiss*), and water howellia (*Howellia aquatilis*), an aquatic plant federally listed as threatened. A major management problem within wetlands and streams at JBLM is the spread of reed canary grass (*Phalaris arundinacea*). This



non-native grass species can completely choke off stream channels and displace other wetland plants. Sites that are overgrown with reed canary grass can lose their effectiveness for such military training uses as practice zones for airdrops.

Prairies in the Puget Sound region are the focus of yet another stewardship effort. They were once naturally maintained by periodic burning, but fires have been suppressed there for more than 100 years. As a result, trees and invasive species, such as the nonnative Scotch broom (*Cytisus scoparius*), have colonized prairie habitats. This shrub, which can grow up to 10 feet (3 meters) in height, significantly impedes military training and reduces habitat for prairie-dependent species. The Joint Base Lewis-McChord Fish and Wildlife program has responded by using prescribed burning, which benefits both the ecosystem and military training.

When present on a site, Scotch broom degrades open prairie habitat for four federal listing candidates. Eliminating this noxious shrub is the first step to recover a site's natural state, although efforts to restore habitats for native plants take place only on sites where the designated military use is compatible. By increasing the populations of rare species, we reduce



the likelihood of federal listing and significant impacts on military training. In some cases, limited disturbance of non-native ground cover can benefit a native species by recreating open habitat. Such is the case with the streaked horned lark (*Eremophila alpestris strigata*), which prefers some bare ground on which to locate its nests. Other species, such as the Taylor's checkerspot (*Euphydryas editha taylori*) butterfly, require nectar producing native plants and larval host plants, which grow on sites with limited ground disturbance, such as drop zones.

By focusing on a regional cooperative approach to natural resources management with partners such as the Nisqually Indian Tribe, Washington State Department of Fish and Wildlife, U.S. Fish and Wildlife Service, and The Nature Conservancy, JBLM is working to conserve rare species and prevent Endangered Species Act impacts on training. JBLM's use of sustainable programs, such as ecological burning, Taylor's checkerspot reintroduction, and Western gray

squirrel augmentation are now a cornerstone of management practices on the installation, and a model for the recovery of rare species on other military bases.

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**(Opposite page top): Taylor's checkerspot butterfly (*Euphydryas editha taylori*).** Photo by DoD.

**(Opposite page bottom): Muck Creek Channel filled with reed canary grass (*Phalaris arundinacea*) before and after mechanical removal enhancement.** Photo by Rod Gilbert.

**(This page top): Taylor's checkerspot.** Photo by Ted Thomas, USFWS.

**(This page bottom): Mazama pocket gopher (*Thomomys mazama*).** Photo by Rod Gilbert.



Photo by Rod Gilbert.

# Conservation Frontiers

## Plants Conservation on Military Lands and Beyond

by Bernd Blossey and Victoria Nuzzo

**H**undreds of plant species in the United States face extinction, despite significant efforts to protect these species and their habitats. Because plants are

often at the center of conservation actions for land managers at military installations, their declines are troubling and threats are often multifaceted, among them habitat loss and

fragmentation, the spread of invasive plants, animals, and diseases and climate change. Protecting the last remaining populations of rare plant species from extinction, re-building and restoring larger populations of these species, and preventing further decline of species currently at risk of extinction is paramount to conservation efforts.

With funding provided by the Strategic Environmental Research and Development Program (SERDP), a team of ecologists from the Department of Natural Resources at Cornell University is working to disentangle the effects of various threats, or stressors, that contribute to the rarity of four state-listed or vulnerable plant species in New York – beaked agrimony (*Agrimonia rostellata*), Virginia snakeroot (*Aristolochia serpentaria*), reflexed sedge (*Carex retroflexa*) and red trillium (*Trillium erectum*). The team conducts their work at West Point Military Academy (USMA), 50 miles (80 km) north of New York City in the Hudson Highlands ecoregion. Established in 1802, USMA is the oldest of five service academies in the United States. The site, which overlooks the Hudson River, boasts significant forested areas and wetlands, where the team is able to investigate different stressors including invasions by a number of European and Asian earthworms, particularly *Amyntas* and *Lumbricus* spp.; invasions by three plant species, garlic mustard (*Alliaria petiolata*), barberry (*Berberis thunbergii*), and Japanese stiltgrass (*Microstegium vimineum*); invasions by European slugs, mainly *Arion subfuscus*, and root weevils (*Barypeithes pellucidus*); nutrient loading through aerial deposition; and the impact of overabundant white-tailed deer (*Odocoileus virginianus*).

This work is conducted in multiple venues: large (30x30 m) deer exclosures erected at USMA paired with similar-sized unfenced control areas,



experimental plantings and seedlings to assess potential restoration techniques, and a variety of common garden and laboratory experiments to tease apart the contribution of individual and combined stressors on demography of the four state-listed plant species. The team selected the target plant species not only for their status as regionally listed species, but also for their assumed different vulnerability to earthworm invasions, or deer herbivory.

Based on the results of previous research, the team assumed deer herbivory and earthworm invasions would overwhelm the importance of other stressors in the demise of these rare target plant species. In an attempt to assess deer browse intensity at the various field sites, the team employs a sentinel approach using 3-month old oak seedlings. The team monitors these oak seedlings, along with individually marked specimens of the target native plant species growing inside and outside of deer exclosures, for their survival, growth, and deer browse intensity.

After only 2 years of field observation, the team's results show that deer herbivory on oak seedlings and three of the four 'rare' plant species is excessive, and considerably reduces growth, flowering, and fruiting. This is further increasing concerns for long-term survival of rare browse-sensitive species.

Work by other scientists demonstrates that for the closely related white trillium (*Trillium grandiflorum*), browse intensity exceeding 15 percent of reproductive individuals leads to

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**(Opposite page): Virginia snakeroot.**

**(This page top): West Point oak seedling.**

**(This page bottom): Red trillium.** Photos by Bernd Blossey.



long-term population decline. Unlike individuals exposed to deer, individuals of the listed plant species growing inside enclosures show strong signs of recovery, and the taller, more robust plants bear little resemblance to the tiny individuals initially encountered. In the absence of deer herbivory, native plants are better able to stand their ground against invasive plants, at least against the three invasive plants that the team monitors in eastern deciduous forests.

Managers often blame invasive plants for deteriorating native plant communities, but the team's work indicates it is a complex of stressors responsible for this degradation. The results of this research, although preliminary, point to the overwhelming

importance of deer herbivory in the decline of many plant species in eastern forests. Conservation efforts, particularly managing invasive plant species in preserves or on military installations, should focus on the source of degradation to prevent further decline. Merely removing invasive plant species will not achieve the same level of conservation benefits for state and federally listed browse sensitive plant species as reducing overabundant deer herds across much of North America would.

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**(Inset): A good example of rich groundlayer vegetation protected from deer herbivory.**

*Photo by Victoria Nuzzo.*

**(Opposite page): Deer enclosure.**

*Photo by Bernd Blossey.*





# Banking Seeds for the Future

## An Essential Tool for Plant Recovery

by Jane Mallory



Department of Defense (DoD)-managed lands contain habitats that support 186 plant species that are listed under the Endangered Species Act or are candidates for listing. Because listed species on DoD lands can lead to restrictions on training and operations, working towards species recovery whenever possible benefits not only the species but also installation operations and the military mission. To conserve these rare species, the DoD Legacy Resource Management Program enlisted the assistance of the Center for Plant Conservation, a non-profit network of institutions dedicated to conserving and restoring America's native plants.

According to the Center, a number of recovery plans for federally-listed plants propose the reintroduction of nursery-grown stock as one way to increase wild populations to a sustainable level. Such reintroductions originate from *ex-situ* (off-site) collections of plant cuttings, seeds, spores, and/or tissue cultures. However, existing collections are distributed widely among many institutions, and there was no public database on the amount, condition, and age of material potentially available for restoration work. The DoD Legacy Program addressed this problem by funding the Center to conduct a comprehensive study on the state of *ex-situ* material for all DoD-protected plant species.

The Center's report provides detailed information for each species, a description of *ex-situ* material and the collection sites, and identifies species that lack such material. DoD installations and the military services can use this information to examine efforts to secure the genome of vulnerable plant species and improve the potential for any future reintroductions. For example, the study revealed that 130 of the





186 imperiled plant species found on DoD lands lack any DoD site-specific collections. They also found that *ex-situ* material for 61 of the 186 species had never been collected and stored anywhere, possibly hindering recovery efforts and leaving these species particularly vulnerable to extinction.

In 2010, the DoD Legacy Program awarded the Center additional funding to use the study results as a guide for the next DoD endeavor, the “Seed Banking Federally-listed Mainland Plant Species on DoD Lands” project. This is a multi-year effort to collect seeds and other material from species found on DoD mainland installations. Field biologists from the Center and its partner institutions, such as botanical gardens, arboreta, and universities, are now working with natural resource managers at military installations to collect material for the 20 highest priority species and will collect additional species in the coming year. Scientists will store collection information in the Center’s central database to track various attributes (propagule counts, age, location, etc) of *ex-situ* material for future research

and restoration work. They will store the actual seeds and cuttings at the U.S. Department of Agriculture’s National Center for Genetic Resources Preservation in Ft. Collins, Colorado. This effort will secure DoD site-specific wild-collected seed for the most vulnerable species and help safeguard the genetic integrity of declining populations. This research can be used to provide a seed bank resource for immediate and future restoration needs and create a safety net against unforeseen threats to wild populations. These seed collections could also be used for additional research tasks identified in recovery plans and serve as a source material for possible out-planting efforts by DoD natural resources managers.

In addition to collecting data and material that could one day help recover rare plants on military installations, DoD is also providing training for its natural resources managers in topics that relate specifically to plant conservation. In 2007, the Center used funding from the DoD Legacy Program to tailor their plant conservation training course for

DoD managers and presented it during a workshop in Honolulu, Hawaii, an area that supports the lion’s share of imperiled plants in the United States. Thirty DoD personnel, state agency personnel, DoD contracted support, and partners attended this workshop. Over the course of six days, nine PhD faculty members taught 17 different topics, such as Concepts of Rarity and Imperiled Plants, Importance of Systematics, Population Evaluation using Demography Population Viability Analysis, and Recovery Criteria. The course was such a success that the Center presented it again in 2009 in California, and is hoping for a third offering in North Carolina in the near future.

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**(Opposite page): Ute ladies'-tresses (*Spiranthes diluvialis*).** Photo by Bekee Hotze, USFWS.

**(This page): Golden paintbrush (*Castilleja levisecta*).** Photo by Ted Thomas, USFWS.

# Connecting Landscapes for Biodiversity

## Habitat Conservation On and Around DoD Lands

by Aaron Moody

**H**abitat fragmentation due to land-use changes near military bases poses major challenges for wildlife conservation on Department of Defense (DoD) lands. Fragmentation isolates species populations, thereby increasing their exposure to risks from demographic, genetic, and environmental factors (Gilpin and Soule 1986). This potentially undermines the wildlife recovery efforts on installations by DoD land managers.

Fort Bragg, situated in the Sandhills ecoregion of North Carolina, is emblematic of this situation. One of the largest and most active U.S. military bases, Ft. Bragg is an island of nearly intact forest surrounded by agriculture and development. As a result of fire management that mimics natural processes, Fort Bragg contains some of the most extensive high-quality long-leaf pine habitat for the endangered red-cockaded woodpecker (*Picoides borealis*). It fully encompasses the known range of an endangered butterfly, the Saint Francis' satyr (*Neonympha mitchellii francisci*). Fort Bragg also is home to three other endangered species and approximately 70 species of concern. Our research team is working on behalf of DoD's Strategic Environmental Research and Development Program to determine how to conserve habitat connectivity between on- and off-base habitats where multiple species must be managed simultaneously, while also



The Saint Francis' satyr survives only on Fort Bragg.

accommodating the base's military readiness mission.

One approach to offsetting the isolating effects of fragmentation is to preserve connections among protected habitats (Beier & Noss 1998, Tewksbury et al. 2002). The DoD has accelerated land acquisition around some bases to enhance connectivity among existing habitats for rare species (Herring 2004). However, identifying the best

lands to preserve is challenging, especially for multiple species that vary in their abilities to disperse through different natural, managed, or developed habitats (Ricketts 2001).

Historically, lands have been selected using expert opinion on a species-by-species basis (Beier et al. 2009). More recently, computational approaches have been developed to reduce subjectivity and automate the process of quantifying the value of land for habitat connectivity (Calabrese and Fagan 2005). For most species, these approaches are limited by a lack of information about how landscape features affect movement behavior and by the persistence of a single-species focus for connectivity assessment.

Study species include not only the red-cockaded woodpecker and Saint Francis' satyr but also two amphibian species, the eastern tiger salamander (*Ambystoma tigrinum tigrinum*) and Carolina gopher frog (*Rana capito capito*), both of which are listed by North Carolina as threatened at the state level. The team collected detailed data on movement behavior for these species using multiple methods, including radio-telemetry, *in-situ* (on site) observations, experimental releases of captive-bred animals and translocated animals into different landscape types and at landscape boundaries, tracking movement paths using fluorescent dye powder, and pit-trapping for amphibians near

breeding ponds. The team is linking these data with detailed environmental maps derived from field data, satellite remote sensing, and aircraft-based light detection and range (LiDAR), which uses a laser pulse return to map the 3-D structure of the land surface, to understand how different landscape features affect animal movement and dispersal and to map habitat connectivity. The goal is to provide information on the habitat connectivity value of each land parcel that might be acquired for conservation.

The team developed statistical models of habitat connectivity for the red-cockaded woodpecker by using radio-telemetry data from dispersing juvenile females as they searched for breeding sites. Dispersing birds avoided open and developed areas and preferred to disperse through forested landscapes, including forest types that are not used for nesting. The research team used the data to measure the relative resistance of the landscape to dispersal and to map those lands that promote dispersal.

For the Saint Francis' satyr, models of habitat connectivity are based on the simulated dispersal of butterflies through a virtual representation of Fort Bragg and surrounding landscapes. The simulation is based on movement behaviors observed from butterflies in their natural habitats and butterflies experimentally translocated and released into different types of natural and developed habitats. To map habitat connectivity, the team recorded the frequency with which simulated butterflies passed through each grid cell in the virtual landscape. Interestingly, butterflies make longer, straighter movements in upland forests, suggesting that this may be important dispersal habitat. Butterfly behavior at riparian forest edges indicated that these lands also function as dispersal corridors. In contrast, because butterflies rarely enter large

open areas, these habitats may serve as dispersal barriers.

To streamline the process of developing and integrating connectivity models, the team developed a user-friendly software package called "CONNECT" that operates seamlessly with mainstream geographic information software (ESRI ArcGIS 9.3). CONNECT combines habitat data and resistance surfaces (maps that depict how difficult it is for animals to move through the landscape) to generate likely dispersal corridors and habitat networks. CONNECT also allows combining connectivity models for multiple species to identify the highest value locations for multi-species connectivity. CONNECT makes it easy for users to incorporate animal movement models into larger work flows and to explore the affects of alternate land management, conservation, and restoration scenarios on regional-scale habitat connectivity for wildlife conservation.

Our research team is using data, models, and CONNECT to address questions relevant to wildlife conservation on and around DoD installations. The Sandhills Conservation Partnership, a multiple-stakeholder group that coordinates conservation activities in the Sandhills ecoregion, can use the information and methods developed through this project to set land acquisition priorities in order to benefit both the base and the fauna and flora of the region.

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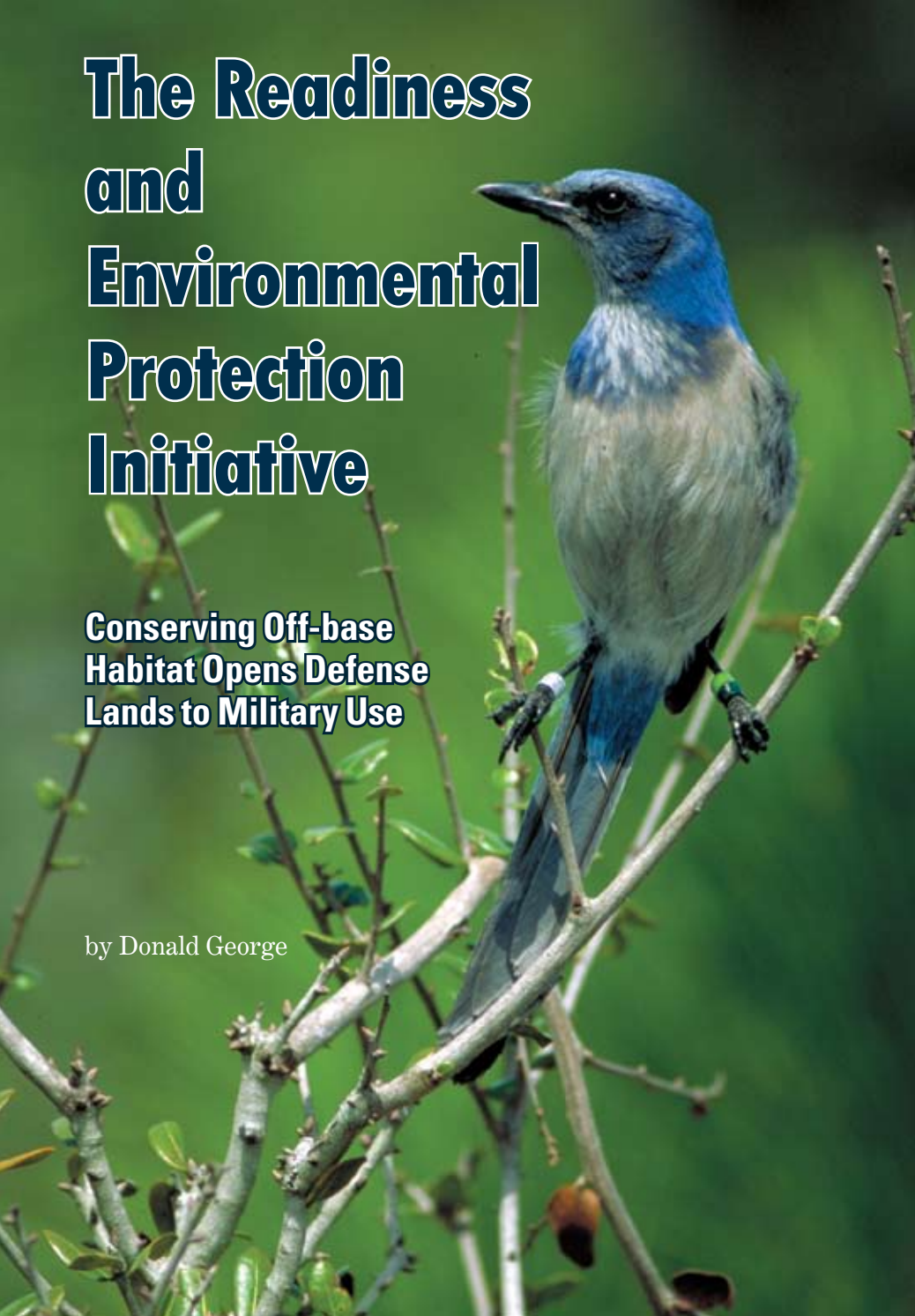
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# The Readiness and Environmental Protection Initiative

## Conserving Off-base Habitat Opens Defense Lands to Military Use

by Donald George



One of the core purposes of the U.S. Department of Defense's (DoD) Readiness and Environmental Protection Initiative (REPI) projects is to conserve such environmental assets as wildlife in a manner that supports military mission readiness and national security. These projects also demonstrate a commitment to landscape-level planning, which helps preserve biodiversity, allows

for species migration, and provides greater opportunities for adapting to, and mitigating, the effects of climate change.

When threatened and endangered species are present on installation habitat, training can be severely restricted. To alleviate this problem, installations are working with an off-post local conservation entity to promote the recovery of listed species

and conserve their habitat on lands off the military base. Installations can accrue credits and alleviate restrictions by contributing to a species' recovery on these non-DoD lands. Similarly, installations can receive credits for protecting off-post habitat, which can be applied to mitigate construction or other on-post habitat uses.

While a number of REPI projects have preserved valuable habitats and allowed DoD missions to continue, the project at Cape Canaveral Air Force Station in Florida illustrates the mutually beneficial relationship between species conservation and DoD's readiness efforts.

Cape Canaveral Air Force Station is the only U.S. space launch site capable of placing satellites into geosynchronous orbit (an orbit that places a satellite stationary over a given spot). Both government and commercial space operations rely heavily on Cape Canaveral's launch capability. However, because Cape Canaveral AFS is a critical conservation area for the threatened Florida scrub-jay (*Apelocoma coerulescens*), current launch programs are confined to their existing footprints to prevent loss of scrub habitat. The only available land for any new "heavy" launch vehicle or processing facilities is mostly scrub jay habitat, and all activities that impact scrub habitat on the base incur a 4:1 mitigation requirement to offset the habitat loss.

Since the Station is only 15,800 acres (about 6,395 hectares) and surrounded on three sides by water, the land available for new facilities is limited. Cape Canaveral has only 8,000 acres (3,240 ha) of undeveloped lands remaining, with 2,000 acres (8,000 ha) acres of that land currently set aside for conservation as a result of endangered species consultations with the U.S. Fish and Wildlife Service (FWS). Based on the offset



requirements, only 1,200 acres (500 ha) on the base remain available for military mission use.

To protect its military mission and conserve habitat, Cape Canaveral partnered with Brevard County and its voter-approved Environmentally Endangered Lands Program to preserve nearby undeveloped scrub habitat. The County acquired 188 acres (76 ha) of scrub habitat, and the Air Force received a conservation easement on 101 acres (40 ha) of that parcel. This project will help protect the survival of the Florida scrub-jay and, in working with the FWS, Cape Canaveral may receive Recovery Credits to alleviate future mitigation requirements when mission development exceeds the 1,250-acre level. This first

successful REPI project in Air Force Space Command will allow continued launches of satellites to support GPS, communications, and weather forecasting for the entire nation.

In another example of the REPI program, Camp Bullis Military Training Reservation in Texas will protect off-post habitat to support the recovery of the golden-cheeked warbler (*Dendroica chrysoparia*). Through a consultation with the FWS under section 7 of the Endangered Species Act, Camp Bullis will be able to clear unoccupied warbler habitat on post for medic field training, which is its primary training mission. Warbler habitat conserved off-post will mitigate for the on-post loss. This innovative use of REPI as a new tool

for alleviating training restrictions is being closely inspected as a model for other installations. Lessons learned from the Army's efforts at Camp Bullis will help a number of other installations currently discussing recovery efforts with the FWS, such as Marine Corps Base Camp Lejeune.

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**(Opposite page): Florida scrub jay.**

*Photo by Thomas G. Barnes.*

**(This page): Golden-checked warbler.**

*Photo by Gil Eckrich.*

# Partnerships from Hawaii to North Carolina

## The Readiness and Environmental Protection Initiative

by Nancy Natoli



**T**he U.S. Department of Defense's (DoD) Readiness and Environmental Protection Initiative (REPI) supports public-private conservation partnerships that work on a cost-share basis. These mutually beneficial partnerships succeed when a partner's focus area includes habitat for endangered species regulated on nearby military lands, or when partners are interested in areas where open space is important to maintaining the military's ability to test and train nearby. REPI's purpose is to sustain the military mission by proactively conserving the landscape and natural infrastructure beyond DoD owned land. For six years, this initiative has helped protect threatened and endangered species and their habitat across the country.

### Hawaii

A biological opinion resulting from endangered species consultation with the U.S. Fish and Wildlife Service (FWS) requires the Army to manage 75 pairs of 'elepaio (*Chasiempis sandwichensis ibidis*), a small bird native to Hawaii that inhabits DoD land. REPI funding supports the permanent protection of 'elepaio habitat at the Honouliuli Preserve and Moanalua Valley on the island of O'ahu. The U.S. Army Garrison Hawaii has a cooperative agreement with the Trust

for Public Land to protect the two locations.

The Trust for Public Land supports the Army with aggressive land management of these parcels, assisted by a large coalition of other partners including the FWS, the City and County of Honolulu, the Office of Hawaiian Affairs, and the Hawaii Department of Land and Natural Resources. Together, these organizations protect endangered species habitat from development, and have conserved an additional 3,004 acres (1,215 hectares) of open space adjacent to DoD lands.

### California

Camp Pendleton, a Marine Corps training base in Southern California, is the largest oasis of undeveloped coastal open space between Los Angeles and San Diego. It is also home to 14 threatened and endangered animal species including San Diego fairy shrimp (*Branchinecta sandiegonensis*), Riverside fairy shrimp (*Streptocephalus wootori*), arroyo southwestern toad (*Bufo californicus microscaphus*), steelhead salmon (*Oncorhynchus mykiss*), tidewater goby (*Eucyclogobius newberry*), Stephens' kangaroo rat (*Dipodomys stephensi*), Pacific pocket mouse (*Perognathus longimembris pacificus*), and seven species of birds.

Camp Pendleton's conservation efforts involving REPI aim to create and maintain linkages between San Diego County's North County Multiple Species Conservation Plan, California's Santa Ana-Palomar Mountains Linkage Conceptual Area Protection Plan, and the Mount Olympic Magee Ridge Reserve Conceptual Area Protection Plan. In addition to working with these conservation efforts, Camp Pendleton has partnered with the Trust for Public Land and San Diego County to pool more than \$4 million to conserve nearly 1,300 acres (526 ha) of wildlife habitat.

### North Carolina

In the late 1990s, training activities at Fort Bragg—one of the most combat-ready and active military installations in the country—were heavily restricted due to the presence of the endangered red-cockaded woodpecker (*Picoides borealis*). In 2000, the Army and The Nature Conservancy initiated an unconventional partnership to protect habitat for the species on private lands. Thanks to this partnership, the FWS and the Army can now celebrate having met their goal of recovering 350 potential breeding groups of woodpeckers in the Sandhills East Recovery unit, a core recovery area for the species. In fact, this goal was achieved in 2006, five years earlier than anticipated. Fort Bragg's success served as the model Congress used for

creating the enabling legislation that is now the foundation for REPI.

Integrating DoD's conservation of endangered species into a larger landscape through REPI allows the agency to use its own real estate more effectively to support the current and future military mission. Conserving endangered species both on and near military lands across the country is a mission enabler.

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**(Opposite page): O'ahu elepaio.**

*Photo by Eric Vander Werf of Pacific Rim Conservation.*

**(This page): Longleaf pine (*Pinus palustris*).**

*Photo by the Department of Defense Military Services.*

