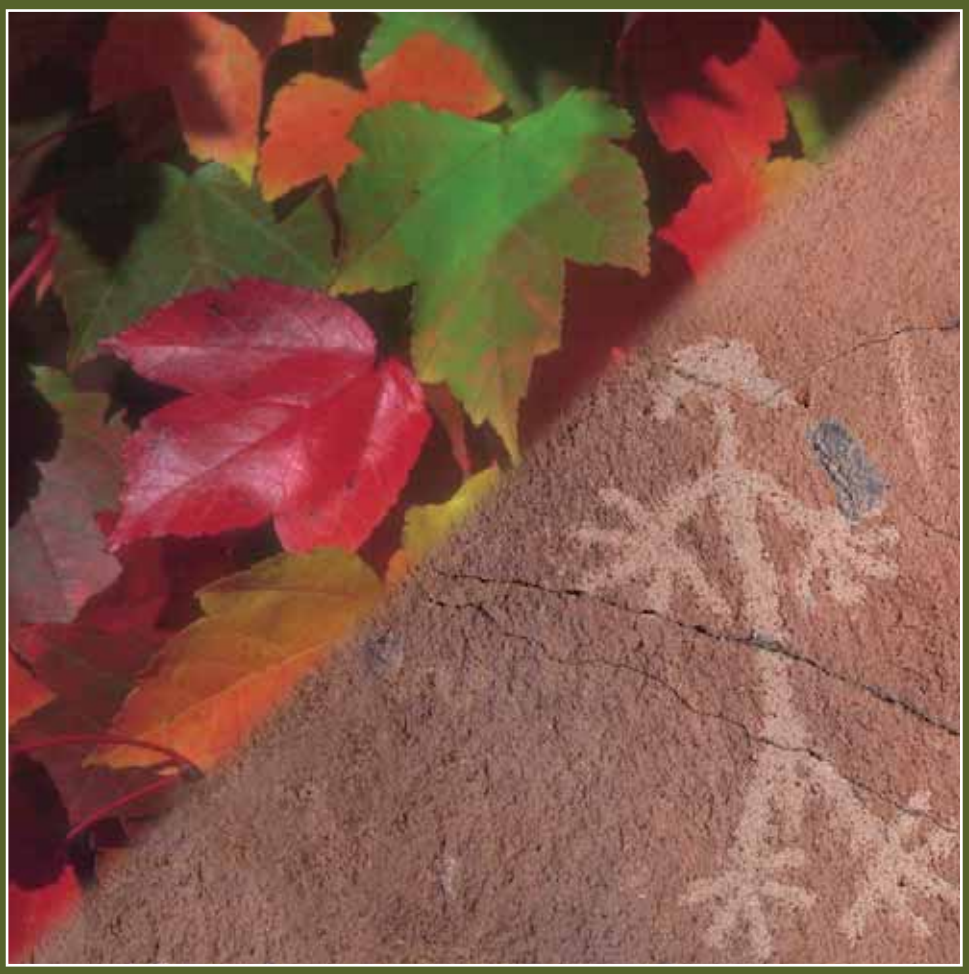
2004



Technical Notes

Conserving Natural and Cultural Resources
on Department of Defense Lands;
Case Studies from the DoD Conservation Program

Contents

Army Natural Resource Conservation Projects

Army Cultural Resource Conservation Projects

Air Force Natural Resource Conservation Projects

Air Force Cultural Resource Conservation Projects

Navy Natural Resource Conservation Projects

Navy Cultural Resource Conservation Projects

Marine Corps Cultural Resource Conservation Projects

Department of Defense Natural Resource Conservation Projects

Department of Defense Cultural Resource Conservation Projects

Defense Logistics Agency Natural Resource Conservation Projects

Introduction

The Department of Defense (DoD) is the steward of approximately 30 million acres (48,000 square miles) of land in the United States. These lands possess an incredible variety and richness of natural and cultural resources. Protecting these invaluable treasures for future generations is a vital part of our defense mission.

These Technical Notes showcase select DoD Legacy Resource Management Program funded natural and cultural resources conservation projects conducted at DoD installations — projects from every service branch and from all parts of the country. More information is available on the Internet at www.denix.osd.mil.

The purpose of these notes is to give readers an overview of the work — to show the vision, give a sense of how it was accomplished, and encourage similar work on installations around the country. These notes do not provide an exhaustive review or technical analysis of the methods used or the results obtained. Readers are encouraged to contact the project points of contact to obtain more information.

Acknowledgments

The DoD Legacy Resource Management Program wishes to thank the many people who helped identify projects and organize and coordinate submission of the information needed to develop and produce these technical notes, especially:

Peter Boice, DoD Legacy Resource Management Program

Pam Behm, DoD Legacy Resource Management Program

Pedro Morales, DoD Legacy Resource Management Program

Claire Henline, DoD Legacy Resource Management Program

Toni Patton-Williams, Department of the Army Secretariat

Lee Foster, HQ, Department of the Army

William Woodson and Robert Decker, HQ, Department of the Army

Lynda Portaszkiewicz, Army Environmental Center

Thomas Egeland, Department of the Navy Secretariat

Jay Thomas and Lorri Schwartz, HQ, Department of the Navy

Lt. Col. Alan Holck, HQ, Department of the Air Force

Anthony Greene and Heidi Hirsh, HQ, Department of the Marine Corps

Maj. Jason Pike, HQ, Defense Logistics Agency

This project would have been impossible without them.

Thanks also to the following people who contributed significant time and effort toward the completion of the technical notes contained in this document. In most cases, these people were also the driving force behind the projects that are showcased here.

Army

Sandra Alvey, USAEC—Pest Management Team; *Model Invasive Species Control Project: Yellow Starthistle*

Herbert T. Bolton, Aberdeen Proving Ground, Maryland; *Model Invasive Species Control Project: Yellow Starthistle*

David A. Buehler and James Giocomo, University of Tennessee; *Monitoring and Managing Grassland Birds for Sustainable Populations*

Alan Colwell, Blue Grass Army Depot, Kentucky;
Establishing Partnerships for Restoration of Native Grassland Savannas and Endangered Plants

Richard Edging and Joe Proffitt, Center for Environmental Management on Military Lands at Colorado State University;
Conserve Resources and Facilitate Military Training: Cave Surveys at Ft. Leonard Wood

Michael L. Hargrave, ERDC-CERL, Illinois State Museum Society;
Conserve Resources and Facilitate Military Training: Cave Surveys at Ft. Leonard Wood

Lance Peacock, Arkansas Nature Conservancy;
Implementation of the Ecoregional Conservation for the Upper West Gulf Coastal Plain

Air Force

Georgia Anast, James Levenson, and Bruce Verhaaren, Argonne National Laboratory, Illinois;
Integrated Ecosystem Databases for all DoD Installations in the Republic of Korea

Richard W. McWhite, AAC/EMSN, Eglin AFB, Florida;
The Gulf Coastal Plain Ecosystem Partnership: Freshwater Ecosystem Demonstration

Jan Nachlinger, and Sue Wainscott, The Nature Conservancy, Nevada;
Creating a Conservation Blueprint at the Ecoregional Scale: The Great Basin

Dawn Southard, The Native Seed Trade Association; *Restoring Native Pollinators and their Habitat*

Martyn Tagg, HQ AFMC/MS (CEVQ) Wright-Patterson AFB, Ohio; *Archaeological Predictive Models*

Navy

Annie Griffen, PACDIV, NAVFAC PACIFIC;
Illustrated Manual for Repair and Maintenance of Historic Military Family Housing in Hawaii

Phillip S. Lobel, Boston University, Massachusetts; *Coral Reef Protection Guidelines*

Ben K. Miehe, SDNFEC, South Carolina;
Anti-Terrorism Force Protection (ATFP) Base Entrance Improvements in a Historic District

Larry E. Murphy, National Park Service, Hawaii; *Corrosion and Fuel Oil*: *Management Strategies for the USS Arizona*

Leonard Reitsma, New England Institute for Landscape Ecology, New Hampshire;
The Importance of Mangroves to Migratory Birds

Matthew Russell, National Park Service, New Mexico; *Corrosion and Fuel Oil*:
Management Strategies for the USS Arizona

Robert E. Schnare, Naval War College, Rhode Island;
Navy Disaster Preparedness Workbook (Including Lessons Learned from 9/11)

Marine Corp

Eric M. Williams and Masayuki Yonaha, Butler Marine Corp Base, Japan; *Restoration of Chibuga Historic Spring and Well Site*

DoD & DLA

L. Peter Boice and J. Douglas Ripley, Pentagon, Washington, D.C.;
Improving Access to Information on Species of Conservation Concern

Nina Chambers and John A. Hall, The Nature Conservancy, Arizona;
Sonoran Desert Ecosystem Initiative: Shared Management Framework, Goals, Standards, and Responsibilities

David F. DeSante and M. Philip Nott, The Institute for Bird Populations, California;
Management Strategies for Reversing Declines in Landbirds on Military Installations

Susan I. Enscore, and Suzanne Keith Loechl, ERDC/CERL, Illinois;
Guidelines for Documenting and Evaluating Historic Military Installation Districts

Susan I. Enscore, Dawn A. Morrison and Julie L. Webster, ERDC-CERL, Illinois;
The Built Environment of Cold War Era Servicewomen

Kathleen A. Fagerstone, USDA/WS/National Wildlife Research Center, Colorado;
Field Evaluation of Chemical Methods for Brown Tree Snake Management

Dennis Fink, Association for Biodiversity Information;
Improving Access to Information on Species of Conservation Concern

Sidney A. Gauthreaux, Jr., Clemson University, South Carolina;
Radar Ornithology: Avoidance of Bird/Aircraft Collisions and Conservation of Migratory Birds

Jonathan Mawdsley, National Fish and Wildlife Foundation, Washington, D.C.;
Pulling Together Initiative: A Public/Private Partnership for Invasive and Noxious Plant Management

Joseph A. Mitchell, University of Richmond, Virginia;
Monitoring and Management of a Sensitive Resource: A Landscape-Level Approach with Amphibians

Paul Parker, Center for Resource Management, Utah;
Making Military Golf Courses More Environmentally Friendly: Southeast Region Demonstration Project

Patti Pride, The National Environmental Education & Training Foundation, Washington, D.C.; *National Public Lands Day*

Peter J. Savarie, APHIS-USDA; *Field Evaluation of Chemical Methods for Brown Tree Snake Management*

Daniel J. Sheehy, Aquabio, Massachusetts;
Evaluating and Enhancing the Performance of Reefs Constructed from Military Armored Vehicles

Dawn Southard, The Native Seed Trade Association;
Intergrated Ecosystem Management Approach to Golf Course Management: A Pilot Study

Mark Widener and Amelia A. Wiley, Florida Army National Guard; *Web-based Virtual Tours Highlight Military Treasures*

Finally, thanks to the many, many people who are working to conserve natural and cultural resources on Department of Defense installations throughout the country. May the projects described here provide hope and inspiration for continued progress in the wise stewardship of Department of Defense lands.

Production

The publication of these technical notes was funded through the Department of Defense Legacy Resource Management Program. The objective of the Legacy Program is to enhance the conservation of natural and cultural resources on military lands. For more information on the Legacy Program please contact the Office of the Deputy Under Secretary of Defense (Installations and Environment), 3400 Defense Pentagon, Room 3E 791, Washington, DC 20301-3400.

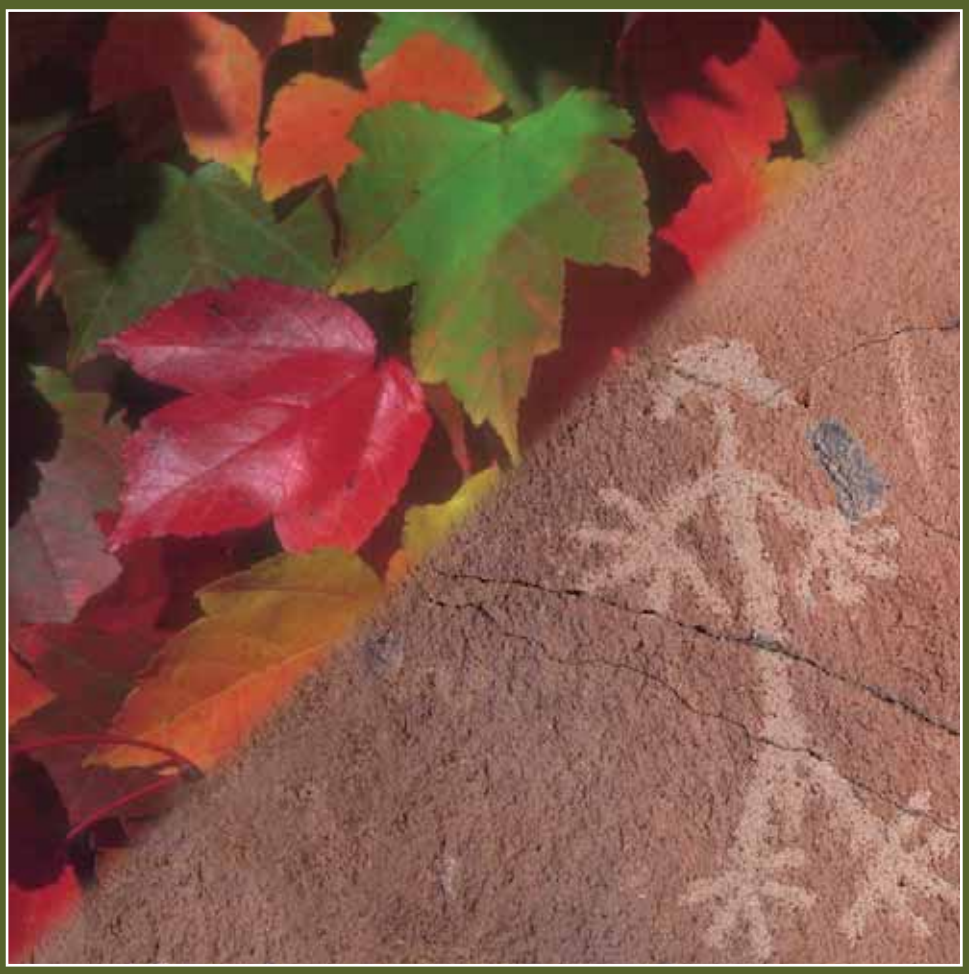
Research and collection of information about the projects listed here, and design, layout, and production of this document were completed by D.J. Case & Associates, specialists in natural resources communications, Mishawaka, Indiana (574-258-0100; www.djcase.com).

How To Use This Document

The technical notes contained in this document are organized according to two primary divisions. The first division is based on service branch. That is, all Army projects are located in one section, separate from the Navy, Air Force, Marine Corps, Department of Defense and Defense Logistics Agency sections.

The second division is based on what types of resources are being conserved—natural or cultural. That is, all Navy projects that are for the purpose of conserving natural resources are in a separate section from Navy projects that conserve cultural resources.

All technical notes are numbered sequentially within these divisions. That is, the first Air Force natural resources project is numbered AF-1N (AF indicates Air Force and N indicates Natural); the second is numbered AF-2N; and so on. Similarly, the first Marine Corps cultural resources project is numbered M-C1 (M indicates Marine Corps and C indicates Cultural); the second is numbered M-C2; and so on.



A R M Y

Natural Resource Conservation Projects

Monitoring and Managing Grassland Birds for Sustainable Populations

Description of Geographic Setting:

The Fort Campbell Military Reservation is a 103,784 acre (42,000 hectare) base located on the Tennessee/Kentucky state line. Fort Campbell contains one of the largest remaining blocks of native prairie "barrens" east of the Mississippi. Barrens are grass-dominated, treeless areas occurring on the hilly, karst topography in west central Kentucky and northwestern Tennessee. Fort Campbell grasslands contain native warm season grasses including little bluestem (*Schizachyrium scoparium*), big bluestem (*Andropogon gerardii*), switchgrass (*Panicum virgatum*), Indiangrass (*Sorghastrum nutans*), and broomsedge (*Andropogon virginicus*). Oak-hickory forests and a limited number of leased agricultural fields (hay, millet, and soybeans) are interspersed among the grasslands.

Abstract:

Widespread declines in native, warm season grasslands have been documented throughout the eastern United States, leading to declines in many grassland dependent wildlife. Fort Campbell, Tennessee/Kentucky, contains some of the most significant native grasslands remaining in the eastern U.S. Because bird populations are declining for many grassland species throughout their range, this project was initiated in 2000 to assess whether grassland bird populations were being sustained in good habitat on a military installation. Researchers monitored 1,308 nests of 43 species from 2000 through 2003. Nest success ranged from 8% to 84% yearly for all target species and most nest failures (>90%) were due to predation. A model land management system is currently being developed to meet military training and wildlife conservation objectives for Fort Campbell specifically and for military installations in general. The land management model for Fort Campbell is currently in review by installation land management staff.

Partners:

Department of Defense Legacy Resource Management Program; Fort Campbell; University of Tennessee Agricultural Experiment Station; Oak Ridge Institute of Science and Education.

Special thanks to Jeff Jones, Daniel Moss, Andrew Leonard, and Gene Zirkle (Fort Campbell) for logistical assistance.

Service Branch: Army

Project Location: Fort Campbell, Tennessee/Kentucky

Installation Size: 103,784 acres (42,000 hectares)

Installation Primary Mission: Airborne training into open drop zones, ground-based infantry, light-mechanized training, and various artillery ranges.

Project Point of Contact: James Giocomo • Department of Forestry, Wildlife and Fisheries
University of Tennessee • Knoxville, TN • Phone: (865) 974-8749 • Email: jgiocomo@utk.edu

Purpose/Need:

The number of acres of native grasslands in the U.S. has dramatically decreased during the 20th Century. This decrease can mainly be attributed to the clearing of land for agriculture and discontinued use of fire. Historically, lightning strikes and Native Americans started fires, which maintained and invigorated grassland ecosystems. During the 20th Century, farmers converted native grasslands to small grain crops and cool season forages for livestock. More recently, increasing urbanization and a shift from pastures and small grains to row crops of corn and soybeans have continued the decline in grass dominated habitats. In some states (e.g., Wisconsin and Minnesota), more than 99% of the native prairies have been converted to agriculture. This decline in grassland habitats has put the population viability of numerous wildlife species in serious jeopardy. Depending on size, location, and mission, military installations can play a large role in reversing this decline and restoring/maintaining native, warm season grasslands.

Approach:

The specific objectives of this project were to

1) Document population density and reproductive success of grassland birds and relate those parameters to habitat characteristics and management practices;

2) Propose a design for land management on military bases with grasslands that optimizes the management of grassland habitats for wildlife and military training;

3) Use the knowledge gained through this project to promote grassland bird conservation in the region, in conjunction with state and federal wildlife agencies, and Partner's In Flight.

The sampling methodology included:

Nest Searching—Nest searching was conducted in selected fields. The field crew systematically searched all fields looking for males on territory or nesting behavior. Behavioral cues such as birds flushing close to observer, birds chipping close to observer, birds carrying nesting material, or birds carrying food or fecal sacs were used to identify nest sites. At Fort Campbell, nest searching was concentrated primarily on Henslow's sparrow, grasshopper sparrow, dickcissel, eastern meadowlark, field sparrow, indigo bunting, prairie warbler, and yellow-breasted chat. Nests of all species found were monitored.

Once nests were located, a flag was placed at least five meters from the nest, and detailed maps of the nest locations were drawn. Nests were monitored every three to four days to determine nest fate. Quail and turkey nests were monitored every seven days due to their longer incubation time. Apparent yearly nest success (# successful nests/total nests) for individual species where sample sizes were sufficient (n > 9) was calculated.

Monitoring Dispersal and Return/Survival Rates—Surviving color-banded grasshopper sparrows and Henslow's sparrows banded during the previous two breeding seasons (2000 and 2001) were relocated. Early in the breeding season, all banding locations from the previous seasons were revisited and all individuals within three territories (~1 Ha, personal observation) from the original banding location were checked for color-bands. Throughout the breeding season, all birds were checked for bands, where possible. Locations were recorded using global positioning system (GPS) and will be compared to the original banding location to determine minimum dispersal distances.

Habitat evaluation—Vegetation was sampled at all Henslow's sparrow, grasshopper sparrow, field sparrow, northern bobwhite, eastern meadowlark, and dickcissel nests and random locations to characterize habitat composition and structure. These data will be used to build habitat models for target species to identify which specific habitat variables are related to observed patterns of avian use based on logistic regression statistical procedures. These habitat models will shed further light on how the burning regime affects habitat structure and composition important to these species.

Recommendations/Lessons Learned:

Between May and August in the 2000, 2001, 2002 and 2003 field seasons, 88 species of breeding birds were documented on Fort Campbell. A total of 381 nests (26 species) were located and monitored in 2000, 425 nests (22 species) in 2001, 225 nests (20 species) in 2002, and 277 nests (23 species) in 2003. Nest success ranged between 8% and 69% for all target species. Most nest failures were due to predation and the primary predator of nests appeared to be snakes. Brown-headed cowbird nest parasitism was observed in nine nests.

Data from vegetation sampling will be used to build habitat models for target species to identify which specific habitat variables are related to observed

patterns of avian use based on logistic regression statistical procedures. These habitat models will shed further light on how the burning regime affects habitat structure and composition important to these species.

Researchers are currently developing a model land management system to meet military training and wildlife conservation objectives for Fort Campbell specifically and for military installations in general. The Fort Campbell land management model is currently in review by installation land management staff. A preliminary overall grassland bird management strategy for military installations in the Eastern United States was presented at the 3rd North American Ornithological Conference, September 2002. A project summary was presented at the 121st meeting of the American Ornithological Union during a symposium session entitled "Avian Conservation and Research on Department of Defense Lands."

Military installations have a tremendous opportunity to contribute significantly to wildlife conservation goals while achieving the basic military mission. Fort Campbell has realized this opportunity by integrating natural resources management with the military mission in a variety of ways. It contains one of the largest blocks of native grasslands in the eastern United States. Management of this landscape to meet military objectives in the past has protected native grasslands. As a result, the base supports an important and unique grassland wildlife community that has largely disappeared across the region.

Project Publicity:

None

Technical Reports Produced:

Giocomo, J. 2001. Grassland bird management at Fort Campbell Military Installation, KY/TN. Tennessee Wildlife Society, Fall Creek Falls, TN.

Giocomo, J., and D. Buehler. 2002. Managing Grassland Birds on Military Installations in the Eastern United States. North American Ornithological Council Meeting, New Orleans. Poster.

Giocomo, J., Daniel Moss, David A. Buehler, and Billy Minser. 2002. Breeding grassland sparrow distribution, diversity, natural history, and conservation at Fort Campbell Military Reserve, KY/TN. Northeast/Southeast joint Partners in Flight Meeting, Blacksburg, VA. Poster.

Giocomo, J., and D. Buehler. 2003. Breeding grassland bird populations at Fort Campbell Military Reservation, KY/TN. American Ornithologist's Union Meeting, Symposium: Managing Bird Populations on Military Installations, Champagne-Urbana, Illinois.

Giocomo, J., David A. Buehler, Daniel Moss, and Billy Minser. 2004. Grassland birds at Fort Campbell Military Reservation, KY/TN. Nashville chapter of the Tennessee Ornithological Society, Nashville, TN.

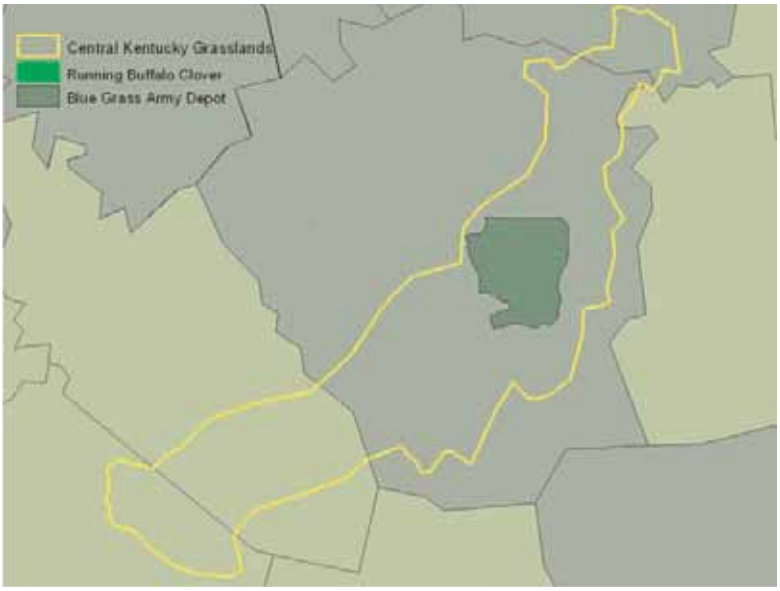
Giocomo, J., David A. Buehler, Daniel Moss, and Billy Minser. 2004. Grassland birds at Fort Campbell Military Reservation, KY/TN. Knoxville chapter of the Tennessee Ornithological Society, Knoxville, TN.

Giocomo, J., Daniel Moss, and David Buehler. 2004. Breeding bird populations in early-successional habitats at Fort Campbell Military Reserve, Kentucky/Tennessee. Joint Meeting of the American Ornithologist's Union and Society of Canadian Ornithologists, Quebec City, Canada.

Establishing Partnerships for Restoration of Native Grassland Savannas and Endangered Plants

Description of Geographic Setting:

The Blue Grass Army Depot (BGAD) lies in Madison County, Kentucky, in a geologically complex transition from the Outer Bluegrass Region to the Knobs Region. This is an area where browsing by native ungulates (bison) and burning by Native Americans maintained a mosaic of grassland, open woodland (Savannas), and forest prior to European settlement. Several vegetation types have become endangered or locally extinct, including the federally endangered running buffalo clover, native grasslands, and several species of grassland birds.



Blue Grass Army Depot

Abstract:

Native vegetation on BGAD has been severely impacted by conversion of land to agriculture and other human uses over the past 230 years. Native vegetation is now restricted to less than 10% of the landscape. The historic open woodlands and native grasslands have been particularly hard hit by conversion to farmland. Incompatible grazing practices and fire suppression are the two primary threats to restoration and maintenance of these native communities and an associated endangered plant species, running buffalo clover. Restoration of the native woodlands and grasslands on BGAD requires a variety of disciplines not available on BGAD. Therefore, a partnership with agencies and organizations that possess the needed expertise was developed. Partners with expertise in GIS technology conducted an inventory and identified locations and abundance of endangered plant species, problematic non-native species, and areas of concern. Plans were developed for growing seed stock for native plants that were indigenous to BGAD, and for maintaining the native plants with prescribed burning. BGAD staff are also working with local livestock producers to help them utilize native grasses as livestock forage in areas where livestock can be used to simulate the historic effects of bison.

Service Branch: Army

Project Location: Blue Grass Army Depot (BGAD), Madison County, Kentucky

Installation Size: 15,000 acres (6,070 hectares)

Installation Primary Mission: To provide munitions, chemical defense equipment, and special operations support to the Department of Defense.

Project Point of Contact: Alan Colwell • Blue Grass Army Depot • Natural Resources Specialist • Building S-14
2091 Kingston Highway • Richmond, Kentucky 40475 • Phone: (859)625-6328 •
Email: Alan.Colwell@bluegrass.army.mil

The endangered running buffalo clover.

Partners:

Department of Defense Legacy Resource Management Program; Kentucky Department of Fish and Wildlife Resources; Kentucky State Nature Preserves Commission; U.S. Fish and Wildlife Service; Kentucky Chapter of The Nature Conservancy; Biology and Geography Departments at Eastern Kentucky University

Purpose/Need:

Native vegetation on BGAD has been severely impacted by conversion of land to agriculture and other human uses that have occurred over the past 230 years. Native vegetation is now restricted to less than 10% of the landscape and most of the remnant areas were greatly changed by heavy logging, over-grazing, fire suppression, and other human effects that occurred on the land well before BGAD was established. The historic open woodlands and native grasslands have been particularly hard hit due to conversion of most of this vegetation to farmland. More specifically, incompatible grazing practices and fire suppression have been determined as the two primary threats to restoration and maintenance of these native communities and the associated endangered plant species, running buffalo clover. Restoration of the native woodlands and grasslands on BGAD requires a variety of disciplines not available on BGAD. Therefore, a partnership with agencies and organizations that possessed the needed expertise was needed to help reach restoration goals.

Approach:

The landscape scale significance of the plant communities of BGAD was not fully realized until BGAD began to partner with state, federal, and private conservation groups. Specifically, the Kentucky Department of Fish and Wildlife Resources (KDFWR), Kentucky State Nature Preserves Commission (KSNPC), the U.S. Fish and Wildlife Service (USFWS), the Kentucky Chapter of The Nature Conservancy (TNC) and the Biology and Geography Departments at Eastern Kentucky University (EKU) all expressed interest in the unique attributes of the native plant and animal communities present or historically present on BGAD. Although each of these partners has concern for the proper management of these unique ecosystems and frequently offers technical guidance in the form of management recommendations, none has dedicated funds for restoration work. The expertise to professionally manage native ecosystems on BGAD is in place and good working relationships have been developed with partners. In many cases the limiting factor has been funds to support the work. A Pulling Together Initiative grant provided funds to allow much-needed work to be initiated.

Prescribed burns are used to restore healthy fire-dependent ecosystems

Partners worked together with BGAD staff to establish several project priorities.

- Reverse the negative influence that incompatible agricultural practices, particularly cattle grazing, have on native plant communities.
- Re-introduce fire into fire-dependent ecosystems.
- Reduce or eliminate the influence of exotic invasive plants on native communities.
- Utilize local ecotype seed in grassland plantings.
- Utilize cattle to simulate native ungulate disturbance for management of running buffalo clover.

Agricultural outleases on BGAD provide the opportunity to maintain grasslands at no cost or even to generate project income. Significant gains have been made at reducing the negative impacts that cattle grazing may have on grasses, forbs, and woody native vegetation. However, the USFWS has made recommendations for the experimental use of cattle grazing to restore and maintain populations of running buffalo clover on BGAD. The livestock would simulate the historic

presence of bison in the region. Inadequate fencing and water facilities to allow rotational grazing and control of grazing regimes remain a concern.

Improvement in the use of GIS on BGAD would greatly facilitate good livestock management. Additionally, proper native plant community restoration and endangered species protection all require reliable inventory data storage, data analysis, and presentation capabilities possible through GIS. Installation staff does not currently possess the knowledge needed to identify native and exotic plant species on BGAD. An EKU biology student has conducted an inventory and marked locations of running buffalo clover on BGAD in the field with flags, signs, and PVC pipe. The student has entered coordinate data of those locations as a GIS layer using EKU's GIS laboratory.

Primary species of concern have been identified and general locations of greatest abundance have been mapped. Species such as bush honeysuckle, non-native thistle, tall fescue, and *Sericea lespedeza* are among the most problematic. These will be targeted for control during the upcoming growing seasons. Some herbicide application did occur late in the growing season to eliminate tall fescue from fields to be converted to native grasslands and to increase local ecotype seed harvest capacity and for livestock forage production.

BGAD staff wishes to replace exotic invasive plants with native species that are genetically unique to BGAD. Limited harvest of local ecotype native grass species (little bluestem, big bluestem and Indian grass) was accomplished by a private seed-harvesting cooperative. This seed will be utilized for planting in spring of 2004 in an area to be setup as both a seed harvest site and future warm season grass rotational grazing area.

Local livestock producers lack experience in utilizing native grasses as forage. There is a need to establish native grasses in locations suitable for future grazing or haying. The lessons learned from these native grassland agriculture fields will be important in establishing a native grassland/livestock forage tradition among the local producers and will be critical in the future management of native grassland restoration areas both on BGAD and on adjacent private lands.

Maintenance of native grasses in this region requires prescribed burning, and there is thus the need for professional prescribed burning crews. To increase capacity for prescribed burning on BGAD, the staff natural resources specialist conducted a training course in conjunction with TNC and the KDFWR. The purpose of this training was to certify University of Kentucky

Harvesting Indian grass seed used in re-establishing native plant communities

and EKU students to serve as a source of volunteers to assist with prescribed burning activities on BGAD as well as lands belonging to other partners and private landowners.

Recommendations/Lessons Learned:

It is important to realize that developing capacity in order to accomplish project activities is sometimes a very time consuming process requiring constant attention of the project manager. Establishing memoranda of understanding with various partners, initiating contracts, locating or training partners with necessary expertise, and dealing with the experimental management for an endangered species having no specific recovery plan are just a few examples of activities that require thoughtful planning and patience.

Other installations should be sure to dedicate sufficient time up front in such projects to assure adequate attention to building capacity to conduct all activities. Prospective grantees should also realize that grant funds might not be available at the exact time they are needed. This can be managed by conducting the portions of the project that are low cost or no cost first, or plan on deferring project costs until grant funds are received, possibly at the end of the fiscal period.

Project Publicity:

The only known publicity for this project was a local newspaper article that featured local 4-H volunteers who helped plant trees on the site as part of the restoration.

Technical Reports Produced:

None

Implementation of the Ecoregional Conservation for the Upper West Gulf Coastal Plain

Description of Geographic Setting:

The Upper West Gulf Coastal Plain (UWGCP) is an area of approximately 26,250,000 acres (10,600,000 hectares) or 41,016 square miles (106,231 square kilometers), covering parts of Arkansas, Louisiana, Oklahoma, and Texas. The ecoregion extends south approximately from Little Rock, Arkansas, to south of Shreveport, Louisiana, southwest to Houston, Texas, and northwest to outside the Dallas/Fort Worth area. Physiographically the UWGCP is bordered by the Lower West Gulf Coast Plain to the south, the Gulf Coast Prairies and Marshes to the southeast, the Crosstimbers and Southern Tallgrass Prairie to the west, the Ouachita Mountains to the north, and the Mississippi River Alluvial Plain to the east. The delineation between the Lower West Gulf Coastal Plain and the UWGCP is the northern limit of the natural range of longleaf pine.

Upper West Gulf Coastal Plain ecoregional placement map

Abstract:

The Upper West Gulf Coastal Plain (UWGCP), which includes parts of Arkansas, Louisiana, Oklahoma and Texas, is an ecoregion with superlative aquatic and terrestrial biodiversity. Ecoregional conservation is being implemented in the UWGCP, at site and multi-site levels, based on the ecoregional plan for the UWGCP completed previously with the support of Legacy. That plan identified more than 70 action sites and called for site-specific conservation plans, and the development and application of multiple-site high leverage strategies necessary to perpetuate ecoregional conservation targets, by increasing ecological fire and reducing ecosystem stresses such as wholesale conversion to pine plantations.

Service Branch: Army

Project Location: Pine Bluff, Arkansas. (70 different action areas defined by ecoregional plan).

Installation Size: Roughly 14,000 acres (5,665 hectares)

Installation Primary Mission: The installation primarily does chemical weapons work, weapon building, and a process for deactivation of munitions that have become obsolete by treaty or outdated. They specialize in construction and destruction of weapons.

Project Point of Contact: Mr. Lance Peacock • Arkansas Nature Conservancy
601 N. University • Little Rock, AR 72205 • Phone: (501) 614-5078 • Email: lpeacock@tnc.org

To improve forest practices in priority conservation areas, The Nature Conservancy and partners are holding workshops for the three key forest management groups: non-industrial private forest landowners, professional forestry consultants, and corporate foresters managing lands under the Sustainable Forestry Initiative. Photo courtesy of The Nature Conservancy.

For site-specific planning, priority action sites at or close to Department of Defense (DoD) facilities in the region were selected. Multi-partner planning efforts involved the private sector and governmental stakeholders. Planning products include maps of critical ownerships, ecological stress analysis, analysis of conservation targets represented, and conservation recommendations.

Sustainable and adaptive conservation forest management is the highest priority multi-site strategy to advance and demonstrate. It engages the majority ownership class, non-industrial private forest landowners, as well as public and corporate owners. All forest owner classes in the region were engaged to improve conservation silvicultural management and enhance species conservation and viability on non-DoD lands, thereby reducing the management burden on DoD lands. Several conservation forestry products were prepared and include well-distributed conservation forestry workshops, Sustainable Forestry Initiative workshops, and guidance for industry lands/staff and consulting foresters.

Partners:

Department of Defense Legacy Resource Management Program; Multi-partner planning efforts involving the private sector and governmental stakeholders; corporate and private timber interests; various military bases; and private timber company consultants.

Purpose/Need:

The Upper West Gulf Coastal Plain (UWGCP), which includes parts of Arkansas, Louisiana, Oklahoma and Texas, is an ecoregion with superlative aquatic and terrestrial biodiversity. The Nature Conservancy (Conservancy) is implementing ecoregional conservation in the UWGCP, working at site and multi-site levels, based on the ecoregional plan for the UWGCP completed previously with the support of Legacy. That plan identified more than 70 action sites and called for site-specific conservation plans, and the development and application of multiple-site high leverage strategies necessary to perpetuate ecoregional conservation targets, by increasing ecological fire and reducing ecosystem stresses; such as wholesale conversion to pine plantations. The Conservancy is requesting support for the implementation of the plan.

In 1996 The Conservancy developed an ecoregional approach to conservation, outlined in *Conservation by Design: A Framework for Mission Success,* stating that biodiversity conservation requires working at larger scales and along ecological instead of geopolitical lines. Ecoregions, large units of land and water delineated by characteristic biotic and abiotic factors, provide a better geographic basis than states for organizing conservation priorities and actions. Strategic planning on an ecoregional scale encourages review of many species and ecological communities at once, providing a structure for capturing genetic and ecological variability within species or communities.

The major products of an ecoregional plan include: 1) identification of a portfolio of sites that, if protected, collectively conserve the biodiversity of the ecoregion, 2) an implementation strategy to protect the sites, including strategies and conservation partners, and 3) identification of data gaps to improve the quality of future conservation decision-making and ensure ecoregional plan updates capture relevant and useful data. A critical element of the conservation portfolio sites is the data captured through the plan, which not only provide a science-based foundation for ecoregional planning but also provide a starting point for site conservation planning in the implementation phase.

The portfolio conservation areas depicted in this iteration of the UWGCP ecoregional plan are intended as a prioritization management tool for conservation action and resources. This plan also contains the supporting data for each portfolio conservation area, as well as an ecoregional management strategy applicable to the portfolio management areas. Portfolio management action areas are prioritized by biodiversity, threats,

complementarity, and leverage. Results and data from this ecoregional planning process should be used to create working site conservation plans as part of the initial implementation phase of the plan.

Approach:

For site-specific planning, the Conservancy prepared plans for priority action sites at or close to DoD facilities in the region. The Conservancy created multi-partner planning efforts involving the private sector and governmental stakeholders. Planning products prepared for Legacy and partners include maps of critical ownerships, ecological stress analysis, analysis of conservation targets represented, and conservation recommendations. It is estimated that seven to ten plans will be produced per year.

Conservation in the UWGCP ecoregion was strengthened at many levels. These include: 1) science-based, iterative planning, 2) well-designed conservation strategies to reduce biological stresses, and 3) greatly strengthened capacity for implementation.

A biologist with The Nature Conservancy's Arkansas Field Office checks a drift fence trap, during a year-long inventory of herpetofauna. Photo courtesy of The Nature Conservancy.

The first step in ecoregional planning was development of a science-based list of species and plant community conservation targets, with subsequent refinements by experts knowledgeable about viability and habitat needs. A portfolio of conservation areas (PCA) was developed and mapped. The PCAs are designed to perpetuate biodiversity in each ecoregion by conserving sufficient viable examples of the conservation targets to assure their long-term survival. The UWGCP plan now guides the work of the Conservancy, DoD, and many other partners. The ecoregional plan is iterative and adaptive, and explicitly identifies data gaps.

Using prescribed fire to restore pine/oak stands to their original structure and composition. Photo courtesy of The Nature Conservancy.

Site-based conservation actions flow from the ecoregional plan and the identified PCAs. Implementation actions under the current DoD Legacy planning effort in the UWGCP include: land protection of priority tracts at four sites in Louisiana (Bayou Pierre/Cannisnia, Bayou Dorcheat, Summerfield Springs, and Bieneville) and five sites in Arkansas (Terre Noire, Warren Prairie, Falcon Bottoms, Alcoa-Bauxite, and Nacatoch Ravines). Conservation staff is now in place at Alcoa-Bauxite, the Blacklands/Sandhills (AR/LA/TX), as well as Northwest Louisiana (NWLA), and action teams of ecologists, foresters and others support the UWGCP Program Manager. Two UWGCP implementation team meetings have been held, and the Conservancy staff is in the second year's operating plan for the ecoregion.

The Conservancy's capacity to work with partners has been greatly enhanced through the addition of the Blacklands/Sandhills and Alcoa-Bauxite staff. Key partners in this region include US Army Corps of Engineers (USACOE), Arkansas Game and Fish Commission (AGFC), Arkansas Natural Heritage Commission (ANHC), and several corporations. NWLA partners include U.S. Fish and Wildlife Service (USFWS), USACOE, and state natural resources agencies. Caddo Lake/Black Bayou, a very important PCA on the Louisiana/Texas state line, involving many partners, is an additional focus for NWLA staff.

Multi-site conservation strategies are also being implemented, with conservation forestry and ecological fire the highest priorities. The UWGCP has one tract (Kingsland Prairie, AR), acquired as a conservation forestry demonstration area, and will establish several other demonstration areas at existing, or newly acquired Conservancy tracts, as well as at the U. S. Forest Service Southern Experiment Station property at

Crossett, Arkansas. The Conservancy continues to work on ecological fire implementation, with partners such as the Pine Bluff Arsenal, AGFC, ANHC, and USACOE. Advocacy of ecological fire with agency decision-makers and private constituencies is also an important effort for long-term results.

Recommendations/Lessons Learned:

Sustainable and adaptive conservation forest management is the highest priority multi-state strategy to advance and demonstrate. It engages the majority ownership class, non-industrial private forest landowners, as well as public and corporate owners. It is necessary to work with all forest owner classes in the region to improve conservation management, and enhance species conservation and viability on non-DoD lands, thereby reducing the management burden on DoD lands. Conservation forestry products should be prepared to include well-distributed conservation forestry workshops, Sustainable Forestry Initiative workshops, and guidance for industry lands/staff and consulting foresters. It is recommended that five workshops per year should be conducted.

Warren Prairie Conservation Area, Arkansas, a superlative example of saline barrens and prairies in the Upper West Gulf Coastal Plain. Photo courtesy of The Nature Conservancy.

Project Publicity:

None.

Technical Reports Produced:

Upper West Gulf Coastal Plain Ecoregional Plan—Final Implementation; Version 2.0. December 2002. The Nature Conservancy.

Model Invasive Species Control Project: Yellow Starthistle

Description of Geographic Setting:

Fort Hunter Liggett (FHL) covers 257 square miles (66,677 hectares) in southern Monterey County, California. The installation is located ten miles (16 kilometers) east of the Pacific Ocean and lies between the crest of the Santa Lucia mountain range to the west and the Salinas River Valley to the east. Elevation ranges from 850 to 4,000 feet (260-1,220 meters) above sea level. Vegetation consists of annual and perennial grasslands, coastal scrub, foothill and blue oak woodlands, live oak woodlands, valley oak savanna, mixed chaparral, mixed evergreen forest, riparian and vernal pool communities.

Abstract:

Yellow starthistle (YST) is the single most troublesome invasive species in Fort Hunter Liggett. The plant currently covers more than 20,000 acres (8,000 hectares) and restricts military training activities, increases fire danger, displaces native vegetation, and threatens endangered species on the installation.
In 1999, a cooperative project was initiated to demonstrate large-scale integrated control of YST. A multi-year management plan was developed for three “at-risk” habitats. Four integrated control methods—prescription burning, biological control, herbicide applications, and revegetation—were evaluated on each of these habitats. This integrated control approach has proven to be 99% effective in controlling YST. This has great management implications for any installation with YST problems.

Partners:

Department of Defense Legacy Resource Management Program; California Department of Food and Agriculture (CDFA); University of California at Davis (UC Davis); FHL, Land Rehabilitation and Maintenance (LRAM) component of the Integrated Training Area Management (ITAM) program and Environmental Division; Monterey County Department of Agriculture; California Department of Fish and Game; U.S. Army Corps of Engineers (ERDC); and U.S. Army Environmental Center

Service Branch: Army

Project Location: Fort Hunter Liggett, Monterey, California

Installation Size: 257 square miles (665 square kilometers)

Installation Primary Mission: Largest U.S. Army Reserve Command training installation and an active military training site since 1940.

Project Point of Contact: Herbert T. Bolton, Ph.D., B.C.E. • U.S. Army Environmental Center
ATTN: SFIM-AEC-BDC • Aberdeen Proving Ground, MD 21010-5401 • Phone: (410) 436-1587 • Fax: (410) 436-1680
Email: Herb.Bolton@aec.apgea.army.mil

In addition to crowding out all native vegitation, yellow starthistle causes obvious training difficulties. Fort Hunter Liggett, California.

Purpose/Need:

Training and technology testing over the past 62 years at FHL has included all branches of the Department of Defense (DoD) and has emphasized infantry maneuvers, engineering/construction activities, aviation exercises, wheeled and tracked vehicle maneuvers, and the use of high explosives. This type of training removes existing vegetation, leaving these areas vulnerable to invasion by undesirable non-native plant species. Yellow starthistle (YST) is the single most troublesome invasive species at FHL. The YST is virtually fireproof during the green growing stage, and produces 80,000-100,000 seeds per plant per year. About 90% of these seeds are viable after dispersal and remain viable in the soil for up to ten years. During the height of the YST invasion the average increase of YST was 525 acres (212 hectares) per year. Currently, it is estimated that YST is increasing at a rate of 100 acres (40 hectares) per year. The plant currently covers more than 20,000 acres (8,000 hectares) and restricts military training activities, increases fire danger, displaces native vegetation, and threatens endangered species. For all of these reasons, there is a great need to develop an effective control method for YST.

Approach:

In 1999, a cooperative project was initiated to demonstrate large-scale integrated control of YST. A multi-year management plan was developed for three “at-risk” habitats. These three habitats included:

1. Grasslands disturbed annually (by military training, grazing, agriculture, etc.),
2. Grasslands surrounded by oaks (Quercus spp.), and
3. Grasslands supporting rare plant populations.

Four integrated control methods (prescription burning, biological control, herbicide applications, and revegetation) were evaluated on each of these habitats.

In grasslands disturbed annually, the pre-treatment YST cover was about 23% of the vegetation. From 1999 through 2001, approximately 1,600 hairy weevils (*Eustenopus villosus*) and 200 flower weevils (*Larinus curtus*) were released in the area. These insects attack YST flower heads and produce larvae that feed on seeds within the seedhead. In 2000, 200 acres (80 hectares) were burned and treated with 8 oz/acre Transline® herbicide, and in 2001, 1,200 (480 hectares) acres were burned and treated with 6 oz/acre Transline®. Post-treatment (2001) measurements showed YST cover down to 0.8%, a 99.6% reduction.

In grasslands surrounded by oaks, pre-treatment YST cover was estimated at 56%. Between 1999 and 2001, 1,000 hairy weevils and 200 flower weevils were released in the area. In 2000, 200 acres (80 hectares) were burned and treated with 8 oz/acre Transline®, and in 2001, 200 acres (80 hectares) were burned. Post treatment (2001) measurements showed YST cover down to 3%, a reduction of 94.6%.

Research area before treatment for yellow starthistle.
Fort Hunter Liggett, California

Research area after treatment for yellow starthistle.
Fort Hunter Liggett, California

In grasslands supporting rare plant populations, the U.S. Fish and Wildlife Service (USFWS) was concerned about the use of Transline® on or near purple amole (*Chlorogalum purpureum var. purpureum*) and precluded herbicide use in this area. In pre-treatment measurements, YST cover was about 73%. Between 1999 and 2001, approximately 800 hairy weevils were released, and in both 2000 and 2001, 50 acres (20 hectares) were burned. Post treatment (2001) measurements showed YST cover down to 36%, a reduction of 37%.

The project also included re-vegetation trails in these habitats to re-establish native plant cover to prevent YST re-invasion. Legumes and perennial grasses were identified as the best choices to competitively displace YST.

Recommendations/Lessons Learned:

The Integrated Weed Management Plan for control of YST at FHL details three typical western U.S. habitats that are at risk for severe YST infestation. Prescribed fire, herbicides, biological control, and re-vegetation all are available as tools to help manage YST. When used in an integrated fashion, these tools can be 99% effective in controlling YST. Military land management practices are becoming some of the most effective tools available for ensuring long term sustained health and utility of the environment and the training mission.

Researchers recommend that other installations establish a multi-year management plan for “at risk” habitats, set up management goals, and choose the appropriate control method for each habitat.

Project Publicity:

Soldiers Radio and Television, Washington, D.C., produced and aired a 2:55-minute story on the YST project at FHL.

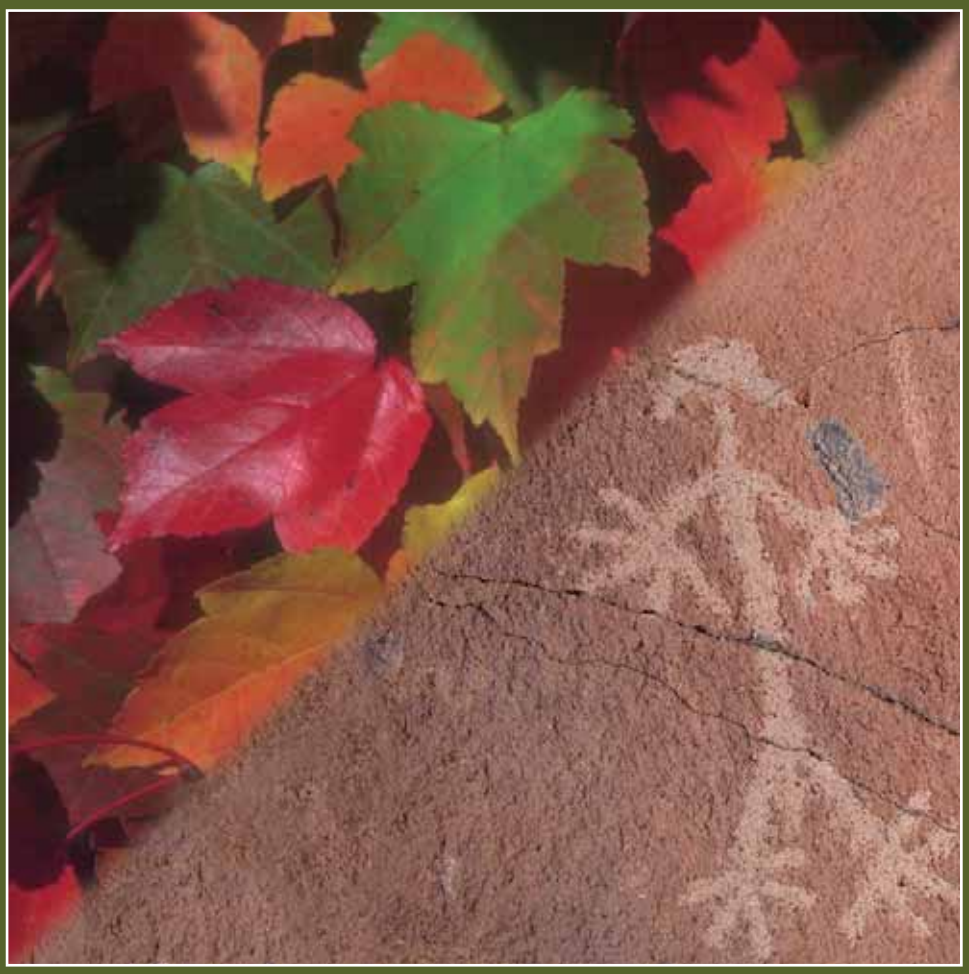
Technical Reports Produced:

Fieldwork on this project just concluded in December 2003. Researchers are in the process of preparing a user's manual that will describe the management plan for YST in each of the habitats studied. Researchers are also preparing scientific articles for publication.

Awards

National On The Ground Award presented to the YST project from The Invasive Weeds Awareness Coalition during National Invasive Weed Awareness Week, February 2003.

Telly Award for videography was presented to Mr. Javier Hernandez for the production of a short video segment on the YST project for the Soldiers Radio and Television Network.



A R M Y

Cultural Resource Conservation Projects

Conserve Resources and Facilitate Military Training: Cave Surveys at Ft. Leonard Wood

Description of Geographic Setting:

Well preserved geological features at the Martin Pool cave.

The Maneuver Support Center (MANSCEN) at Fort Leonard Wood (FLW) is located in the Ozark Plateau region of south-central Missouri. The Mark Twain National Forest borders the installation on three sides. Geologic features such as rock outcrops, karst topography (caves and sinkholes), and sheer bluffs that commonly rise 200 feet in elevation border narrow, flat, alluvial floodplains. Elevations range from 760 feet above sea level to over 1,300 feet above sea level on hilltops in the southern portion of the installation. Sixty three known caves occur within FLW boundaries.

Biologically, FLW is located at the crossroads of several natural biome divisions in the United States. This transition area is where the western edge of the eastern deciduous forest meets the savanna tall-grass prairie. The high diversity of life forms is reflected in the flora and fauna documented on the installation. Forested areas dominate the landscape outside the cantonment with 44,470 acres (17,996 ha) and 1,552 acres (628 ha) of the property are wetlands.

Abstract:

Current international military activities have accelerated the need for training in caves. Currently, military training in caves is not permitted due to incomplete, partial, or outdated cultural and biological inventories, lack of adequate mapping, and other safety issues. This project is the initial phase of a multi-year Legacy project to establish a strategy, plan, and priority list for managing cave resources from a military training, biological, geophysical, cultural, and historical resources standpoint. The project will also help natural resource managers establish "cave policy" for installations that will facilitate management for natural, cultural, military training, and recreation resource issues as increased regulation

Service Branch: Army

Project Location: MANSCEN (Maneuver Support Center) & Fort Leonard Wood, Missouri

Installation Size: 61,140 acres (24,742 ha)

Installation Primary Mission: MANSCEN is a values-based, multi-disciplined, innovative team that provides the Nation with values-based individuals, leaders, and teams trained in basic combat skills and engineering, chemical, military police, and transportation disciplines that are prepared for success in any future operational environment.

Project Point of Contact: Joe Proffitt • Natural Resource Specialist (CEMML) MANSCEN & FLW
ATTN: ATZT-DPW-EENR (Proffitt) Bldg. 2112 • Directorate of Public Works • 1334 First Street
Fort Leonard Wood, Missouri 65473-8944 • Phone: (573) 596-0131 ext. 6-3742 • Fax: (573) 596-0869
Email: proffitj@wood.army.mil

and pressure is put on cave ecosystems. This Legacy project developed and field-tested a program for inventorying and monitoring caves. The project identified a number of caves, which can be utilized as training sites. Over reliance on previous cave surveys, The Native American Graves Protection and Repatriation Act (NAGPRA) consultation and notification process when human remains were discovered, and the availability of experts to classify invertebrate cave life took much more time than expected. A final technical report is being completed and a "how-to" brochure for other installations is planned for completion in 2004.

Radio-controlled robotic devices such as this allow caves to be surveyed with minimal impact or disturbance.

Partners:

Department of Defense Legacy Resource Management Program; Engineer Research and Development Center—Construction Engineering Research Laboratory (ERDC—CERL) is supporting FLW's execution of this Legacy project. Dr. Michael Hargrave is providing technical oversight on a contract with Illinois State Museum Society.

Illinois State Museum Society (ISMS) is conducting the natural and cultural inventory of caves under the direction of Dr. Steve Ahler. Dr. Ahler is conducting the cultural resource component of this project.

University of Illinois at Urbana-Champaign (UIUC) is assisting ISMS. UIUC researcher Dr. Steve Taylor is conducting the natural resource component of the study.

Center For Environmental Management on Military Lands (CEMML) at Colorado State University is under contract to MANSCEN & FLW, Directorate of Public Works, Natural Resource Branch to support the on-site biological and cultural resource component of the project. Mr. Joe Proffitt, Natural Resource Specialist and Dr. Richard Edging, Post Archeologist are facilitating the cave survey project at MANSCEN & FLW.

Purpose/Need:

Current international military activities have accelerated the need for military training in caves. Military training in caves is currently not permitted due to incomplete, partial, or outdated cultural/biological inventories, lack of adequate mapping, and safety issues. This project is the initial phase of a multi-year Legacy project to establish a strategy, plan, and priority list for managing cave resources from a military training, biological, geophysical, cultural, and historical resources standpoint. There are sixty three known caves within the installation boundary of FLW. The initial phase of the project will concentrate on caves that the Directorate of Public Works (DPW) Natural Resource Branch feels are potentially least sensitive from a biological and cultural resource perspective. The initial biological and cultural surveys will help determine if caves are available for use in military exercises. A primary goal of the project is to identify five to ten caves as military training sites [based on unit Program of Instruction (POI)] in order to support current force protection strategies.

Military cave training protocols need to consider bats (Indiana bats) and other natural resources that may be found in caves.

Additional project objectives are to:

- Protect significant biological systems and species including those contained on the federal Endangered Species List.
- Establish a standard Department of Defense (DoD) methodology for the collection, storage, and retrieval of all biological, geophysical, cultural, and historical resources information and historical assets of DoD lands.
- Establish programs to protect, inventory, and conserve the artifacts of Native American civilization, settler communities, and others deemed to have historical, cultural, or spiritual significance.

- Establish inventories of all scientifically significant biological, geophysical, cultural, and historical assets of DoD lands.
- Establish educational public access and recreation programs designed to increase public appreciation and awareness of, and support for national environmental initiatives.
- Establish and coordinate with other federal departments, agencies, and entities a project to inventory, protect, and conserve the physical and literary property and relics of the DoD.

This project will help natural resource managers establish "cave policy" for installations that will facilitate management for natural, cultural, military training, and recreation resource issues that need to be addressed as increased regulation and pressure is put on cave ecosystems.

Specifically, this Legacy project was to develop and field test a program for inventorying and monitoring caves. This program will consist of the following characteristics:

Cultural resources discovered in caves are documented and given special attention.

1. It will integrate the management of cultural and natural resources;

2. It will develop and field-test a protocol for base line inventorying and subsequent monitoring field work. The protocol will emphasize methods for the proper management of a wide range of cave dwelling biological taxa, including relevant threatened and endangered species;

3. The program will specify a protocol for consultation with Indian tribes that is essential for the proper treatment of Native American human remains and items of cultural significance;

4. The program will also develop a field protocol for management of the wide range of potential archaeological deposits that are not directly relevant to The Native American Graves Protection and Repatriation Act (e.g., fragile floral and faunal remains, basketry, textiles, etc.);

5. The program will develop a GIS database that will ensure that baseline inventory data (including maps and digital photographic images) is readily accessible to the cultural and natural resource managers on the installation;

6. The database will be designed to manage information resulting from periodic monitoring visits in a manner that facilitates the detection of change in the condition of the cave resources; and

7. The inventory and survey ranking will allow installation managers to establish a hierarchical system in order to protect the most valuable sites as “yearly budgets allow.”

Approach:

The initial phase of the project involved communicating with the military training community to find out the exact cave training scenarios needed for each unit’s POI and exact details on what type of military activities would occur in each type of cave training. The Directorate of Public Works (DPW) Natural Resource office then made contact with both federal (U.S. Fish and Wildlife Service) and state (Missouri Department of Conservation) regulators and discussed the intent and scope of the project.

After these initial discussions, the type of biological species surveys and other cave characteristics to record was defined. Based on the previous cave survey, which was limited in scope and outdated (new caves had been discovered and species of concern had changed), it was decided to do a new and more complete set of biological surveys for all caves.

The FLW Directorate of Public Works Natural Resource Branch has responsibility for management of both biological and cultural resources on FLW. In the past, various types of cultural surveys and The National Register of Historic Places (NRHP) testing had been conducted on specific caves due to vandalism, but the vast majority of caves had limited or incomplete data. It was decided to do a complete systematic set of surveys for all caves due to the sensitive nature of human remains and potential burial sites. An initial timetable

and budget was developed for completing the surveys of sixty caves. Due to time and money constraints it was evident that funding outside of the normal installation budget was needed.

FLW Natural Resource Branch contacted the Legacy program and received funding for this project in two consecutive years (2002 and 2003). In the first year, the overall goal was to develop and field test a protocol for monitoring the nature and condition of cultural and natural resources located within and immediately outside (within the talus slope) sample caves. The monitoring strategy was intended to include brief monitoring visits and development of reliable maps, with minimal collection of cultural artifacts. The second year of funding permitted base-line inventories (as initial monitoring visits) of the remaining caves at FLW.

Soldiers participate in specialized cave training exercises

Based on results of this inventory, nine caves have been identified as suitable for military training. This will allow a set of three caves for each military scenario. Specific standard operating procedures are being developed for each training scenario, along with safety risk assessments and use/monitoring protocols for the DPW Natural Resource Branch to monitor military cave training units.

To date there have been limited opportunities to assess impacts of military training on cave resources. Initial data from military training scenarios and based on DPW Natural Resources cultural/biological and safety guidelines suggest that training impacts are no more detrimental than educational (post-elementary school class field trips) activities already permitted at one cave (Miller cave) on the site.

Recommendations/Lessons Learned:

The challenges researchers experienced during this project were largely caused by an over-reliance on a 1985 cave survey. Mapping information and the extent of the caves in the 1985 report was discovered to be incomplete and often incorrect. The new and much more extensive survey that was completed nearly doubled the project cost.

Human remains were discovered in a number of caves. Most were disturbed from previous vandalism but one intact burial was discovered. Because of the human remains, these sites had to be surveyed differently, and the NAGPRA consultation and notification process requires additional time. If another installation plans to conduct surveys in places where human remains could be discovered, it should have a NAGPRA consultation process in place. This process can save time and potential non-compliance actions, which could impact military training. Separate funds from the cultural resource program should be on hand if mitigation of cultural resource sites is required due to significant cultural deposits discovered during the survey project.

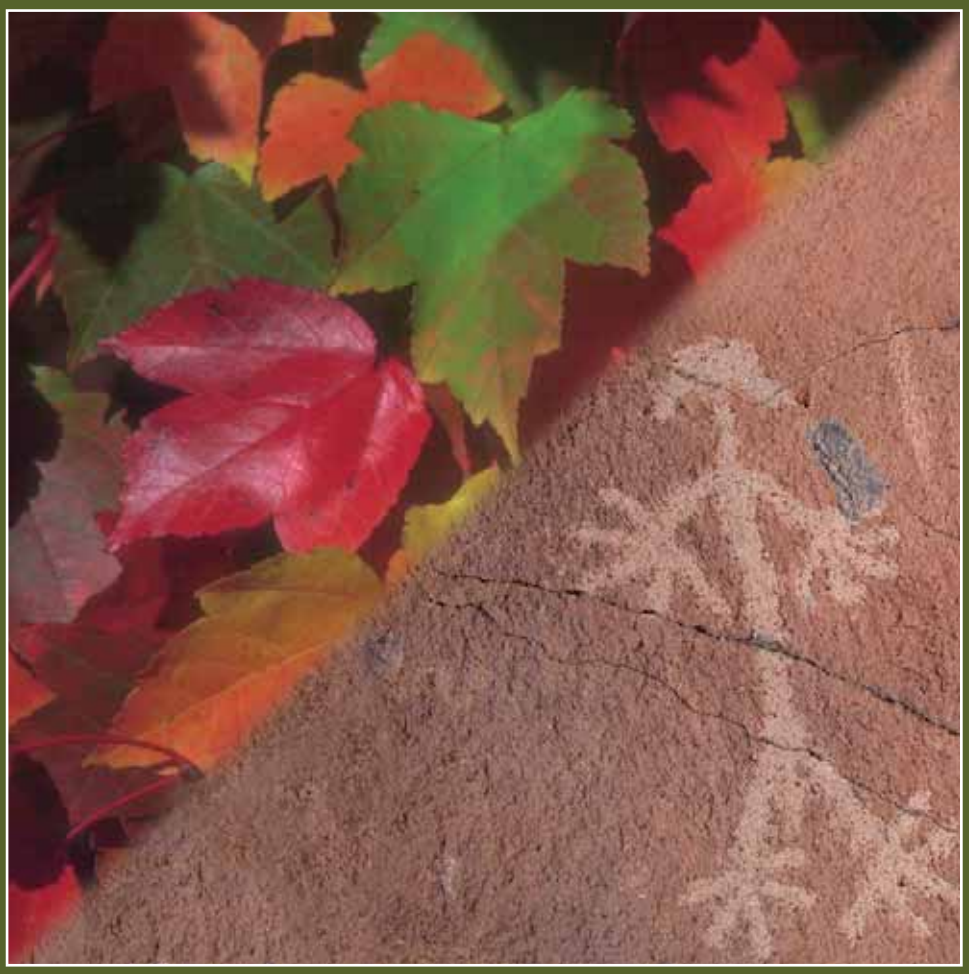
The only biological constraint was the amount of time involved for the identification and classification of invertebrate cave life. Many of the invertebrate creatures that live in caves require a detailed examination for identification to the species level. Compounding this, there are only a moderate number of qualified scientists available for this identification work. Managers should be aware that the complete identification of invertebrate cave life could potentially take much longer than expected. In areas where few cave life surveys have been done, expect many new state and county records to be entered into the state biological databases.

Project Publicity:

Publicity was not sought for the initial stages of the project due to the potentially sensitive nature of the cultural & biological data involved. Researchers have contacted and sought approval from various tribal groups and the results have been positive. One article was published in the post paper on the project and the need for limited military cave training. Researchers made one presentation at a DoD workshop on the project. They are also participating in a multi-agency Missouri cave and karst working group with the Missouri Department of Conservation.

Technical Reports Produced:

The draft technical report and draft final report are in development. These and a “how to” brochure for other installations will be completed in 2004.



AIR FORCE

Natural Resource Conservation Projects

Restoring Native Pollinators and their Habitat

Description of Geographic Setting:

Dyess Air Force Base (DAFB) is located in Abilene, Texas. Abilene is in the northeast corner of Taylor County, which ranges in elevation between 800—3000 feet (243—915 meters) above sea level. The landscape is very flat, was highly degraded, and is covered with Johnson grass (invasive), Bermuda grass (introduced invasive) and mesquite (invasive).

Restored native plant community at Dyess Air Force Base, Texas.

Abstract:

Efforts to promote biodiversity and restore degraded lands are an important Department of Defense (DoD) responsibility. Many installations are attempting to restore native plant populations, and many of these plant populations are ecologically linked to specific insects and other animals for pollination. The decline of native pollinator populations is linked to fragmentation of native plant populations and competition with alien invasive species. Restoration efforts that seek to augment and maintain native plant populations must address and incorporate pollinators. Dyess Air Force Base (DAFB) provided four study areas to restore habitat through the removal of invasive species and augmentation of native plant and native bee species. Two of the plots, adjacent to public use areas, were used as an instructive setting for the understanding of habitat restoration techniques and goals, the importance of native insect pollinators, and in providing information concerning the destructive role of invasive plant species on ecosystem health. The other two plots served as the base natural resource manager's training ground. The measure of biological success was to establish a viable population of plant species that could regenerate itself. The management plan developed serves as a model for other DoD lands with similarly degraded and disturbed systems.

Partners:

Department of Defense Legacy Resource Management Program; Abilene Christian University; Hardin-Simmons University; Boy Scouts of America; Lady Bird Johnson Wildflower Center; Texas A&M University; Botanical Research Institute of Texas.

Service Branch: Air Force

Project Location: Dyess Air Force Base, Abilene, Texas

Installation Size: 6,117 acres (2,475 hectares)

Installation Primary Mission: The 7th Bomb Wing develops and maintains operational capability for 38 B-1B aircraft, delivering global power to theater commanders. The base produces combat-ready aircrews in the command's only B-1B formal training unit.

Project Point of Contact: Ms. Dawn Southard • The Native Seed Trade Association • Phone: (202) 833-1150
Email: dsouthard@nativeseed.org

Purpose/Need:

As native plant communities are in decline nationwide, so too are their pollinators. Native pollinators are critical members of the ecological community and are commercially important to local agriculture. Military installations offer an opportunity to develop these resources through revegetation and restoration projects at a local level. If military land stewards realize the importance of keeping native plant communities and ecosystems intact, native pollinators will be available to nearby food crops.

The management plan, workbook, and research produced through this effort will help any military land manager implement a comprehensive plant and insect monitoring program while demonstrating the value of understanding the historical ecology of the region. This strategy can help military installations take a more comprehensive ecosystem approach to land management, especially as it relates to invasive species control and removal. Planting native plants after an invasive community is removed is essential for invasive control. Otherwise, it is likely that other invasive species will move in, instead of the desired native plant community.

Native plant communities increase the biological health and resilience of the base community as a whole. Money can be saved if natural communities are restored and invasive species removal and control is minimized. Because they are adapted to the local environmental conditions, native plants need significantly less water and do not need to be controlled by the use of chemicals. The economic savings to the military could be substantial if implemented on all DoD installations.

Inventory and monitoring of the insect pollinator community is regionally important. Very few entomological collections in the U.S. have regional inventories of bee communities. This makes it very difficult to understand the scope of the native pollinator situation. The DoD could become one of the most important contributors to these collections, helping to increase the knowledge and database regarding insect pollinators and native plants. The DoD could be a leader in providing information about national biodiversity. The services could be viewed as important contributors in the conservation community at the national level and could set an example for other federal agencies.

Approach:

This project began in 2000 with a focus on understanding the current components of the degraded ecosystem. The first step in this effort was to gather baseline information. There was no historical ecological information about the insect community in Taylor County, but the plant community was well documented as a short-grass prairie ecosystem. There remains a void in information about the insect community associated with prairie systems and specifically native insect pollinators in a 10-county region surrounding DAFB. A potentially viable species list of native pollinators that should exist in the restored system was therefore created based on prairie plant morphology, natural history, and nectar and pollen output.

The demonstration project consisted of four plots: two that were highly visible plots located in public use areas, one control plot, and one experimental plot. To achieve the goals of restoration and to provide educational opportunities in ecosystem stewardship, four smaller plots were chosen rather than one large, ten acre (four hectare) plot. This approach has a much broader reach from an education standpoint and would enhance overall aesthetics on the installation's housing and family areas. Also, having four plots in different places on the base provided the ability to work in several different types of environments, which offered the additional challenge of developing multiple management strategies and increased the overall educational value of the project. Each plot ranged between 1.5 to 5 acres (0.6 to 2 hectares) in size and the two plots in the public use areas had trails with interpretive signage.

The restoration strategy involved a four-part process. After an initial inspection of the project locations, historical information on the floral and invertebrate communities for Taylor County was researched and compiled. The goal was to establish a reference condition for the area prior to disturbances to the environment by invasive species. The historical research phase of developing a list of plant and invertebrate taxa provided a foundation from which all other decisions were based. The next step was to inventory current floral and faunal conditions of the project sites. Current and historical surveys were compared and this information was used to develop and implement a restoration plan. Finally, after the restoration plan had been implemented, follow-up inventories and monitoring were used to assess both biological and project success and to develop a future management plan.

Recommendations/Lessons Learned:

The project started in the middle of a four year drought that was one of the most severe in 100 years. Initial soil samples were not collected and, in the final year of the

project, when the drought conditions ended, there were a number of unexpected invasive plant species on the site. This did not cause a problem initially because native seeds were able to become established and grow enough biomass to protect them from competition. However, this did change the nature of the long-term management plan and required the removal and additional control methods for invasive species that were not originally identified. This also required the re-seeding of the plots with more of the preferred native species as a precaution. The measure of biological success was to ensure the establishment of a viable population of plant species that would be regenerative.

Project Publicity:

No publicity was sought for this project.

Technical Reports Produced:

The primary publications for this project included:

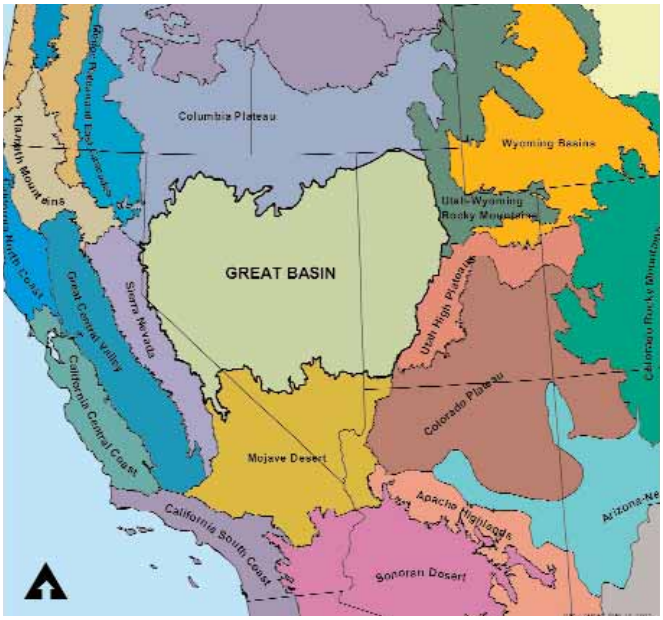
1. Guidebook for creating pollinator (micro) habitats at military installations.
2. Habitat Management Plan for Public and Non-public Plots.

A final technical report was also prepared for the Legacy Resource Management Program with a synopsis of the management plan and guidelines for other demonstration plots.

Creating a Conservation Blueprint at the Ecoregional Scale: The Great Basin

Description of Geographic Setting:

The Great Basin encompasses more than 72 million acres (29 million hectares) of semi-desert from the east slope of the Sierra Nevada across much of Nevada to the Wasatch Mountains of the Western Rocky Mountains in central Utah. Salt desert scrub and sagebrush, open conifer forests, and alpine areas in the mountain ranges characterize the ecoregion.



Ecoregions in the Western United States

Abstract:

The Great Basin has a unique biological character; more than 280 plants and animals are considered endemic to this cold desert ecoregion. In the spring of 1999, The Nature Conservancy of Nevada (TNCNV) initiated the Great Basin ecoregion planning processes, with funding provided by the DoD Legacy Program and others. The primary goal of the initial stage of the project was to identify important conservation area networks that would protect the diversity of species, communities, and ecological systems in the Great Basin. Conservation goals were established for each conservation target based on its global distribution, rarity, and vulnerability. The Great Basin planning team gathered information on the status and distribution of the conservation targets and identified 358 potential conservation areas encompassing almost 28.5 million acres (11.5 million hectares) as important areas of biodiversity. The Great Basin Blueprint is a guide for directing conservation work; it does not itself outline specific strategies for action.

Partners:

Department of Defense Legacy Resource Management Program; The Nature Conservancy of Nevada; Bureau of Land Management; U.S. Forest Service; U.S. Fish and Wildlife Service; Department of Defense; Nevada Division of Wildlife;

Service Branch: Air Force

Project Location: Great Basin Ecoregion, Nevada, California, and Utah

Installation Size: N/A

Installation Primary Mission: N/A

Project Point of Contact: Jan Nachlinger, Director of Conservation Planning • The Nature Conservancy of Nevada
1 East First Street, Suite 1007 • Reno, Nevada 89501 • Phone: (775) 322-4990 x 18 • Email: jnachlinger@tnc.org

Sue Wainscott, Conservation Planner • The Nature Conservancy • 3380 West Sahara Avenue, Suite 120
Las Vegas, Nevada 89102 • Phone: (702) 737-8744 • Email: swainscott@tnc.org

Utah Division of Wildlife Resources; University of Nevada-Reno; Utah State University; California Natural Diversity Database; Nevada Natural Heritage Program; and Utah Conservation Data Center.

Funding for this effort was provided by the DoD Legacy Resource Management Program, the President's Office of The Nature Conservancy, and Patagonia, Inc.

Purpose/Need:

Prior to this project, there had been no broad effort to assemble biological information in the Great Basin for strategic conservation planning. The goal of the Great Basin Conservation Blueprint was to develop a portfolio of conservation areas that fully represent natural communities and species characteristic of the Great Basin in viable populations and landscapes within the least area possible.

The planning team recognized a series of specific needs: to identify areas where stakeholders in the conservation community should work on the ground to achieve the overall goal; to identify important partners needed to develop better lasting working relations to successfully implement the plan on public and private lands; to identify common threats across sites to help frame strategies necessary to protect those areas; and to identify knowledge gaps that need to be filled for better informed future assessments and plan revisions.

Approach:

The Great Basin planning team contacted about 170 biologists, land managers, academics, and other experts. It gathered information on the status and distribution of the conservation targets and started off with an initial database of nearly 2,800 viable occurrences of species and terrestrial communities derived from the California Natural Diversity Data Base, Nevada Natural Heritage Program, and Utah Natural Heritage Program. To fill data holes, the planning team traveled throughout the ecoregion and met with biological experts and stakeholders that had knowledge about the abundance and distributions of conservation targets, their viability, the state of ecological processes at these locations, and threats to both site processes and the conservation targets.

The team also used ecological models of vegetation and physical gradients to map the distribution and diversity of ecological systems throughout the Great Basin. Conservation goals were established for each conservation target based on its global distribution, rarity, and vulnerability. The team sought to capture within the assessment all known viable and feasibly restorable occurrences of imperiled species and plant communities, and all aquatic species targets.

To handle the enormous amount of biological data collected for the ecoregional planning effort, the Great Basin team chose to use a computerized portfolio selection program. This tool enabled the planning team to evaluate each potential conservation site relative to all known viable occurrences of conservation targets and their surroundings.

The resulting plan identified 358 potential conservation areas encompassing almost 28.5 million acres (11.5 million hectares) as important areas of biodiversity. If this network of potential conservation areas is successfully managed for long-term conservation, much of the biodiversity of the Great Basin would be protected. The Great Basin Blueprint is a guide for directing conservation work; it does not itself outline specific strategies for action.

Recommendations/Lessons Learned:

The Ecoregional Conservation Blueprint provides a solid foundation to guide future conservation efforts in the Great Basin. An ecoregional implementation team will assist with next steps needed to protect the portfolio of sites. These actions include:

- soliciting feedback on the portfolio of sites from the conservation community, including public partners, private landowners, academics, and practitioners;
- Great Basin conservation plan communication and outreach activities;
- identifying and refining multi-site strategies;
- building strong working relationships with key partners;
- implementing conservation strategies on sites led by key partners;
- identifying specific strategies at Conservancy-led action sites and implementing actions at those sites;
- prioritizing anchor sites and community-based projects;

- prioritizing inventory and research needs to fill knowledge gaps; and
- ensuring that the next iteration of the ecoregional plan occurs in five years.

A variety of strategies will need to be employed by the conservation community to achieve conservation success. Innovative, clever, and possibly risk-taking strategies should be considered along with historically effective ones. The implementation team and key partners can assist with developing site-specific conservation strategies. Multi-site threats are complex and need broad scale strategies to reduce their impacts on biodiversity health. General strategies that TNCNV currently uses at sites involving private lands include working with private partners, finding conservation buyers, making key acquisitions, and using conservation easements.

Critical strategies to engage public partners will be needed to address the majority of portfolio sites that occur on public lands. The support and commitment of key federal managing agencies—Bureau of Land Management, United States Forest Service, DoD, Fish and Wildlife Service, National Park Service—and state and local agencies will be needed to take the lead on conservation actions at many sites. Providing the database and spatial files for the Great Basin ecoregion portfolio will allow partners to incorporate conservation considerations into their required planning efforts. There also will be the need to engage other conservation partners at sites that TNCNV has ranked lower for action priority because of limited capacity and resources. The implementation team will ensure that as new information becomes available the conservation blueprint for the Great Basin will be periodically updated.

Project Publicity:

None

Technical Reports Produced:

Nachlinger, J., K. Sochi, P. Comer, G. Kittel, and D. Dorfman. 2001. Great Basin: An Ecoregion-based Conservation Blueprint; The Nature Conservancy of Nevada: 160 p.

n.a. (2001) Great Basin: An Ecoregion-based Conservation Blueprint (Executive Summary); The Nature Conservancy of Nevada: 10 p.

The Gulf Coastal Plain Ecosystem Partnership: Freshwater Ecosystem Demonstration

Description of Geographic Setting:

The East Gulf Coastal Plain (EGCP) ecoregion stretches from the southern portion of Georgia across the Florida Panhandle and west to the southern portion of Louisiana, and encompasses portions of Georgia, Florida, Alabama, Mississippi, and Louisiana. It is one of the richest ecoregions in North America in species richness, species endemism, and community diversity for terrestrial, freshwater, and estuarine systems.

Abstract:

The purpose of the Gulf Coastal Plain Ecosystem Partnership (GCPEP) is to develop and implement a voluntary, cooperative stewardship strategy to sustain the long-term viability of native plants and animals, the aquatic and terrestrial ecosystems, the production of commodities and ecosystem services, and the human communities that depend on all of them. The aquatic part of the project encompasses freshwater ecosystems within the GCPEP region. The freshwater ecosystem demonstration provides a workable model using site conservation planning as the basis for successful, on-the-ground watershed protection and restoration. Partners identified major threats to GCPEP conservation targets on their lands during this site conservation planning process. This threats analysis has been used as the foundation for the formation of short and long-term strategies and actions to decrease threats. The GCPEP Site Conservation Plan contributes key aquatic-related information and an action plan to the natural resources staff at Eglin Air Force Base. Eglin Air Force Base and the Partnership have made tremendous progress in improving management of the aquatic conservation targets selected by the GCPEP Steering Committee. This successful Freshwater Ecosystem Demonstration Project on Eglin Air Force Base and GCPEP has regional and national applications for aquatic conservation management on military installations.

Partners:

Department of Defense Legacy Resource Management Program; Blackwater River State Forest; Blackwater River State Park; Coastal and Aquatic Managed Areas; Conecuh National Forest; Eglin Air Force Base; International Paper; Northwest Florida Water Management District; The Nature Conservancy

Service Branch: Air Force

Project Location: Eglin Air Force Base

Installation Size: 724 square miles (1,875 square kilometers) of reservation and 97,963 square miles (253,723 square kilometers) of water ranges in the Gulf of Mexico.

Installation Primary Mission: The mission of Eglin Air Force Base is to research, develop, and test non-nuclear weapons.

Project Point of Contact: Richard W. McWhite • AAC/EMSN • Eglin Air Force Base, Florida 32542-5000
Phone: (850) 882-4164 x301 • Email: mcwhiter@eglin.af.mil

Purpose/Need:

The Gulf Coastal Plain Ecosystem Partnership (GCPEP) landscape is considered by The Nature Conservancy to be one of the two most important landscapes in the EGCP ecoregion, and is a critical link in conserving the biodiversity of the Southeastern Unites States. The East Gulf Coastal Plain (EGCP) ecoregion is one of the richest ecoregions in North America in species richness, endemism, and community diversity. Embedded within terrestrial uplands (which themselves are biologically diverse) are specialized aquatic communities that provide excellent habitat for plants, amphibians, and invertebrates. These freshwater systems are among the most significant aquatic diversity resources in North America, especially for fish and mussel species. The EGCP's longleaf pine system covers less than five percent of its former range, making it one of the most endangered landscapes in North America. The aquatic systems of this ecoregion have been severely affected by hydrologic alterations, pollution, damming, and the introduction of invasive nonnative species. Conservation actions are imperative to reduce the degradation and to prevent further loss.

The purpose of the GCPEP is to develop and implement a voluntary, cooperative stewardship strategy to sustain the long-term viability of native plants and animals, the aquatic and terrestrial ecosystems, the production of commodities and ecosystem services, and the human communities that depend on all of them.

Approach:

The goal of the GCPEP Freshwater Ecosystem Demonstration project is to provide conservation and protection to an ecoregion that provides excellent habitats to a wide variety of species. The project's specific objectives are to:

1. Identify and assess target freshwater systems, species of concern, and sources of stress,
2. Identify key freshwater conservation issues,
3. Analyze and synthesize ecological and socioeconomic data,
4. Identify conservation targets and stresses,
5. Develop one- to five-year strategies and action plans,
6. Identify each partner's roles and responsibilities,
7. Coordinate with stakeholders, regulators, and decision makers,
8. Identify funding sources,
9. Implement key projects,
10. Disseminate information to partners and cooperators,
11. Develop strategies and maps for acquisition of buffer lands,
12. Assist partners with monitoring of rare aquatic species, and
13. Organize a partnership workshop to discuss rare aquatic species.

The Partnership identified 18 focal terrestrial and aquatic targets that it felt will best protect total biodiversity across the GCPEP landscape. During the site conservation plan process, the aquatic specialist and conservation ecologist divided the targets according to whether they were aquatic or terrestrial to allow for easier communication with the partners. The aquatic targets are as follows:

- Alluvial rivers/streams/floodplains
- Black water rivers/streams/floodplains
- Depression wetlands
- Estuarine systems
- Fish/mussel complex
- Flatwoods salamander (federally threatened)
- Florida bog frog (endemic to GCPEP)
- Gulf sturgeon (federally threatened)
- Okaloosa darter (federally endangered, endemic to GCPEP)
- Seepage slopes
- Steephead stream/slope systems

In preparation for the GCPEP-wide assessment of target freshwater systems, species of concern, and sources of stress, the GCPEP aquatic specialist initiated an aquatic information and resource gathering effort in cooperation with aquatic ecologists from Eglin, US Geological Survey, Florida Department of Environmental Protection, Florida Fish and Wildlife Conservation Commission,

Department of Environmental Protection-Aquatic Preserves, US Fish and Wildlife Service, Florida A&M University, Florida Natural Areas Inventory, and National Forest in Alabama.

Partners identified major threats to GCPEP conservation targets on their lands during this site conservation planning process. This threats analysis has been used as the foundation for the formation of short and long-term strategies and actions to decrease threats.

Information gathered from the assessment areas were used to identify threats and prioritize areas for conservation and restoration.

The socioeconomic assessment was made focusing on the seven-county GCPEP area. It is an update to the report "Gulf Coastal Plain Ecosystem Partnership: An Assessment of Conservation Opportunities." The GCPEP, using site conservation planning, serves as a template for protection, management, and restoration of aquatic and terrestrial biodiversity.

Recommendations/Lessons Learned:

These successful and cooperative conservation projects have ultimately led to increased health and viability of GCPEP conservation targets, thus increasing management and mission flexibility. Working together has helped all the partners develop a conservation plan that works where it counts, restoring and protecting conservation targets. Eglin Air Force Base and the GCPEP have made tremendous progress in improving management of the aquatic conservation targets selected by the GCPEP Steering Committee. This successful freshwater ecosystem demonstration project on Eglin Air Force Base and GCPEP has regional and national applications for aquatic conservation management on military installations. GCPEP staff will continue to work with partners and the public to further restore and protect the GCPEP conservation targets.

Project Publicity:

None

Technical Reports Produced:

Davis, Stephanie. et al. (2002) The Gulf Coastal Plain Ecosystem Partnership: Freshwater Ecosystem Demonstration; The Nature Conservancy: 83 p.

Integrated Ecosystem Databases for all DoD Installations in the Republic of Korea

Description of Geographic Setting:

Korea is a mountainous peninsula extending south-southwest from the northeastern part of the Chinese mainland. The east coast shows typical features of an uplifted topography, chiefly a relatively straight shoreline, whereas the west coast has the features of a submerging shoreline. Although mountains are not high (rarely exceeding 4,000 feet [1,200 meters]), the terrain is rugged and steep. Only near the west and southwest coasts are extensive flat plains and more subdued rolling hills. Due to the peninsula's length and topographic diversity, there are wide variations in vegetation, including warm-temperate and cold-temperate ecosystems.

Abstract:

To assist United States Forces Korea (USFK) meet their natural and cultural resource management goals, integrated ecosystem databases were incorporated into a Geographic Information System (GIS) for the Republic of Korea (ROK). The Integrated Ecosystem Databases of the Republic of Korea GIS, collectively called IEDROK, covers the entire ROK, and may be used by any USFK installation. IEDROK displays the locations of natural and cultural resources against a background of vegetation cover, soil type, or a variety of topographical features. IEDROK facilitates a rapid initial screening and identification of natural and cultural resources that may be affected by planned USFK undertakings. Such information is the basis for sound ecosystem management, conservation management, and environmental review processes.

Partners:

Department of Defense Legacy Resource Management Program; 8th U. S. Army-U. S. Forces Korea J4 Office—Conservation; Korean Association for Conservation of Nature; Korean Environment Institute; Korean Cultural Properties Administration; National Research Institute of Cultural Properties; and NIMA (National Imaging and Mapping Agency [now the National Geospatial—Intelligence Agency]).

Service Branch: Air Force, Army

Project Location: Republic of Korea

Installation Size: The Republic of Korea encompasses a total of 54,895,448 acres (22,215,400 hectares),

Installation Primary Mission: N/A

Project Point of Contact: James Levenson • Environmental Assessment Division, Argonne National Laboratory 9700 S. Cass Ave. • Argonne, IL 60439-4832 • Phone: (630) 252-7476 • Email: levenson@anl.gov

Bruce Verhaaren • Environmental Assessment Division, Argonne National Laboratory • 9700 S. Cass Ave. Argonne, IL 60439-4832 • Email: brucev@anl.gov • Phone: (630) 252-3240

Purpose/Need:

Congress established the Legacy Resource Management Program in 1990. The Defense Appropriations Act of that year set out nine legislative goals for the program. The program was to provide for the stewardship of all Department of Defense (DoD) controlled or managed air, land, and water resources, and establish inventories of all scientifically significant biological, geophysical, cultural, and historical assets on DoD lands. Such inventories were to catalog not only the attributes of these resources, but also their scientific and/or cultural significance, as well as their inter-relationship to the surrounding environment, including the military mission carried out on the land upon which they reside.

The Environmental Governing Standards (EGS) for Korea (USFK Pam 200-1) incorporate US and Korean legal requirements for the management of natural and cultural resources under US control in the ROK. Specific management criteria are intended to " ...ensure military actions are not likely to jeopardize the continued existence of natural resources and any biological species declared endangered or threatened by the Korean government." The EGS defines natural resources as "all living and inanimate materials supplied by nature that are of aesthetic, ecological, educational, historical, recreational, scientific or other value." Species declared endangered by the Korean government are known as "Specified Wild Species," which are "...any species of flora or fauna ...designated and declared by the MOE (Minister of Environment), whose continued existence is, or is likely to be, threatened or whose species is worth[y] of protection for scientific research, and is therefore subject to special protection from destruction or unbalance of a natural ecosystem."

IEDROK is a tool that assists resource managers to comply with these requirements by providing information on the known occurrences of endangered and Specified Wild Species. It helps meet three of the management criteria.

Approach:

The IEDROK GIS, or more simply IEDROK, presents the locations of protected resources in their environmental context and is a tool for rapidly identifying potential impacts to natural and cultural resources resulting from planned USFK actions. Specifically, IEDROK allows USFK planners and resource managers to determine whether or not endangered or reserved species have been reported on or near their facilities. It also allows them to determine the presence of nationally and locally important cultural properties.

IEDROK is broad in scope and includes the best available data. However, the data sets included vary in scale and detail, thus this GIS should be thought of as a first screening tool useful in alerting managers to the potential of natural and cultural resource issues, and not a detailed representation of resource locations. IEDROK is intended for use early in the planning process to screen for natural or cultural resource constraints. The earlier it is used, the more time will be available for mitigation of any adverse impacts. For Korean security reasons, none of the source maps include the location or boundaries of any military facilities. It is assumed that each user knows the location of his or her facility and can either merge IEDROK with their installation GIS or vice versa with the appropriate installation layers.

This GIS allows the user to display the natural or cultural resources reported for a given area against a base layer showing either topography or vegetation cover type. The natural resources displayed include plant and animal species listed either as 1) Specified Wild Species by the Korean Ministry of Environment (MOE), 2) Natural Monuments designated by the Korean Ministry of Culture and Tourism, and 3) Endangered and Reserved Species by the Korean Association for the Conservation of Nature (KACN), the research arm of the MOE. IEDROK also contains provincially listed species by Gangwon Province.

The reported presence of protected natural resources is indicated with symbols or icons suggesting the type of organism (e.g., bird, insect, mammal, etc.). Detailed information, such as the scientific name, common name, and status of a species is obtained by clicking on the symbol. The most recently available data on the distribution of natural resources of concern was provided by KACN specifically for this project.

A tomb monument located at Kunsan AB.

IEDROK also shows the location of nationally and locally designated cultural properties. Symbols are used to indicate the type of resource while information that is more detailed is available by clicking on the symbol. The ROK divides cultural properties into a number of categories. The most significant of the categories are designated National Treasures. Therefore, IEDROK incorporates the locations of all National

Treasures throughout ROK. Resources falling in other categories (Treasures, Historic Sites, and Important Folk Materials), are included in IEDROK only when they were located in relatively close proximity to a major USFK facility.

Cultural resource locations were obtained from source maps supplied by the Korean Cultural Properties Administration (KCPA), located in Taejon, and the National Research Institute for Cultural Properties (NRICP) located in Seoul. These source maps varied in scale and precision. These map sources do not detail the locations of military installations. The positions of cultural resources in close proximity to or on USFK facilities was in a general sense based on our knowledge of the installation locations. Individual users should determine precise locations when the IEDROK layers are incorporated into the installation's GIS, or vice versa.

Recommendations/Lessons Learned:

A significant wading bird rookery located on a USFK facility.

As with any GIS, IEDROK has a few shortcomings. Protected species locations were derived from point data where species were actually sighted. Data reflecting seasonal distribution or ranges in the form of polygons are not yet available. In addition, cultural resource coverage is not presented in uniform detail over the entire Korean Peninsula. Coverage is most detailed near major USFK installations.

One of the major challenges in constructing IEDROK was the blending of data derived from a variety of sources. An integrated database, IEDROK includes previously existing GIS baseline data, data sets derived from maps that were scanned, digitized, and georeferenced; data from maps that were digitized on a tablet and georeferenced; and point data from published sources that were entered directly into ArcView shapefiles.

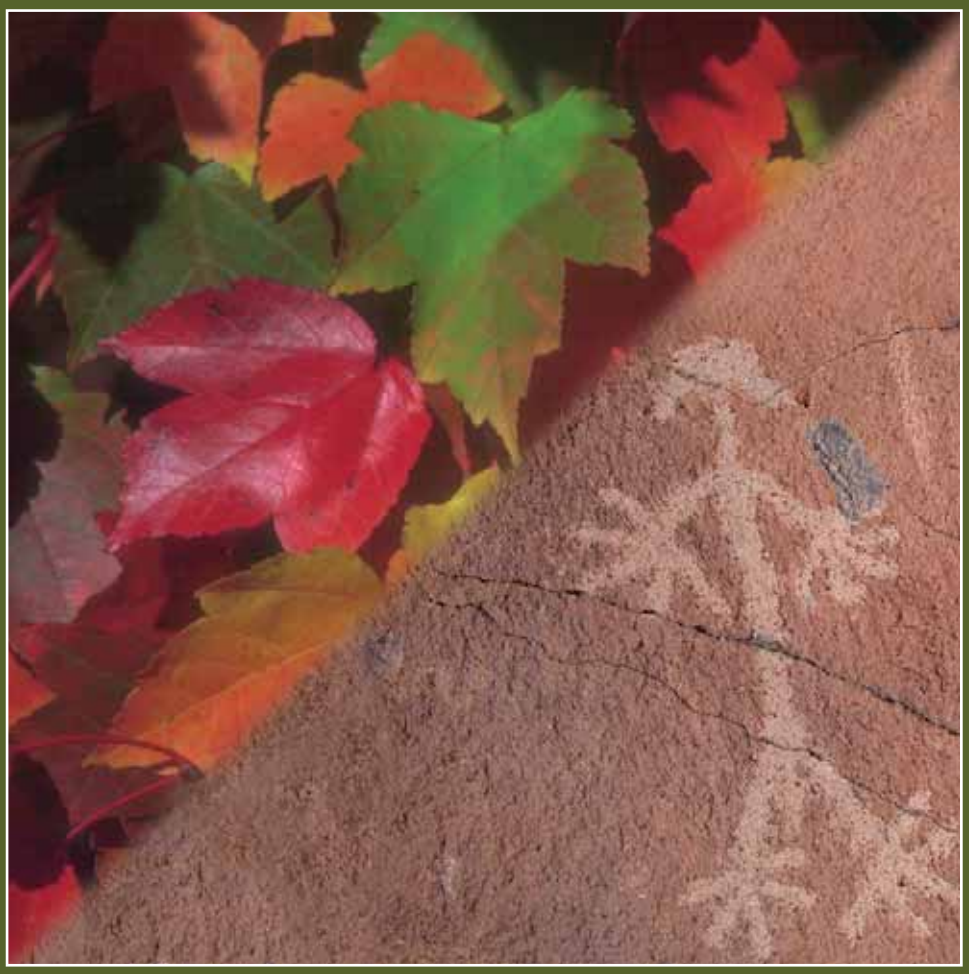
IEDROK was initially conceived as an ecosystem-based GIS system. Although it remains so, the type of available data dictated a more general approach. The best available baseline data for the Korean Peninsula came from the National Imagery and Mapping Agency (NIMA), now the National Geospatial-Intelligence Agency (NGA). While NGA data sets do include important environmental information, they are designed to meet the tactical needs of the DoD (e.g., factors affecting the movement of troops), not its environmental stewardship requirements. NGA layers indicate slope (topography), soil type, water resources, and vegetation cover. However, since these same layers are significant factors in affecting the range and distribution of both natural and cultural resources, they also provide a sound baseline for the construction of a useful management tool. Soil, vegetation, and water clearly constrain the kinds of plants and animals that are able to live in a given area. These same factors constrain human settlement and land use. For centuries, Koreans have considered the physical environment when selecting a site for the construction of a dwelling, shrine, or grave. The principles of feng shui, or geomancy, relate the cultural to the natural environment.

Project Publicity:

No publicity was sought for this project.

Technical Reports Produced:

No technical reports, only an executive summary, User's Guide, and a 5-disk set of CD ROMs in ArcView format. The GIS includes limited distribution NGA data. Distribution is authorized to DoD and U.S. DoD contractors only.



AIR FORCE

Cultural Resource Conservation Projects

Archaeological Predictive Models

Description of Geographic Setting:

Four Department of Defense (DoD) installations participated in this study: 1) Eglin Air Force Base, located in the Northwest Florida Panhandle; 2) The Fort Bliss McGregor Range of the Tularosa Basin of New Mexico; 3) Fort Drum in upstate New York; and 4) Fort Stewart in Georgia's lowland coastal zone.

Abstract:

In the 1980s, many military installations created archaeological predictive models to aid in the identification of possible locations of cultural resources. However, interest in these models decreased when it was realized that model results would not alleviate the need for extensive ground surveys. In the last 20 years, installations have continued to perform cultural resource surveys, providing data to answer the simple question, "did the predictive models work?" Four Army and Air Force installations were selected and their existing models were evaluated for accuracy, whether they can be refined to work better, whether they could be used in making management decisions about cultural resources, and finally, if they improve cost efficiency of cultural resource management at large installations. Four principal areas for potential improvement of modeling efforts on a national scale and in an integrated manner were identified. First, how the environment is categorized in the spatial database greatly influences the success or failure of the model. Second, there is a need for a thorough discussion at the national level on the modeling techniques available along with guidelines about the level of expertise needed to put them into operation. Third, there is a need for an evaluation of why few modeling processes have been integrated into the cultural resource management programs at military installations. Fourth, there is a need to develop programs that are focused less on identifying and avoiding sensitive sites and more on predicting and understanding why humans chose those areas.

Partners:

Department of Defense Legacy Resource Management Program; SRI Foundation; Statistical Research, Inc.

Service Branch: All service branches were included in the questionnaire on predictive modeling; however, only Air Force and Army installations were chosen for detailed evaluation.

Project Location: Eglin Air Force Base, Florida; McGregor Range of Fort Bliss, New Mexico; Fort Drum, New York; and Fort Stewart, Georgia.

Installation Size: Eglin AFB—464,000 acres (187,000 hectrares), Fort Bliss—700,000 acres (283,000 hectrares), Fort Drum—107,000 acres (43,000 hectrares), and Fort Stewart—279,000 acres (113,000 hectrares).

Installation Primary Mission: Various

Project Point of Contact: Martyn Tagg • HQ AFMC/MS (CEVQ) • 4225 Logistics Avenue, Room A128
Wright-Patterson AFB OH 45433-5747 • Phone: (937) 656-128—DSN 986-1281
Fax: (937) 257-5875—DSN 257-5875 • Email: martyn.tagg@wpafb.af.mil

Purpose/Need:

The project was designed to address and answer four specific questions:

1) Do archaeological predictive models created for military installations work?

2) Can they be refined to work better?

3) Are they sufficiently accurate so that land managers and State Historic Preservation Officers can use them to evaluate management decisions about cultural resources?

4) Can a predictive model be integrated into a more dynamic operational model that would be useful across the DoD to increase cost efficiency of cultural resource management at large installations?

Approach:

To determine the pervasiveness of archaeological predictive modeling in the military, a questionnaire was sent to installations representing all branches of the DoD. Twenty-three installations were selected based on their geographical diversity, size, and known use of predictive models. These installations were sent follow-up questionnaires that included questions on when the predictive model was created, who created it, how many sites were used in development of the model, whether it was still in use, the platform it used, and how many sites had been found subsequent to the model's creation.

In order to select four models for detailed evaluations, six criteria were used:

1. Age of the model;

2. Amount of inventory subsequent to model development;

3. Availability of documentation;

4. Size of the datasets;

5. Installation interest in being a part of the study, and

6. Installation staff familiarity with the structure of the dataset.

Four of the responding installations were selected for in-depth evaluation of their models' technical quality, accuracy, and general utility as management tools. The models from the four selected installations vary widely in design and operation. Fort Drum's model is based on a visual, intuitive method that capitalizes on the tendency for sites to be located along ravines. Fort Stewart's model correlates site location with soils. Eglin AFB's model uses proximity to water, elevation relative to water, and regional topography to predict site locations. The Fort Bliss model uses soils, aspect, landform, and elevation to predict the location of archaeological sites.

Because of the substantial differences in how the models were designed and developed, simplified versions of some of the models had to be used to permit comparisons with the other models.

Suggestions were then developed on ways to improve the utility of each model. Finally, using the results of the evaluation, a recommended follow-up study was designed that could directly contribute to more effective use of archaeological predictive modeling by military installations.

Recommendations/Lessons Learned:

Installations can use existing predictive models to present and analyze new site data as long as sufficient documentation exists describing how the model was originally developed and tested.

Each of the models evaluated was found to be reasonably successful at predicting site locations, and recommendations were made to improve both the predictive success and the management utility of each model. Interestingly, each model used a different approach to define the relationship between archaeological sites and environmental variables. Within this diversity, six recurring themes were identified.

- Despite all the interest in predictive modeling in the military, there is no mechanism for sharing information and collaboration among installations. While this approach encourages innovation, it restricts the potential of many models because of the constraints imposed by isolated decisions made early in the process. The installations could have profited from the lessons learned by the limitations and successes of the other models.

- In many respects, there has been a loss of sophistication in the predictive models developed in recent years. Most models are simple

intersection models or simple correlation models. Few models are based on multivariate statistical techniques or theoretically based constructs, such as optimal foraging.

- Most current models are restricted to predicting surface manifestations; geomorphology is rarely a component.
- Most models do not make use of remote sensing techniques. The lack of satellite imagery is particularly noticeable, since much of this imagery is available to the military at little or no cost.
- While much effort has gone into creating models, little effort has been expended in refining them. Models are treated as final products rather than being viewed as an adaptive process that requires continual modification and improvement.
- Models are not integral to the compliance process. Decisions regarding level of inventory, determinations of eligibility, and resolution of adverse effects rarely include model predictions, yet the information available from the models could substantially contribute to the decisions made at each of the steps in the process.

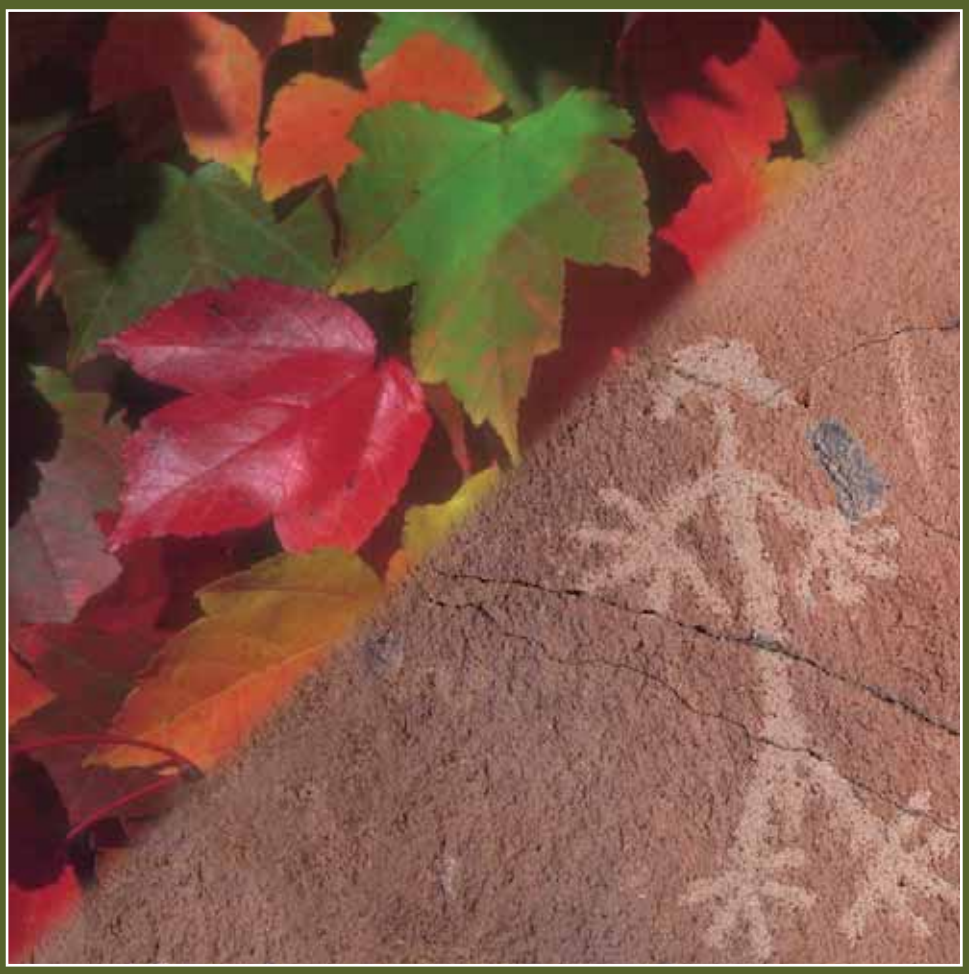
If predictive models are to be used on other installations, the above information and suggestions would be helpful. In addition, with the advent of GIS technology, the driving force behind many predictive modeling efforts is not archaeology, but software. In some situations, the archaeologists are not an integral part of the process; instead, the GIS specialist on base is charged with defining the variables and the algorithms to use. Not surprisingly, this practice has led to models that are not very useful. It is suggested to make modeling a dynamic process in which archaeologists and GIS specialists work together (along with others in DoD) to ensure that the problems outlined above are addressed.

Project Publicity:

Copies of the final report in hard copy and CD format have been distributed to various DoD major commands, installations, and support organizations (such as the Air Force Center for Environmental Excellence and the Fort Worth Corps of Engineers), and will also be posted on DoD web pages such as DENIX and Air Combat Command and Air Force Materiel Command environmental web pages. Results are being presented in professional meetings both inside and out of DoD.

Technical Reports Produced:

Altschul, J. H. , L. Sebastian, and K. Heidelberg. Final report: Predictive Modeling in the Military: Similar Goals, Divergent Paths.



N A V Y

Natural Resource Conservation Projects

Coral Reef Protection Guidelines

Description of Geographic Setting:

Coral reefs are unique and dynamic ecosystems created by limestone-secreting animals called corals. The limestone foundation created by corals provides habitat to many organisms including algae, invertebrates, and vertebrates. Reefs and are found in approximately one third of tropical coastlines, covering an estimated 232,000 square miles (600,877 square kilometers).

Diver conducting an underwater video survey.

Abstract:

Coral reefs are among the most diverse, complex, and beautiful ecosystems on Earth. Reef organisms can tolerate only a narrow range of environmental conditions and are vulnerable to damage from climate change and pollution. Anthropogenic impacts from overfishing and coastal development is a major cause of reef degradation worldwide. Additionally, direct physical impacts by ocean going vessels from improper anchoring and ship groundings cause significant localized damage to reefs. The purpose of this project was to develop specific guidelines for the Department of Defense (DoD) to prevent damage to coral reefs and other sensitive marine ecosystems by installations and while operating at sea. This guide does not create new policy but instead consolidates and reviews existing directives that protect coral reefs and highlights procedures for use when navigating near coral reef ecosystems.

Partners:

Department of Defense Legacy Resource Management Program; U.S. Navy; Boston University Marine Program.

Purpose/Need:

Coral reefs are among the most diverse, complex, and beautiful ecosystems on Earth. Reefs comprise an assemblage of many organisms, including algae, corals, gorgonians, anemones, zooanthids, and other benthic organisms. Corals are the animals that build the beautiful structural formations that people normally envision when they think of coral reefs.

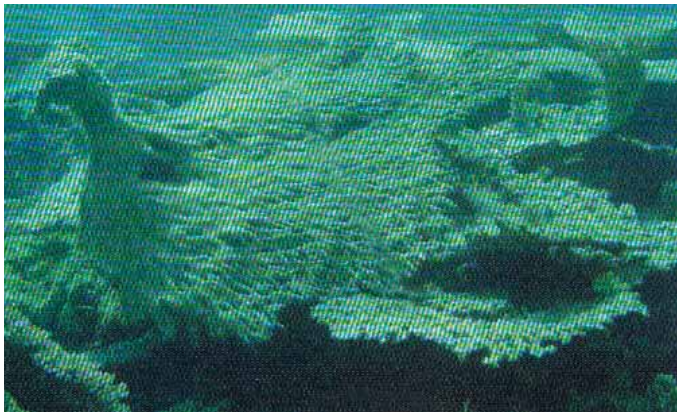
Service Branch: Navy

Project Location: Global

Installation Size: N/A

Installation Primary Mission: N/A

Project Point of Contact: Dr. Phillip S Lobel • Boston University Marine Program • Marine Biological Laboratory
7 MBL Street • Woods Hole, MA 02543 • Phone: (508) 289-7675 • Email: plobel@bu.edu



An example of the delicate and fragile coral reef ecosystem.

The outer surface of the reef structure is covered with numerous individual animals with symbiotic algae living in their tissues. These animals secrete a limestone exoskeleton that over long periods of time forms the coral's three-dimensional structure. Reef surfaces swarm with fishes, crustaceans, mollusks, and worms. There are many more tiny animals and plants living in reef crevices and deep holes that human visitors rarely see. Many of these organisms are still scientifically unknown and no one has yet accurately estimated the total number of different species living on reefs.

It is known, however, that parts of the reef ecosystem depend upon one another, and that the entire reef ecosystem depends upon neighboring systems. For example, reef herbivores, such as the long-spined sea urchin, consume algae that might otherwise smother living corals. The larval stages of many reef animals drift as plankton in the open ocean, and there are also reef connections to sea grass meadows, sand flats, intertidal zones, and mangroves. Thus, the complex web of reef life intertwines with the larger lattice of Earth's biodiversity.

Little was known about the global health of coral reef ecosystems until about ten years ago, when government agencies and environmental interest groups in the United States and abroad began wide-scale monitoring and assessment programs. Since then, scientists have discovered that many of the world's coral reefs are gravely imperiled and will continue to deteriorate unless more is done to protect them. Human activities such as coastal development, destructive fishing practices, pollution, and sedimentation are the leading causes of coral reef degradation worldwide.

The majority of pollutants of concern with respect to coral reef protection are derived from land based sources, such as coastal runoff and point source pollution. However, sewage and contaminants from vessels, particularly gasoline and oil, can injure or kill marine life and cause significant damage to coral ecosystems. Solid waste and other garbage also degrade the marine environment and can harm marine animals. In particular, plastic garbage is a significant hazard to marine life. Current rules and regulations governing ocean dumping and discharge from DoD vessels are designed to limit pollution and impact to costal communities and ecosystems, including coral reefs.

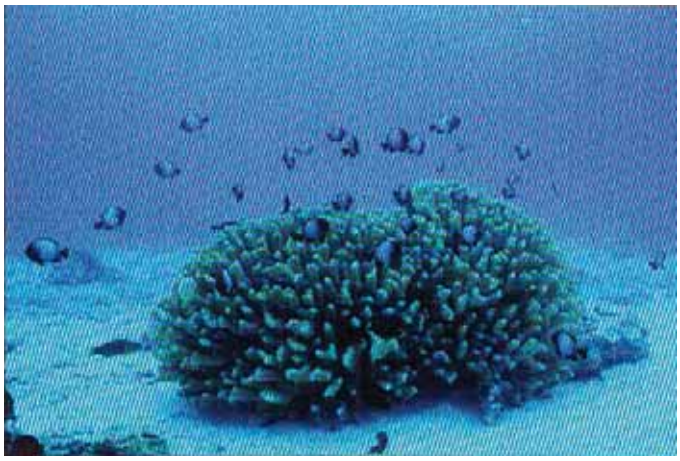
Approach:

The Coral Reef Protection Guidelines publication describes DoD's policies, actions, and programs related to coral reef conservation and protection. The first section provides an overview of DoD authorities and policies pertaining to the protection of coral reef systems. This includes an overview of Executive Order 13089, DoD authorities and policies to protect coral reefs, the ecosystem management policy directive, environmental conservation programs, a description of the global coral reef distribution, and DoD coral reef policy statements.

The second section describes actions potentially affecting coral reef systems. Military services are advised to rapidly resolve or minimize any conflicts between coral reef protection and the military's mission. Specific information is provided on the identification of DoD actions that may affect coral reef ecosystems, the environmental impact assessment process, integrated natural resource management plans, actions identified through coastal zone consistency determination, actions identified by the Army Corps of Engineers regulatory program, and the process to elevate actions determined to affect coral reefs to appropriate service level for notification/evaluation.

The third section discusses existing funding sources available to the military services to implement Executive Order 13089. This included details on existing funding sources for coral reef stewardship, operations, and maintenance, environmental compliance, the DoD Legacy Resource Management Program, and the Strategic Environmental Research and Development Program (SERDP).

The fourth section contains ongoing programs and projects that demonstrate the military's commitment to the protection and enhancement of coral reef ecosystems through other mandates and authorities are presented. Such protection efforts include preventative measures taken during military operations and training exercises, shipboard pollution prevention, DoD's pollution prevention program, oil spill prevention, response, and clean-up, invasive species management, and land management practices.



Coral reefs provide habitat to a wide diversity of ocean life.

The fifth section examines DoD stewardship initiatives to protect and enhance coral reef systems including conservation, outreach, and research initiatives and information on artificial reef creation.

Finally, Section Six presents ongoing initiatives to protect coral reefs and associated habitats, and describes future directions in DoD coral reef protection programs. For reference, information of legal authority and related legislation, Executive Order 13089, DoD Coral Reef Policy Documents, Air Force, Army, Marine Corps, and Navy Coral Reef Memoranda, and/or related DoD and/or service policy reference listings are included as appendices.

Recommendations/Lessons Learned:

This guide does not create new policy but instead reviews existing directives that protect coral reefs and highlights procedures for use when navigating near coral reef ecosystems to avoid damage.

Project Publicity:

This is an internal document for the DoD. The document has been presented at meetings of the U.S. Coral Reef Task Force and announced on *ReefBase*, which provides information services to coral reef professionals involved in management, research, monitoring, conservation and education. www.reefbase.org/management/man_capacity.asp/changearea/true/region/41/country/USA

Technical Reports Produced:

The document can be found at: www.denix.osd.mil/denix/Public/ES-Programs/Conservation/Legacy/Coral-Reef/Plan/coralreef.html

The Importance of Mangroves to Migratory Birds

Description of Geographic Setting:

Naval Station Roosevelt Roads (NSRR), Puerto Rico is a mixture of ports and developed residential, commercial, light industrial, and natural habitat. It is a combination of coastal scrub and an extensive complex of different types of mangroves. NSRR has an 11,000 foot (3,350 meter) runway, nine piers, a water treatment plant, four sewage treatment plants, 110 miles of road, 1,340 buildings, and approximately 194,000 square miles (502,458 square kilometers) of ocean for naval exercises.

A typical mangrove ecosystem.

Abstract:

Throughout 2002-03, the New England Institute for Landscape Ecology (NEILE) documented the relative abundance of migratory and resident birds in the mangrove forests of Naval Station Roosevelt Roads (NSRR). The team also documented the multiple habitat use patterns of several migrant species, and radiotelemetry was used to track diurnal movement between feeding areas in a variety of habitats, including coastal red mangrove roost sites. The project focused primarily on the northern waterthrush because it makes up nearly 80% of all the species present in this habitat and because it is large enough to accommodate radio transmitters. Differences in habitat quality among mangrove habitat types are most apparent at the end of March when conditions become very dry. The goal of NEILE was to examine how the tropical dry season impacts migratory birds inhabiting different mangrove types. This was done using radiotelemetry, blood analysis of body condition, and measurements of the physical conditions of the mangroves. The work conducted thus far at NSRR has uncovered behaviors and patterns of migratory bird habitat use never before documented. Migrants were documented using multiple habitat types and shifting occupancy patterns. Results suggest that coastal red mangroves appear to be a habitat anchor throughout the non-breeding season to migrants occupying many other habitats during the day, and also to migrants with shifting habitat preferences. The implications of these findings are profound for both management at NSRR and for management of Neotropical migrant birds in general. These data will not only benefit the managers of the natural resources at NSRR, but also potentially at Guantanomo Bay and other areas with extensive mangroves, including state forests and National Wildlife Refuges within Puerto Rico and the rest of the Caribbean Basin.

Service Branch: Navy

Project Location: Naval Station Roosevelt Roads, Puerto Rico.

Installation Size: 8,600 acres (3,480 hectares)

Installation Primary Mission: Naval Station Roosevelt Roads supports more than 13,000 people, including: 2,300 active duty military, 2,000 family members, 2,050 civilian employees, and more than 7,990 retired military. It contributes about $300 million per year to the economy of Puerto Rico. Up to 300 military (U.S., foreign, and NATO) and maritime ships use the facilities and ranges at NSRR annually.

Project Point of Contact: Leonard Reitsma • New England Institute for Landscape Ecology
266 Prospect Hill Road • Canaan, NH 03741 • Phone: (603) 535-2558 • Fax: (603) 535-2723
Email: leonr@plymouth.edu

Partners:

Department of Defense Legacy Resource Management Program; U.S. Forest Service.

Purpose/Need:

The primary goal of this project was to determine the value of different types of mangroves to migratory birds. The study was completed in the biggest remaining complex of mangroves in Puerto Rico, which is owned by the U. S. military. Little is known about how migratory birds use mangroves and why. Over the last decade, much debate has arisen over the decline of Neotropical migrant birds, and considerable effort has been devoted to determining which factors might be responsible for the decline. Progress toward this goal has been slow, in part due to the complex annual cycles of migrant birds. Also, most studies have largely been concerned with describing patterns (e.g., distribution and habitat associations) rather than understanding population processes. Data on how habitat occupancy impacts the birds' physical condition and survival are almost nonexistent. These data are essential for the development of habitat management priorities and for assessing the degree to which the winter period is limiting for Neotropical migrants. This represents some of the most critical information currently needed for conservation planning in Neotropical regions.

Surveys of overwintering migrant birds in the Caribbean demonstrate that mangrove forests consistently have among the highest densities of migrant birds. Given the high level of dependence of migrants on mangroves and the rate of mangrove destruction, more studies of migrant use of mangroves are urgently needed.

Objectives of this project were to 1) quantify patterns of habitat use by migratory birds and yellow-shouldered blackbirds among different mangrove habitat types; 2) assess the suitability of mangrove habitat types to a target species population by directly measuring physical condition of northern waterthrushes and the changing conditions of the mangroves they occupy; and 3) use radiotelemetry and carbon isotope analyses to more intensively quantify use of mangrove habitat by the most abundant species (northern waterthrush). Results from this study will provide critical information on habitat use of migrants within mangrove systems. Managers of the natural habitats and extensive mangrove complex at NSRR may benefit from more detailed information concerning trends and use of this habitat by Neotropical migrant birds.

Approach:

Mistnetting was conducted with 12 nets at each of eight mangrove sites. Each net was 16 m long. Two netting periods were conducted at each site, one from 0645-01030 and one from 1545-1815. Upon capture, birds were weighed, measured (tarsus, wing chord, tail), color-banded, and blood samples were taken for detection of West Nile Virus, determination of sex, and analysis of body condition. A tail feather was taken to measure the rate of regrowth. To assess the physical condition of migrant birds, the mass corrected for body size of individual birds was compared in different habitat types. Mass corrected for body size provides an estimate of body condition with a single capture of a bird. Birds that were light given their body size were in poor condition (negative values) and birds heavy for their body size were considered in healthy condition (positive values). To calculate mass corrected for body size, the scores of a principal component analysis (PCA) were first calculated based on unflattened wing chord and tarsus length for each species across their habitats of occurrence. The scores from the first principal component were used as an estimate of skeletal body size. Body mass was then regressed against these PCA scores and the residuals were used from this regression as an estimate of mass corrected for body size. Blood samples were analyzed for plasma metabolites as a further index of body condition. Analysis of carbon isotopes in the blood allowed the determination of movement across mangrove habitat types and thereby rank the quality of habitats by correlating these values with the index of body condition on a per individual basis. The rate of fat deposition was also analyzed across habitat types as an index of departure schedule.

Telemetry was used to directly quantify locality and habitat use patterns of northern waterthrushes (*Seiuris novaboracensis*). Within different mangrove habitats, transmitters were attached to the backs of individuals with leg harnesses. For each bird, location data was obtained throughout the day and simultaneously measured habitat variables as described below. Telemetry was also used to quantify home range size and to monitor the use of multiple habitats, such as movement from feeding areas to roost sites, and movement throughout the season among mangrove patches. Individuals with transmitters were recaptured to quantify seasonal change in body condition.

Two aspects of spacing behavior were documented for individuals with transmitters. To determine home range overlap, standardized counts of con-specific individuals at the time of location was conducted. Territorial

behavior was quantified through experimental trials. In these trials a mounted northern waterthrush model along with a playback of recorded chips was presented to individuals. Habitat variables (ground cover, canopy cover, canopy height, tree species composition and basal area, and moisture levels) were measured on a continuous basis as data were collected on individual bird locations. These standardized data were collected as specific bird locations were marked with GPS. Habitat data from a network of random points were also collected to document seasonal change.

Comparison of these data to that of individual home ranges allowed for the identification of key habitat attributes selected by northern waterthrushes. Insect sampling was conducted at the telemetry-based and random points described above. Visual counts of all arthropods within one square meter plots were conducted over five minute observation periods. Arthropods were categorized to the most detailed taxonomic level possible (at least to order). The above data were analyzed in a variety of ways including ANOVA for among habitat differences (both in bird condition and habitat attributes), Principal Component Analysis for relating body condition with habitat type, and other parametric statistical tests for cross-habitat comparisons.

Recommendations/Lessons Learned:

The work conducted thus far at NSRR has uncovered behaviors and patterns of migratory habitat use never before documented. The implications of the multiple habitat use and shifting habitat occupancy patterns are profound for both management at NSRR and for the management implications of Neotropical migrant birds in general. For example, the consistent use of red mangroves as roost sites for birds feeding in other mangrove habitats and in non-mangrove habitats indicates the important role this habitat serves at the landscape scale. If this critical mangrove type were to decline, the implication is that species from many habitat types may also decline. In addition, the coastal red mangroves appear to be a habitat anchor throughout the nonbreeding season to migrants occupying many other habitats during the day, and also to migrants with shifting habitat preferences. The continuation and refinement of the work conducted over the past two years will provide the Environmental Division of Public Works at NSRR with detailed information on the importance and ranking of different, geographically distinct mangrove areas on the base. These data will not only benefit the managers of the natural resources at NSRR, but also potentially at Guantanomo Bay and other areas with extensive mangroves, including state forests and National Wildlife Refuges within Puerto Rico and the rest of the Caribbean Basin.

The current work has opened up new avenues of inquiry regarding the quality of different mangrove forest types, and these questions can best be answered through multiple year studies. For example, this study suggests that migrant bird abundances vary over short time periods at the end of the season. More data are needed to measure the condition of birds in different mangrove habitat types at the end of the season prior to migration to their breeding grounds. Departure schedules also need to be documented to assess whether the type of mangrove that a bird inhabits constrains when it is ready to depart for the breeding grounds. More data are needed to describe patterns of multiple habitat use in migratory birds. This project showed that northern waterthrushes, commonly regarded as a wetland species, spends large amounts of time in scrub forest. Dry forest species were also seen moving to coastal mangroves for roosting. Increased samples of birds' blood will help to further define differences between the many mangrove types at NSRR and the consequences of these differences to migratory birds.

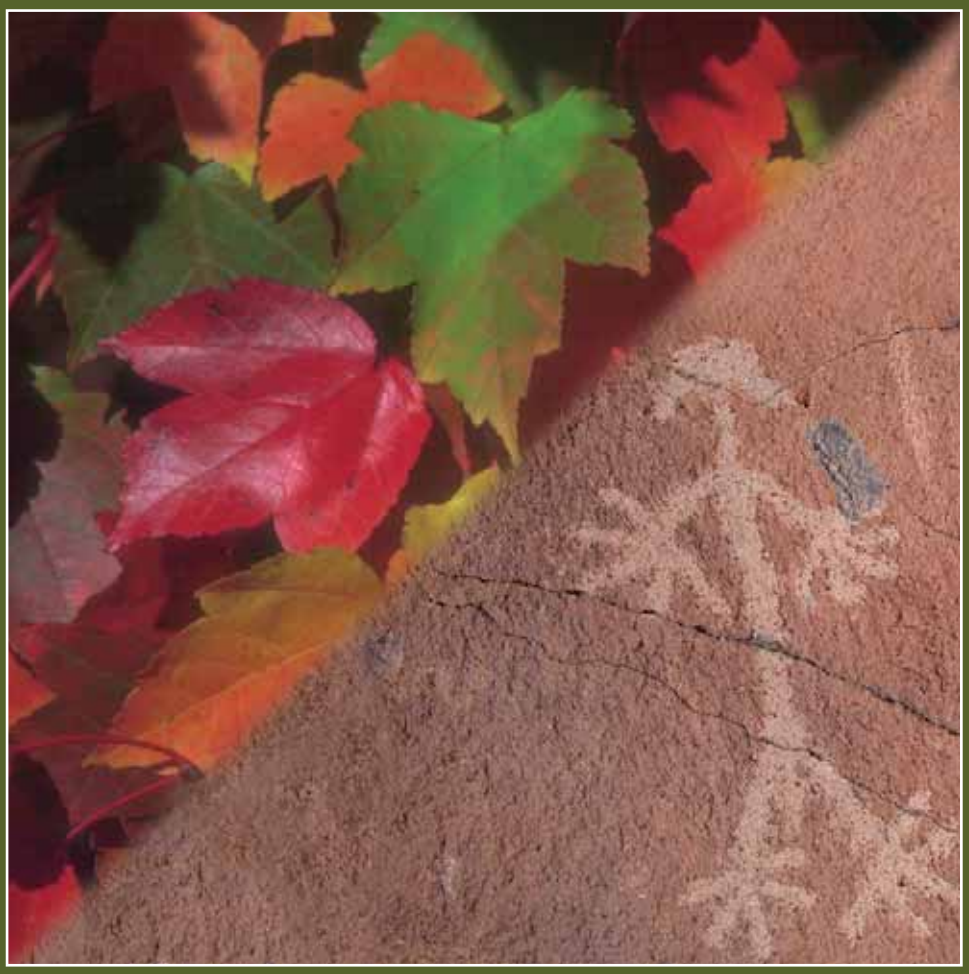
Researchers propose continuing their work but with refinement to explore in detail the ecology of the northern waterthrush in order to better understand the population level consequences of habitat differences. Such data are not only essential to the managers of the natural resources at NSRR, but also at Guantanomo Bay and other areas with extensive mangrove habitats, including state forests and National Wildlife Refuges within Puerto Rico and rest of the Caribbean Basin.

Project Publicity:

No publicity was sought for this project.

Technical Reports Produced:

Technical reports are scheduled to be completed in October 2004.



N A V Y

Cultural Resource Conservation Projects

Navy Disaster Preparedness Workbook (Including Lessons Learned from 9/11)

Description of Geographic Setting:

Any military installation.

Abstract:

The Disaster Preparedness Workbook focuses on the disaster-related needs of U.S. Navy librarians, archivists, and records managers regarding protection of collections of printed documents, magnetic media, electronic records, etc. It contains plans for addressing a wide range of events, from routine leaks to large-scale natural disasters. This revision updates the previous edition based on the changing world after 9/11, threats of terrorism, the Pentagon Library disaster and recovery, and the need for an Information Technology (IT) disaster recovery plan. It has been expanded to include protecting the cultural resources of museums and historical sites. Because this document will be used in Navy installations throughout the world, a wide variety of disasters are covered, but the focus is upon those most common within the United States. The revised Workbook is currently being peer reviewed and will be published in late 2004 or early 2005. The revised Workbook (which is on paper and on a computer disc) will be shared with all DoD libraries, archives, historical sites, and museums. It has been designed so that each institution can customize the document to its institutional needs.

Partners:

Department of Defense Legacy Resource Management Program.

Purpose/Need:

The first edition of the Disaster Preparedness Workbook (Workbook) published in 1998 was designed to make Navy libraries and archives aware of how to protect their institutions and their historical, intellectual, and cultural resources, given the fact that all Navy and DoD libraries and archives are self-insured. The Workbook was designed to be customizable, so each institution can use it to create a disaster plan that meets its specific needs. However, much has changed in the world since 1998, and new threats needed to be addressed. This revision addresses the changing world after 9/11, threats of terrorism, the Pentagon Library disaster and recovery, and the need for an IT disaster recovery plan. It has been expanded to include protecting the cultural resources of museums and historical sites.

Service Branch: Navy and Department of Defense

Project Location: Naval War College

Installation Size: N/A

Installation Primary Mission: N/A

Project Point of Contact: Robert E. Schnare, Library Director • Naval War College • 686 Cushing Road Newport, RI 02841 • Phone: (401) 841-2641 • Fax: (401) 841-6491 • Email: schnarer@nwc.navy.mil

Approach:

The Workbook outlines plans to address a wide range of events, from routine leaks to large scale natural disasters. It was developed to be used by personnel in widely divergent types of institutions, from small libraries on military bases to major historical and research collections in academia. The Workbook provides basic information and instructions as well as templates that personnel can use to write their own plans.

The three basic elements of disaster preparedness are:

1. Protection
2. Recovery
3. Planning

1. Protection involves activities taken to prevent or minimize damage to collections. The first priority is for a repository to assess its vulnerability to natural disasters (floods, earthquakes, hurricanes, etc.), social threats, and incidents such as roof leaks, plumbing malfunctions, fire, and mold outbreaks. Second, an institution must be prepared to take actions to prevent or reduce the impact of disasters. Preventive work takes a variety of forms, including installing fire detectors and sprinkler systems, bracing shelves to resist earthquake damage, regularly maintaining plumbing and drainage systems, and storing collections in areas unlikely to sustain water damage from natural or manmade disasters. The "Prevention/Protection Plan" section of the Workbook and several of the appendices provide guidance on this element of preparedness.

2. Recovery begins after a disaster has occurred and involves three stages: response, salvage, and rehabilitation. In the response stage, the staff organizes the recovery project by notifying necessary personnel, procuring supplies and services for recovery, stabilizing the building's environment, and assessing the damage. The salvage stage involves packing and removing materials from the affected site, stabilizing them (most often through freezing), and drying them by any of a variety of processes (including air-drying, dehumidification, and vacuum thermal-or freeze-drying). The rehabilitation or restoration stage includes such steps as cleaning, fumigation, repair, rebinding, affixing new labels and plates, reshelving/rehousing archival materials, and deodorization and removal of smoke or soot. Rehabilitation of non-paper materials such as photographic and magnetic media often involves reprocessing and/or copying the salvaged item onto a new, stable medium. Much of the text in the Workbook provides guidance for recovery operations.

3. Planning is the third element of disaster preparedness, and the most critical. It supercedes protection and recovery. During planning, discrete lists of facts, resources, procedures, priorities, and options are brought together to form a coherent working document that guides institution policy and action (not just in disaster situations, but day-to-day as well). The disaster plan should include informational components such as floor plans, lists of suppliers and other resources, personnel directories, insurance and accounting instructions, and various checklists. Perhaps more importantly, it should serve as a guide for staff in recovering from disasters, and it should include instructions and procedures that will be relevant in various scenarios. That is, it should reflect in some detail the repository's plans for responding to incidents ranging from small water leaks to mold outbreaks to devastating fire or natural disaster.

It is recommended that planning begin with the portions of the institution deemed most important, of greatest concern, or most vulnerable. Depending on geographic location and the nature and purpose of the collections, some sections may be deleted altogether. For example, an organization far inland will not need the hurricane preparedness sections. Above all, the Workbook should be tailored to the needs of the specific collection.

The Workbook focuses on protection and recovery of collections. However, the protection of human life and safety should be the unquestioned first priority of all repositories at all times. When training personnel to implement response and salvage procedures, make clear that they are never to risk their safety to protect the collections. Similarly, be mindful of specific health risks that may relate to recovery. All individuals involved with the recovery should have an up-to-date tetanus shot. Other immunizations may also be needed based upon the recommendations of the local Navy medical officials. Some individuals may be highly allergic to mold, latex gloves, various chemicals, or other substances used in disaster projects. To the extent possible, identify these conditions in the planning stage and be sure personnel are not assigned jobs that would be risky for them. Some people may have undiscovered conditions, so be alert to symptoms during the recovery operation.

Recommendations/Lessons Learned:

To be effective, the Workbook must be kept current as situations change and new lessons are learned. The hardest part to keep current is the section on websites, because they are changing continually. Creating a disaster preparedness plan and then placing it on the shelf and never looking at it defeats the entire purpose of having it. Keep copies offsite so that if you have a disaster and cannot enter your institution, you still have access to your plan. Review it and train your staff on using it. Involve other appropriate personnel throughout the planning process. The fire department, facilities staff, and administration may have useful contributions to make, as well as staff within the repository. Once the plan is written, be sure to share a copy with those other units.

Project Publicity:

Information regarding the Workbook was distributed to many preservation and DoD listservs and websites. It is hot-linked on the Federal Library Information Center Committee (FLICC) Preservation and Binding Working Group websites. A draft of a Disaster Recovery Contract is also on this site.

The original Navy Disaster Preparedness Workbook has been distributed to all DoD libraries and archives, sent through the GPO Depository Program to depository libraries, placed on a web site for Disaster Mitigation Planning Assistance at Michigan State University, used in the Pentagon Library disaster planning and recovery, used in teaching numerous disaster planning courses (including disaster planning at the Northeast Document Conservation Center), and sent to many institutions across the country. It was also distributed at a FLICC session on "Disaster Recovery: The Pentagon Library Experience." This session was video taped by FLICC. Numerous speeches on disaster preparedness and planning using the Workbook have been delivered to many groups.

Technical Reports Produced:

Copies of the previous workbook are available. Please contact: Robert E. Schnare, Library Director, Naval War College, 686 Cushing Road, Newport, RI. 02841-1207. You will receive a paper copy with revised websites and a disc (Word 6.0).

Corrosion and Fuel Oil: Management Strategies for the USS Arizona

A sample of fuel oil is captured for laboratory research. NPS photo by Brett Seymour

Description of Geographic Setting:

The USS Arizona is situated at Pearl Harbor, in the city of Honolulu, on the island of Oahu, Hawaii. It lies underwater and it is the final resting place for many of the ship's 1,177 crewmen who lost their lives on December 7, 1941. The Arizona's physical properties prior to sinking were: length: 608 ft; beam: 97ft.; draft: 28 ft 10 in; displacement: 31,400 tons.

Abstract:

The USS Arizona was designated a National Historic Landmark on May 5, 1989. The most severe of the explosions that took place during the Pearl Harbor attack occurred in the Arizona, on which 1,177 crewmen were killed and hundreds more wounded. The remains of the ship lie in Pearl Harbor as a silent memorial of the attack and as the final resting place for the sailors entombed within. In addition to its historical significance, the Arizona has also become the center of attention because of its potential to endanger the environment. Approximately 1.5 million gallons of fuel oil still remain within the hull of the ship, and it has been slowly escaping since 1941. Eventually, corrosion may cause a structural collapse and the release of larger quantities of oil. The National Park Service received funds from the Legacy Resource Management Program (FY 2002) for research directed to understanding the nature and rate of natural processes affecting the deterioration of the USS Arizona. While the project is designed to deal with the potential environmental hazard created by the oil fuels of the battleship, it is also focused on the long-term preservation of this significant historical site. This project will ultimately allow managers to make informed decisions about Arizona's future based on solid scientific evidence.

Partners:

Department of Defense Legacy Resource Management Program; National Park Service

Collaborations: USS Arizona Memorial; National Park Service Submerged Resources Center; Naval Facilities Engineering Service Center-Ocean Construction Division; Navy Mobile Diving and Salvage Unit One; Titan Maritime Industries Inc.;

Service Branch: Navy

Project Location: USS Arizona Memorial, Honolulu, Oahu, Hawaii

Installation Size: 608 ft. length, with a beam of 106 ft 2 in

Installation Primary Mission: N/A

Project Point of Contact: Larry E. Murphy • Submerged Resources Center • National Park Service, Hawaii
Phone: 505-988-6750 • Email: larry_murphy@nps.gov

U.S. Geological Survey; National Institute of Standards and Technology; Medical University of South Carolina; U.S. Army's 29th Engineer Battalion Survey Platoon; U.S. Geological Survey's Western Region Coastal and Marine Geology Program; Harvard University; US Navy Region Hawaii; US Navy Naval Station Pearl Harbor; VideoRay, Inc.

Purpose/Need:

The USS Arizona is a National Historic Landmark, but it also is a potential ecological hazard because of slowly leaking fuel oil that remains on board. To manage this risk while maintaining the integrity of the historical site, there is a need to understand the complex corrosion processes that affect the USS Arizona's hull, both internally and externally, and to be able to model and predict the nature and rate of structural changes. The USS Arizona Long Term Management Strategies Research Project is designed to be a multi-year, interdisciplinary, and cumulative project that helps achieve an overall management strategy for minimizing environmental hazard from fuel release and providing the basic research required for making informed management decisions for long-term preservation of the Landmark.

An NPS archeologist takes ultrasonic thickness measurements of the encrusted hull of the USS Arizona. NPS Photo by Brett Seymour

Approach:

In order to analyze the process and rate of corrosion, measurements have been taken in a thorough manner along Arizona's hull, including pH and corrosion potential. Multiple samples were drilled in a vertical transect at each station at varying water depths in order to analyze how the corrosion process changes with water depth and concretion thickness. The National Park Service Submerged Resources Center (NPS-SRC), along with the Naval Facilities Engineering Service Center-Ocean Construction Division, the Navy's Mobile Diving and Salvage Unit One, and Titan Maritime Industries Inc., collected external hull plate samples from USS Arizona for electrochemical, microbiological, metallurgical and metallographic analyses. A total of eight samples were collected, four on the port side and four on the starboard side. A 2.2-inch diameter sample of concretion was collected to provide information on the kinetics and mechanisms of the corrosion processes. Investigations in this analysis were done by X-Ray diffraction and environmental scanning electron microscopy. Baseline data such as wind, wave, and current patterns along the vessel, as well as basic environmental factors such as pH, temperature, salinity, dissolved oxygen, oxygen reduction potential, and conductivity are being measured via oceanographic and water-quality monitoring instruments. A Finite Element Model is being developed to facilitate the understanding of the vessel's present condition and in projecting its future condition, rate, and nature of the hull's deterioration.

A SonTek current/wave height meter records continuous baseline data of seasonal variation of current direction and speed and wave direction and height. NPS photo by Brett Seymour

Medical University of South Carolina (MUSC) researchers are analyzing oil leaking from the hull and trapped in interior spaces of Arizona in a manner that will enable use of internal leak points as inferential indicators of interior structural collapse. The NPS-SRC is also collecting oil, sediment, water, microbial and concretion samples from Arizona that are being analyzed by MUSC. Interior investigation of the hull was also conducted using a remotely operated video (ROV), which was a result of the partnership between the NPS and Video Ray Inc. between September 2000 and June 2001. The ROV was presented as an alternative to systematic interior investigation by divers, and it removed entrapment issues while simultaneously preserving the site as a war grave. The goal of this investigation was to search for access to lower decks where oil bunkers are located and to obtain measurements and observations to characterize interior corrosion.

Recommendations/Lessons Learned:

The current project, which builds upon earlier research, was initiated in 1998, when the NPS began developing a multidisciplinary research design that was intended to be a comprehensive analysis of Arizona's corrosion and deterioration. It provided information for Arizona's long-term preservation and it also helped decrease the risk to the environment caused by oil release. The current NPS/DoD partnership has allowed the research to move forward in a substantial manner. This project will ultimately allow managers to make informed decisions about Arizona's future based on solid scientific evidence. Fieldwork and data analysis still ongoing. Work on additional products such as an interim report, video report, professional seminar, and analysis of remote monitoring technology are ongoing and scheduled to be completed during FY 2004.

NPS researchers use an oil collection device to measure the quantity of oil seeping from the hull at different locations over a 24-hour period. NPS Photo by Brett Seymour

Project Publicity:

Newspapers and Magazines:

Navrot, Miguel. "Saving History: Santa Fe center helps researchers in rush to slow USS Arizona's Corrosion in Pearl Harbor," Albuquerque Journal, December 7, 2002.

Russell, Matthew A. "USS Arizona: Preserving an American Icon," Immersed Magazine, Fall 2002.

Makinson, John, et al. "In Situ Corrosion Studies on the Battleship USS Arizona." Materials Performance, October 2002.

"Studying the USS Arizona," Pride of Place: A Magazine for the Friends of the University of Nebraska Foundation, Summer 2002.

ROV Pictorial, Underwater Magazine, January/February 2002

Burlingame, Burl. "Fading Voices: Saving the Arizona," Honolulu Star-Bulletin, December 7, 2001.

Ditzler, Joseph. "Santa Feans Dive Into Past," Albuquerque Journal, December 3, 2001.

Veslind, Priit. "Oil and Honor at Pearl Harbor," National Geographic Magazine, June 2001.

Lenihan, Daniel J. "The Arizona Revisited," Natural History Magazine-Editor's Pick from the Past, December/January 2001.

Documentary Films and Television News Programs:

"Preserving the USS Arizona." Montana Public Television, Summer 2004

CNN News, December 2003

Channel One, December 2003

"Unsolved History: The Death of the Arizona." The Discovery Channel, Fall 2002.

"Pearl Harbor: Legacy of Attack." National Geographic Television, June 2001.

"Save Our History: The USS Arizona." The History Channel, December 2001.

"The Death of the Arizona." The Discovery Channel, December 2001.

Technical Reports Produced:

Long Term Management Strategies for the USS Arizona: A Submerged Cultural Resource in Pearl Harbor, Hawaii, 2002.

Illustrated Manual for Repair and Maintenance of Historic Military Family Housing in Hawaii

Description of Geographic Setting:

Hawaii is composed of 137 islands that encompass an area of 6,423.4 square miles (1,663,653 ha) in the north central Pacific Ocean. It is approximately 2,400 miles (3,900 km) off the American mainland. Oahu, like the rest of the islands of Hawaii, has a mild subtropical climate. The island is home to many military bases that were of great importance during World War II. Among the most well known are Hickam Field, established in 1935 and Wheeler Air Force Base, established in 1922. Other important military housing sites include Fort Shafter World War II quarters, Makalapa quarters, Schofield barracks, Hale Alii quarters, Palm Circle quarters, and Pearl City Peninsula quarters.

Commanding Officer's House (Facility A) at the Radio Transmitter Facility Lualualei. Constructed in 1937. (Source: Mason Architects, Inc.)

Front view, Senior Officer's Quarters (Facility 512) at the Marine Corps Base Hawaii. Constructed in 1941. (Source: Mason Architects, Inc.)

Abstract:

The National Historic Preservation Act of 1966 requires all federal agencies to identify the historic resources under their control and to protect those properties to the maximum extent possible. Maintenance guidelines were prepared in conjunction with a historic context study of Department of Defense (DoD) housing on Oahu to assist the DoD in compliance with this regulation. The context study is intended to provide a historic background of the significant housing areas, and a description of important, character-defining elements in these Army, Navy, Air Force, and Marine housing areas. The military bases established in Oahu played a crucial role in the World War II effort. Each housing establishment, whether it is officer housing, military quarters, or headquarters buildings, has historical value that validates the need to preserve it as intact as possible.

Partners:

Department of Defense Legacy Resource Management Program; Mason Architects, Inc.; Belt Collins Hawaii; Pacific Division, Naval Facilities Engineering Command.

Service Branch: Navy

Project Location: Military housing sites in Oahu, Hawaii

Installation Size: N/A

Installation Primary Mission: N/A

Project Point of Contact: Annie Griffin, PACDIV, NAVFAC PACIFIC • Phone: (808) 474-4887
Email: annie.griffin@navy.mil

Purpose/Need:

The Illustrated Manual for Repair and Maintenance of Historic Military Family Housing in Hawaii was created in order to assist the DoD in complying with the requirements of the National Historic Preservation Act of 1966. Oahu has many military housing establishments that date back from the early 20th century to the World War II era. These housing facilities still possess the architectural style of their time period, thus making them distinctive from other buildings on the island. In Hawaii's tropical, warm climate, rot, termite infestation, and salt-caused deterioration all contribute to the decline of these sites. The purpose of this project was to provide solutions for the maintenance, repair, and rehabilitation of historic housing while simultaneously preserving their historic integrity. In addition, the guidelines also serve to raise awareness of basic preservation principles and approaches and to relate them to specific building types, features, and materials.

Officers' House plan "J" (Quarters 544) at Hickam Air Force Base as it appeared newly constructed in 1938. (Source: Mason Architects, Inc.)

Officers' House plan "J" (Quarters 544) at Hickam Air Force Base as it appeared in 1986. (Source: Mason Architects, Inc.)

Approach:

This project required development of a detailed account of the steps needed for the different aspects of military housing preservation. These repair and maintenance guidelines are supplemental and are not intended to replace those of the service branches. The final manual includes instructions on preservation, repair, and replacement of concrete (repair of cracking, spalling, deflection, and erosion), lava rock, stucco and interior plaster, wood, architectural metals, windows and doors, hardware, interior finishes, plumbing, mechanical systems and ventilation, electrical fixtures and systems, structural systems, and hazardous materials. Regardless of the material, each feature should be maintained intact. If this is not an alternative, it must be repaired with the minimum intervention possible. Replacement of the feature is not recommended unless it is replaced so that it is identical to the original and maintains the building's historical character. The manual includes a section on landscape maintenance, which is also considered to be a crucial aspect to the historical character of the buildings. Guidelines for the preservation of landscape include preservation of trees, shrubs, palms, groundcover, grass, and other elements. The character-defining features of landscapes were listed as follows:

- Natural systems (topography, drainage)
- Circulation
- Spatial relationship (organization, land patterns)
- Views, vistas
- Vegetation
- Structures
- Site furnishings (objects)

Recommendations/Lessons Learned:

The Department of Interior's Standards for Rehabilitation indicates six general guidelines recommended for the revitalization of a historic housing facility. They are:

- Identify, retain, and preserve the form and detailing of architectural materials and features that define the historic character.
- Protect and maintain important materials that must be retained in the process of rehabilitation.

- Repair physical conditions of character and define materials and features that warrant additional work. Begin with the least degree of intervention.

- Replace an entire character-defining feature with new material if the level of deterioration or dam age of materials inhibits repair. Replace if the essential form and detailing are still evident and the entire feature must be replaced rather than repaired.

- Design replacement features when an interior/exterior feature is missing or no longer plays a role in physically defining the historic character of the building, unless it can be accurately recovered in form and detailing.

- Renovations and additions to historic resources should be done with care. It is important that alterations made to ensure the building's continual use do not radically change, obscure, or destroy character-defining spaces, materials, features, or finishes.

This type of project requires very close coordination among all concerned parties at the installation-housing area managers, cultural resources managers/coordinators, housing staff, and most importantly, the housing residents themselves. This study required access to the interior of the selected historic homes and some residents would not allow the contractors inside. Maintain a flexible schedule to allow substitution of housing units that are inaccessible and ensure that there is sufficient time in the contract to accommodate the residents' schedule in making the units available for site visits.

Project Publicity:

No publicity was sought for this project.

Technical Reports Produced:

Illustrated Manual for Repair and Maintenance of Historic Military Family Housing in Hawaii, August, 2002

Anti-Terrorism Force Protection (ATFP) Base Entrance Improvements in a Historic District

Description of Geographic Setting:

Due to the sensitive nature of this project, it was determined during fieldwork that each installation should remain anonymous and each location should be undisclosed. Both installations are in urban settings with established communities with mature trees and rolling hill terrain. Each installation is separated from the community by a fenced property line.

Abstract:

Because of threats to U.S. security and the corresponding responses to it, additional attention has been placed on the security of governmental installations against terrorist attacks. Improving security provides unique challenges to facilities with culturally significant historical resources. This project assessed current military criteria and guidelines for Anti-terrorism Force Protection (ATFP) with regard to installation entrance facilities within historic districts. An ATFP Base Entrance Improvements Study in National Register Historic Districts was completed at two Department of Defense (DoD) installations. Both installations have a long and rich history dating from the mid-19th century. Both have gates that access the installation through or immediately adjacent to a National Register Historic District. The districts are comprised of primarily late 19th century and early 20th century dwellings and institutional structures. The styles represented within the district include Victorian eclectic, Neoclassical, Bungalow, and Craftsman. The landscape elements within the districts consist primarily of informally placed trees foundation shrub plantings, grassed lawns and parade grounds. The abundance of mature street trees on and off base define the tree-shaded character of the district. Each installation has consistently done a highly commendable job of maintaining both the landscape and the buildings that enhance the high quality historic character that defines the fabric of the districts. As part of the study, gate conditions were inspected and a design charette (an intense, on-the-spot design effort) and archaeological literature review and excavations were completed. Existing conditions were analyzed with respect to traffic flow, pedestrian access, and current security procedures. Deficiencies with respect to current ATFP standards and historic preservation concerns were identified. The design charette resulted in sketches of two proposed solutions for each installation. Archaeological work concluded that there were no significant cultural resources present in the gate areas, so no additional archaeological work was recommended. This study provides examples of specific areas of design that should be taken into consideration when planning ATFP compliance to existing base entrances within a historic district.

Service Branch: Navy

Project Location: Undisclosed.

Installation Size: Various.

Installation Primary Mission: Military training.

Project Point of Contact: Ben Miehe • Phone: (843) 820-7336 • Email: ben.miehe@navy.mil

Partners:

Department of Defense Legacy Resource Management Program; Installation representatives, Mr. Jean Paul Pentecouteau, Historic Architect; Lt. David Milinor, PWO and Mr. Rick Pittman, PWE; The State Historic Preservation Office, Serena Bellew, Review Coordinator, Caroline Wright, Sylvia Cleveland, and Bill Hover, Architect; Historic Preservation planners, Hardlines Design Co.

Purpose/Need:

The purpose of this project is to study the current (latest edition) military criteria and guidelines for ATFP with regard to installation entrance facilities within a historic district. Due to recent and current international threats to United States security and the corresponding responses to it, additional attention has been placed on the security of governmental installations against terrorist attacks. Modifying and improving this security provides unique challenges to facilities with culturally significant historical resources. This study was completed to provide an example of this integration process and provide specific areas of design that should be taken into consideration when planning ATFP compliance to existing base entrances within a historic district.

Approach:

Naval Facilities Engineering Command-Southern Division commissioned Hardlines Design Company (HDC) to assist in the preparation of an ATFP Base Entrance Improvements Study in a National Register Historic District at two DoD installations.

The first case study involved a relatively small Navy installation where the historic main gate provides direct access through the historic district. The second case study involved an Army post with a secondary gate directly adjacent to a historic district. The area immediately adjacent to the gate contains numerous additional structures that are eligible for the National Register and could become part of the historic district through an expansion of the district.

Fieldwork consisted of inspection of the gate and traffic flow conditions, a design charette (an intense, on-the-spot design effort), and archaeological literature review and excavations. The design team included an architect, historic architect, preservation planner, and security specialist/engineer. Base personnel (public works officers, security personnel, and architects) at each installation were included in the charettes. Representatives from the State Historic Preservation Office (SHPO) were in attendance during one day of each charette.

The team began each charette with a general overview of the project, which was funded by a DoD Legacy grant. The grant was originally written to include base entrance improvements at one installation from each military branch. However, funding was available for only two installations, with the hope that future funding will be available to complete the other two branches.

The team conducted a site visit of the all existing base entrances with emphasis on the gate where improvements were proposed. They walked the site and observed conditions from both within the installation and from the outside the fence. In both instances, the group walked along the perimeter of the installation with guidance from the installation representative to collect information about the surrounding neighborhood and traffic patterns. Team members recorded their observations using notes and photographs, which were used later in the design charette and in the final report.

Existing conditions were analyzed with respect to traffic flow, pedestrian access, and current security procedures. Deficiencies with respect to current ATFP standards were identified. During the field visit, two archaeologists from HDC conducted a literature review at base and area repositories, and completed fieldwork in the vicinity of the selected gates. Fieldwork consisted of shovel test units and screening.

After completion of the site visits, the team reconvened and began the design charette process. The team discussed limitations, opportunities, and solutions for each entrance area. These open forum discussions covered design, historic preservation, practicality, and security issues. The installation representatives provided paper, GIS, and cad drawings of the respective areas to be studied. After considering all aspects, the team sketched ideas onto a drawing of the existing entrances. These ideas were refined several times and led to the development of two potential solutions for each installation entrance.

The team consulted the following documents throughout the process:

- ITG 03-03—Interim Tech Guidance (ITG) Entry Control Facilities
- MIL-HDBK-1013/14—Selection and Application of Vehicle Barriers

- UFC 4-010-01—Unified Facilities Criteria (UFC), Department of Defense Minimum Antiterrorism Standards for Buildings

The team attempted to meet all the standards defined in these documents; however, due to various site constraints and historic district concerns, they were unable to meet every requirement and therefore attempted to meet the spirit of the requirements. The team conducted internal discussions concerning the shortfalls and consulted security engineers on possible compromises and mitigation measures. The team incorporated various additional measures to compensate for some of these shortfalls.

Each proposed solution considered the following:

- Clear and visible approach areas.
- Acceptable standoff distances.
- Vehicle inspection areas.
- Sentry booths and gatehouse placement.
- Visitor parking.
- Traffic flow for various vehicular situations (visitors, decaled personnel, service & delivery vehicles, etc).
- Pedestrian access and control.
- Separation of access control point from the main base.
- Control of vehicle's ability to charge and bypass the checkpoint (response zone).

Historic preservation concerns incorporated into each solution included:

- Retention of historic old growth trees.
- Gatehouse design compatible with the historic character of the setting in terms of size, scale, design, material, color and texture.
- Do not create a false historic appearance.
- Retention of historic gate features.

Additionally, due to the sensitive nature of this project, it was determined during fieldwork that each installation should remain anonymous and each location should be undisclosed. Building numbers, street names, and other unique identifiers were therefore changed to generic titles. The team attempted to provide an adequate overview of each installation's security concerns and subsequent solutions while attempting to keep specific information about the installation as private as possible.

The scope of this project focused solely on the overall design and incorporation of the entry design standards into a historic district. The team therefore did not consider administrative issues such as staffing, operations, or funding. It was assumed that these issues would be addressed by the installation's own security forces.

After completion of the fieldwork and charrete, the team further developed and refined the design, developed a detailed narrative, discussed findings, and made recommendations for inclusion in the draft report. A draft review was then held at each installation to review the concepts and obtain comments from each installation's security personnel. These comments and recommendations were incorporated into the final document, which contains the following for each of the installations:

- Installation description.
- Historic background of installation.
- Current entrance conditions.
- Current entrance practices.
- Existing distances to the controlled perimeter.
- Existing traffic and traffic flow.
- Current entrance deficiencies.
- Historic preservation concerns.
- Entrance recommendations.
- Large tractor-trailer entrances.
- Emergency vehicles.
- Lighting recommendations.
- Clear zones.
- Two solutions per entrance.
- Installation cost estimates.
- Summary comparisons of the two solutions.
- Maps and diagrams showing all of the above.
- Breakdown of cost estimates by line item.
- Archaeological investigations for each installation.

The design charette resulted in sketches of two proposed solutions for each installation and the archaeological work concluded that there were no significant cultural resources present in the gate areas, and no additional archaeological work was recommended.

Recommendations/Lessons Learned:

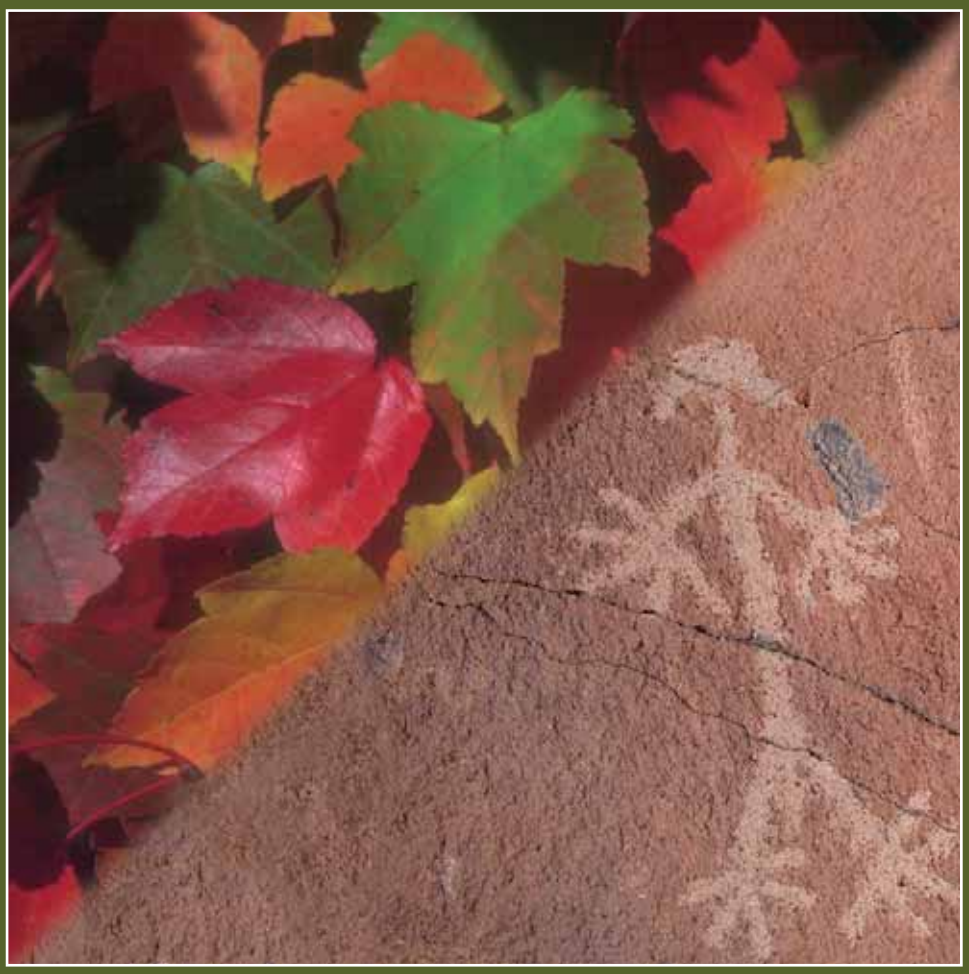
Installations pursuing a project such as this would benefit from better management and awareness of base security, and better relationships and understanding by the SHPO of the unique needs and requirements of military installations. Project programmers and planners should contact the cultural resource specialists and the SHPOs early in the planning process. The project and process have been perceived at both installations as being helpful and valuable to base planners and security personnel.

Project Publicity:

No publicity was sought for this project. The results of this and other ATFP studies have recommended distribution through the DoD.

Technical Reports Produced:

Two PowerPoint presentations and a paper copy (pdf file) of the study report have been provided to the installations and DoD Legacy office.



MARINE CORPS

Cultural Resource Conservation Projects

Restoration of Chibuga Historic Spring and Well Site

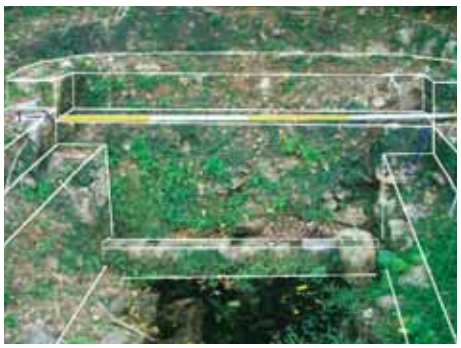
Description of Geographic Setting:

The site is on the Pacific island of Okinawa. It is a natural spring with a cut stone masonry wall surrounding the area where the water emerges from the hillside. It is located in a lush green valley with native trees, in an area that was once used (prior to WWII) as a rice nursery. The streams abound with fish, freshwater shrimp, and eels. Today, the valley resembles a park, and is located adjacent to billeting.

Pre-restoration condition of the Chibuga Spring.

Abstract:

The purpose of this project was to restore a very significant local cultural landmark, and in the process express to the people of Okinawa that the Marine Corps is concerned about its impact on their lives and culture. During the battle for Okinawa in World War II and the subsequent development of Camp Foster, the area that was once called Tamayose Mura was destroyed. Working with local government, archaeologists, and landowner associations to restore the spring to its pre-World War II condition completed this project. Opening the site up to the local community once restoration was completed created a feeling of joy among many of the elders in the local community that remembered playing at the site when they were children before the war. The project received positive publicity with the local press and media.



Design illustration of the restored wall superimposed over the photo of the pre-restoration condition.

Partners:

Department of Defense Legacy Resource Management Program; Chatan Town Board of Education; Tamayose Village Landowners Association.

Purpose/Need:

Chibuga Historic Site and spring is located on Camp Foster in an area that made up the eastern portion of the old Tamayose Mura (village), which was a residential district of Chatan Cho (Town) prior to World War II. The entire area is now occupied by Camp Foster. Folktales indicate that the village was once a part of Chatan Village, which was the largest of the old villages in the Chatan Cho

Service Branch: Marine Corps

Project Location: Marine Corps Base, Camp S.D. Butler, Okinawa, Japan

Installation Size: Approximately 1,680 acres (680 hectares)

Installation Primary Mission: Logistical and administrative support for Marines in Okinawa, Japan.

Project Point of Contact: Eric M. Williams • Archaeologist/Environmental Coordinator • MCAS Futenma
DSN: 636-2066 • Comm: 011-81611-736-2066 • Cell: 090-6861-4126 • Email: williamsem@mcbbutler.usmc.mil

Restored wall and stonework at Chibuga Spring.

area. The people who once lived in the Aza Chatan District of Chatan Cho referred to the area as Tameshi Ga (spring). Unfortunately, as a result of the battle for Okinawa during World War II and the subsequent development of Camp Foster, the area that was once called Tamayose Mura was destroyed.

Chibuga spring is a religious site where many people of the local communities come to pray annually. The water from the spring was used in many religious ceremonies by the local villages, including cleansing for the New Year and the first bathing of a newborn child.

Past archaeological surveys and excavations revealed much information about Chibuga Spring and the surrounding area. In 1991, Chatan Cho Board of Education conducted an excavation in the area that yielded Fensa Kasoshiki type pottery that was common during the Late Shell Mound Period of Okinawa history. This survey and excavation indicated that the area encompassing Tamayose Mura was active from the Late Shell Mound Period, ca. 10th to 12th century, until the Battle for Okinawa during World War II. The spring's infrastructure was destroyed either during World War II and/or by road construction above the spring after the war.

Cultural resources specialists recognized that tremendous goodwill could be generated among the local population through the restoration of this cultural landmark.

Approach:

Restoration efforts focused on reconstructing the stone structure that once surrounded the headwaters of the natural spring. In order to do this, it was necessary to gather information describing what the structure looked like prior to World War II. Archaeologists of the MCB Butler Facilities Engineer Division solicited the assistance of the Chatan Cho Board of Education. Through this coordination, archival records and interviews with local elders provided a good image of what Chibuga once looked like.

In archaeological terms, an historic site is considered significant based on its contributions to local or world history and its abilities to show innovation in construction and engineering. Chibuga is without doubt very important to local history and it shows a profound mastery of masonry skills for the period in which it was constructed. The predominate type of stone masonry used in the construction of Chibuga is referred to as Nunozomi, which is the method of stacking cubic or nearly cubic cut stones atop each other. The other type of masonry used is Aikatazumi, which is a method of shaping stones into a pentagon or hexagon column and stacking the stones face to face. This method is somewhat stronger than Nunozumi.

A mapping survey and illustrated renderings based on the position of remaining original stones still situated in the well was completed and the contractor created architectural drawings. The restoration began by collecting original stones, which were excavated and placed near the site by the town BOE. The stones were then placed in positions where they might have been prior to destruction, and empty spaces were filled with new stones. Workers used miner's drills to shape new materials like the original stones, and these were placed using a combination of Nuno-zumi and Ailkata-zumi methods.

Local village elders practicing traditional events at the restored Chibuga Spring.

People from the local community, especially residents who used to live around the site, warmly received the restoration. They appreciated the Marine Corps' efforts to complete this project that they had expected the

local city office to do for long time. Local TV and print media and U.S. media such as *Stars and Stripes* and *Okinawa Marine* reported the project and covered the completion ceremony. Compared to the usual attitude of the local media, this effort was a huge success. The project (and because of it, the U.S. Military) received positive attention from local society that is rarely received under ordinary circumstances.

Wide view of the restoration project, showing the new stairway leading to the spring.

As part of this project, stone steps with handrails and a stone walkway were constructed to provide access to the site. Stone retaining walls were constructed around the periphery of the site in order to prevent future erosion and damage to the site. A stone monument was constructed and carved with epigraphs in English and Japanese detailing the history of the site and providing the date of restoration.

Recommendations/Lessons Learned:

Projects such as this are good for the conservation of cultural landmarks, as well as for building or enhancing relationships between local people and the military. Cultural resource managers on installations that wish to pursue these kinds of projects should get the support of their command and convince them of the positive publicity that can be generated by such activities. Overseas installations are eligible for funding.

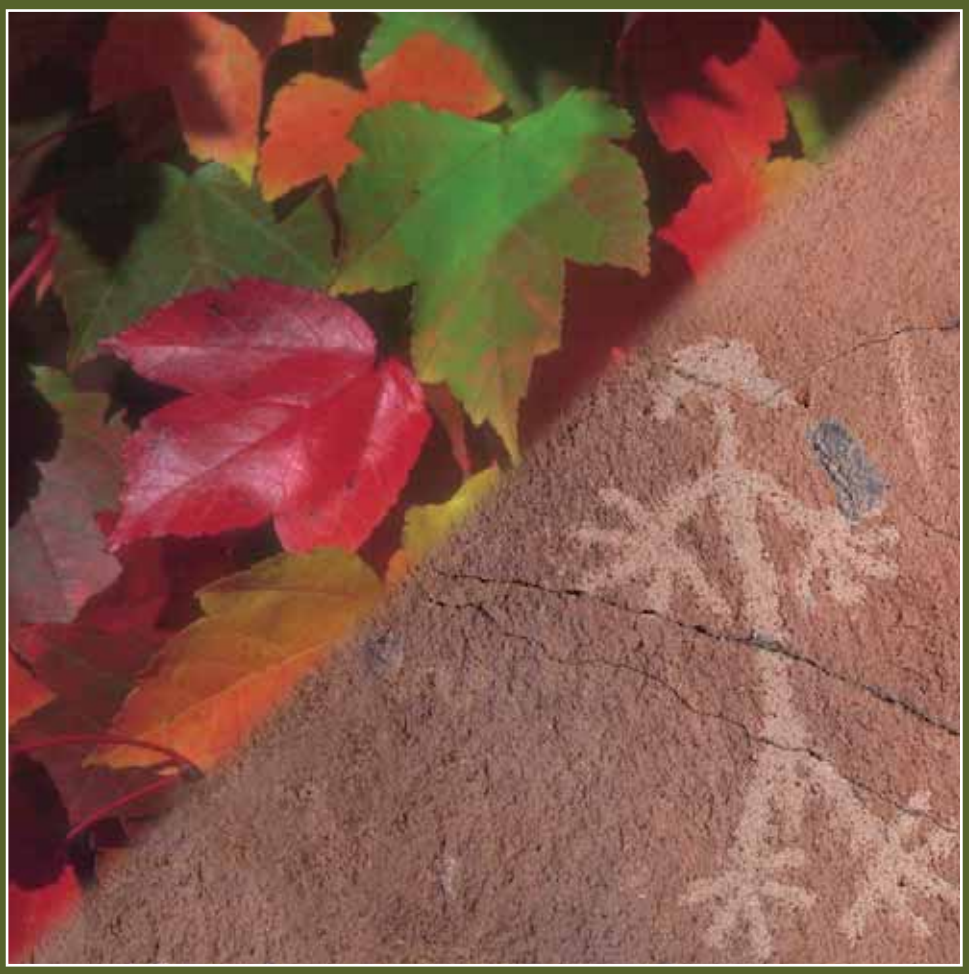
Project Publicity:

The Marine Corps received coverage in the *Pacific Stars and Stripes*, local (Japanese) television, and both major local (Japanese) newspapers.

Technical Reports Produced:

None

Dedication plaque for the Chibuga Spring Restoration Project.



D o D

Natural Resource Conservation Projects

Integrated Ecosystem Management Approach to Golf Course Management: A Pilot Study

Description of Geographic Setting:

The U.S. Naval Academy Golf Course (USNAGC) is situated within the Chesapeake Bay watershed—a 64,000 square mile (165,759 square kilometer) region in the Coastal Plain ecological zone. The Chesapeake Bay is the largest estuary in the United States and is home to 3,600 species of plants and animals. The golf course area of the U.S. Naval Academy is a 140 acre (57 hectare) facility of which 80-90 acres are in play and 50 acres are classed as out-of-play.

Abstract:

Golf course management is often perceived as incompatible with wise use of natural resource and environmental conservation goals. This project focused specifically on designing strategies that would incorporate an ecosystem approach to golf course management with a special emphasis on naturalized landscaping, integrated pest management, and constructed wetland technology. Specifically, it was determined that increasing native plant populations would reduce irrigation needs and help decrease the use of chemical pollutants, thereby modifying most of the current course management practices. A video and a companion workbook were developed to provide Department of Defense (DoD) golf course superintendents with a practical guide to these improved management practices.

Partners:

Department of Defense Legacy Resource Management Program; Environmental Concern; Golf Agronomy International; Robert Trent Jones Golf Club.

Purpose/Need:

The wildlife in the Chesapeake Bay has been adversely impacted by chemical runoff. The USNAGC has the opportunity to take the lead in demonstrating DoD sensitivity and awareness regarding the health of the Chesapeake Bay. By reducing chemical runoff and taking measures to restore native plant communities that help provide critical corridors for wildlife, DoD can set an example for courses around the nation and especially those located within sensitive watershed areas. The Chesapeake Bay is becoming more and more fragile as an ecosystem resulting largely from deforestation. Less than 60% of the original forested area remains today. The biggest environmental stressors on the Bay's health are: 1) excess nutrients; 2) toxic/chemical contamination; 3) air pollution; 4) and landscape changes. The Coastal Plain is

Service Branch: Department of Defense

Project Location: US Naval Academy Golf Course (USNAGC) within Chesapeake Bay watershed

Installation Size: 64,000 square mile (165,759 square kilometer)

Installation Primary Mission: Midshipmen training base for naval career.

Project Point of Contact: Ms. Dawn Southard • Native Seed Trade Association • Phone: (202) 833-1150
EMAIL: dsouthard@nativeseed.org

characterized by gently rolling hills and valleys. It is underlain by a southeastwardly thickening sequence of sediments that consists of sand and gravel aquifers inter-layered with silt and clay confining units.

The main goal of the Golf & Environment Initiative was to help DoD golf course superintendents better manage their courses through a coordinated and practical environmental approach. Golf course management is often perceived as incompatible with wise use of natural resource and environmental conservation goals. However, golf course management can be a process that works with the ecosystem to take advantage of the natural checks and balances that help keep turf healthy and beautiful.

Approach:

The first year of the program was used to determine the golf course management strategies currently practiced at USNAGC. This information was then compared with that provided by other courses to the US Golf Course Association, the US Golf Course Superintendent's Association, and the National Golf Foundation in an effort to determine how far from or close to the norm USNAGC management practices were and in order to help provide a benchmark for the future comparisons. In addition, an inventory of the floral and faunal communities on and adjacent to the course was taken to determine how different the course was within the natural ecosystem and watershed. This information was used to help design a program both for the USNAGC and DoD golf courses nationwide.

Management strategies were devised for all budget levels so that at least some suggestions could be implemented immediately by most military golf courses. Alliances were established with other organizations to demonstrate how a superintendent can still implement components of the plan outside his/her own expertise. For example, the Master Gardener program at both the county and state level has volunteers who are excited about the prospect of teaching superintendents how to prepare a native plant palette and how to install and maintain native plant communities. The US Fish & Wildlife Service is also very interested in partnering with any golf course, especially in programs designed to reduce chemical effluent runoff. These partnerships help bring the superintendent expertise and potential sources of funding to help implement better environmental management strategies.

Specifically, cost effective and practical options are being provided for wildlife enhancement, decreased water usage and surface water runoff, wetland construction, protection and maintenance, integrated pest management, and opportunities for public outreach and education.

Study areas were selected for their potential to be reverted and managed for native species. Computer programs were used to demonstrate how the areas would be visually changed with the various replanting options. This pallete of options was then shown to the public to get feedback on the options and to begin the educational outreach of the environmental and economic value of these management options.

In some cases, filter strips of native plants were planted near water hazards and ponds to reduce the maintenance costs of mowing near these water resources, improve the water quality by reducing the surface runoff (and thus the deposit of sediments and chemicals into the water), and to improve wildlife habitat to attract waterfowl away from the fairway and onto the ponds.

Large areas that are out of bounds are being re-established to native vegetation. All existing exotics are removed and these areas are being replanted with native plant communities. They will generally reduce water use, costly maintenance, and improve local environmental health.

In the second year of the program, a video and workbook were produced to demonstrate a practical approach that is less programmatic and more hands-on than most current programs. Close work with the superintendent and grounds crew made it clear that these individuals need practical information that can easily be incorporated into their everyday routines in order for them to implement environmentally sound best management practices. The video and workbook are aimed at the superintendent and grounds crew and provide practical hands-on information.

Recommendations/Lessons Learned:

The following are the primary lessons learned as a result of this project:

1. It is critical to have base command and the staff's support to implement this program.

2. The base natural resource manager is a vital asset to the golf course superintendent.

3. Communication with course members and staff is an important aspect to the overall success of the program.

4. Each aspect of the program can be done over time as the budget allows.

5. The superintendent can usually receive help in current resource inventory and plan development from local birding clubs, native plant societies, master gardeners, and entomologists.

Project Publicity:

Members from the Armed Services Pest Control Board came out for a site visit and an overview of the program. Several displays were made for the clubhouse that provided members with information about the program and encouraged them to provide input on what they wanted to see planted.

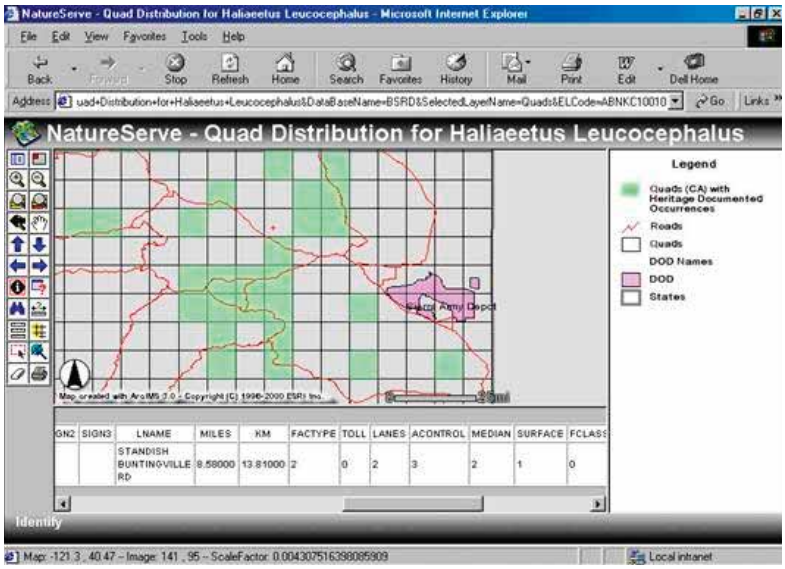
Technical Reports Produced:

Dawn Southard, the project supervisor, provided a final report for the Legacy Resource Management Program in 2001.

Improving Access to Information on Species of Conservation Concern

Description of Geographic Setting:

This project included the states of California, New Mexico, and Arizona, including the tribal lands of the Navajo Nation. This southwestern region of the United States contains more than 100 Department of Defense (DoD) installations. It contains a wide range of ecosystems and is home to nearly 400 species listed as Threatened or Endangered by the U.S. Endangered Species Act (ESA).



Sample view from the NatureServe system. Light green squares show distribution of bald eagles around the Sierra Army Depot.

Abstract:

The project provides a multi-state, multi-jurisdictional dataset of species information over the Internet. This information can be used to guide the stewardship of all DoD-controlled or managed natural resources, and can specifically aid in the protection of species of concern, including those on the federal Threatened and Endangered Species List. The Association for Biodiversity Information (ABI) and The Nature Conservancy (TNC), working with the Natural Heritage Network in each state, have developed a website that provides a wide range of information about species. These data are continually updated using information from the state field surveys performed by the Natural Heritage Programs (NHPs). Under this DoD-funded project, the website was enhanced to include spatial information at a finer scale and to allow users to download information. By providing distribution information as fine as the U.S. Geological Survey 7.5-minute quadrangle, this project provides an important tool that natural resource managers, command staff, and headquarters staff can use for natural resource management and land use planning.

Service Branch: Department of Defense

Project Location: California, New Mexico, and Arizona including the tribal lands of the Navajo Nation in these states

Installation Size: Not applicable

Project Point of Contact: L. Peter Boice, Director of Conservation in the Office of the Deputy Under Secretary of Defense for Environmental Security, • 3400 Defense Pentagon, Room 3E791, Washington, DC 20301-3400, Phone: (703) 604-0524, DSN (703) 664-0524 • Email: boicepl@acq.osd.mil.

J. Douglas Ripley, Ph.D., Natural Resource Manager • HQ USAF/ILEVQ
1260 Air Force Pentagon, Washington, DC 20330-1260 • (703) 604-1812 DSN (703) 664-0632
Email: Douglas.Ripley@pentagon.af.mil.

Dennis Fink, Project Manager, Association for Biodiversity Information, 1101 Wilson Boulevard • Suite 1500 Arlington, VA 22209 • Phone: (703) 908-1800 • Email: dfink@tnc.org

Partners:

Department of Defense Legacy Resource Management Program; Association for Biodiversity Information (ABI); The Nature Conservancy (TNC); Arizona Heritage Data Management System; California Natural Diversity Database; Navajo Natural Heritage Program; and the New Mexico Natural Heritage Program.

Purpose/Need:

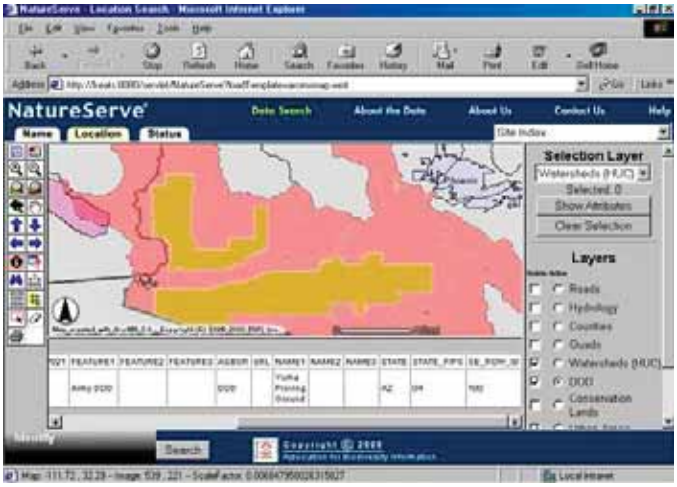
The project's overall purpose is to make multi-jurisdictional species data that are critical to conservation activities accessible to all levels of the DoD. This first phase of the project used data from three states for "proof of concept." Plans are to expand the project to include the entire United States. As the military moves forward in implementing DoD policy guidance on ecosystem management, it needs scientifically reliable biodiversity information at larger scales than on the traditionally available state-by-state basis. Analyses are now being done at the scale of landscapes, habitat ranges, watersheds, ecoregions, and training areas, all of which may cross state boundaries. As the military undertakes these larger scale assessments, there is a growing demand for up-to-date multi-jurisdictional biodiversity data.

To meet this growing demand, the military and other users of biodiversity data face two major challenges: 1) Users of multi-state data must develop separate use agreements with each state, and rules for providing information may vary from state to state. 2) Even state Natural Heritage Programs that use a common technical framework to develop data may interpret data differently, making cross-jurisdictional data aggregation and scientific comparisons difficult. ABI's centrally maintained, multi-jurisdictional database uses standards for data collection and interpretation to reconcile differences in data interpretation.

Approach:

Prior to this project, the ABI and TNC developed a website using the multi-jurisdictional database to publicly provide taxonomic and distribution information. This site (www.natureserve.org) provides a wide range of information about species, including presence by state. ABI and TNC work with NHPs in an annual cycle of data exchanges to update and maintain the database. ABI's multi-jurisdictional database provides a standardized, multi-state, Internet-accessible format that allows the DoD to perform large-scale assessments. The DoD funded project expanded the delivery of data to include county—and watershed-scale information from California, Arizona, and New Mexico, including the Navajo Nation; and USGS 7.5-minute quadrangle-scale information from California.

Agreements were developed with each of these four NHPs to provide this finer scale dataset. Each NHP reviewed its dataset to ensure it met ABI standards to help ensure standardized, high-quality biodiversity data. The data were delivered to ABI and incorporated into a multi-jurisdictional database system, called the Natural Heritage Central Databases (NHCD). Discrepancies between datasets and the standards established by ABI were reconciled during this data exchange. Several enhancements were added to NatureServe™ to allow DoD users fine-scale search capabilities and results presentation; the ability to download taxonomic and distribution information; secured access to fine-scale distribution information and download functionality; and presentation of the number of species occurrences in an area and the last observation of a species occurrence in an area.



Example search option to locate species of conservation concern found in the watersheds around Yuma Proving Ground and Barry M. Goldwater Air Force Range.

The NatureServe™ site was further enhanced so that DoD users can search by county, watershed, or quadrangle. This refinement allows the user to find which species are present on or around a military facility at a scale that can be used for planning. A Geographic Information System (GIS) using the ArcIMS software manufactured by ESRI, Inc. displays reference layers to orient the user. It includes a map of DoD installations, query functionality to select buffered areas around a feature such as a military installation, and standard GIS pan and zoom features. The GIS interface also displays distributions of species, which can be viewed at either a county or watershed level (California, New Mexico, and Arizona) or quadrangle level (California).

Download capabilities for general and distribution information lets DoD users create reports in text-delimited data files that can be used in a variety of end-user applications. Text files containing metadata and field definitions accompany the data files. The general data include species taxonomy, conservation rank, common and scientific names, and ESA status. The geographical distribution is presented as standard county code, watershed code, and quadrangle code. This information can then be imported into the end-user's GIS system and overlaid with other maps for further analyses.

The sub-state search and result functions and the download function appear on the site for users who have entered through the DoD restricted portion of DENIX (Defense Environmental Network & Information Exchange at www.DENIX.gov). Only DoD personnel and contractors can access the secured portions of this site where the link to the secured portions of the NatureServe™ site is posted. ABI and the NHPs consider fine-scale geographical distribution information to be secured information, and therefore only allow access to DoD users under a data license agreement.

In addition to the website and data development, two data license agreements (DLA) were generated. The first was an annual license to provide DoD personnel and their contractors access to the website. Allowable uses of the data for internal and external DoD products are defined in the annual DLA. A model DLA was developed that will facilitate future access to general and location information by DoD for all species of conservation concern in the U.S. This will improve DoD 's ability to contribute to species protection across the U.S. while supporting continuing activities to ensure military readiness.

Recommendations/Lessons Learned:

The project, though currently limited to Arizona, California, and New Mexico, is considered a technology demonstration that can be expanded in the future. The website is available for use by DoD personnel and contractors. More data will be added in the future.

Project Publicity:

The NatureServe™ tool has been cited in several publications including:

Science Magazine, Vol. 289, September 22, 2000: Netwatch, pg. 1999, by Jocelyn Kaiser.

USA Today, October 26, 2000: The Net: New & Notable, pg. 3D by Sam V. Meddis.

Technical Products Produced:

The secure-access NatureServe™ website is available to Department of Defense users through DENIX at www.denix.osd.mil/denix/denix.html.

The non-secure NatureServe™ website can be found at www.natureserve.org.

Monitoring and Management of a Sensitive Resource: A Landscape-Level Approach with Amphibians

Description of Geographic Setting:

North Carolina Dare County Bombing Range (US Air Force) is made up of marshland, forest, and open space. North Carolina Cherry Point Marine Corps Air Station is relatively flat land that is approximately 27 feet above sea level. Georgia's Fort Stewart Army Base is about 39 miles across from east to west, 19 miles from north to south, and has two deep-water ports: Savannah and Charleston. Marine Corp Base Camp Lejeune, North Carolina, includes 14 miles of beach on the Atlantic Ocean.

Green treefrogs (*Hyla cinerea*) commonly breed in shallow wetlands in the Coastal Plain in summer and otherwise lives in trees in the adjacent forest.

Abstract:

Because amphibians are sensitive indicators of environmental change, understanding their population and community dynamics in fluctuating environments provides considerable insight into how resource managers can accomplish their environmental mandates. Development of effective integrated natural resource management plans that are realistic and ecosystem-based requires detailed information on the dynamics of populations at the landscape level. This project focused on amphibian communities in three military installations in

Service Branch: Department of Defense

Project Location: North Carolina: Dare County Bombing Range (US Air Force), Cherry Point Marine Corps Air Station, Marine Corps Base Camp Lejeune, and Georgia: Fort Stewart Army Base.

Installation Size: North Carolina: Dare County US Air Force Bombing Range—46,000 acres (18,616 hectares)
North Carolina: Cherry Point Marine Corps Air Station—29,139 acres (11,792 hectares)
North Carolina: Marine Corps Base Camp Lejeune—153,439 acres (63,714 hectares)
Georgia: Fort Stewart Army Base—279,270 acres (113,017 hectares)

Installation Primary Mission: The Navy and Air Force use Dare County US Air Force Bombing Range for air-to-surface target training.

Cherry Point Marine Corps Air Station's mission is to provide the highest quality operating environment for all using activities; operate and maintain facilities and assigned aircraft; furnish a full range of vital support services; nurture the quality of life; protect the natural environment; conduct proactive community relations; and to provide America with the best trained, best led, best supported armed forces capable of operating anytime, anywhere-to fight, win and survive.

Marine Corps Base Camp Lejeune's mission is to maintain combat ready units for expeditionary deployment.

Fort Stewart's 3rd Infantry Division (Mechanized) units are trained and ready to deploy rapidly to a contingency area by air, land, and sea to conduct mobile, combined arms offensive and defensive operations worldwide.

Project Point of Contact: Joseph C. Mitchell, Ph.D. • University of Richmond • Richmond, Virginia 23173
Phone: (804) 740-7086 • Email: jmitchel@richmond.edu

eastern North Carolina: Dare County Bombing Range (US Air Force), Cherry Point Marine Corps Air Station, Marine Corps Base Camp Lejeune, and one installation in Georgia: Fort Stewart (Army). A three year study using standardized population monitoring techniques in terrestrial habitats showed that multiple techniques are needed for a full assessment of amphibian populations and communities at multiple sites and at the landscape level. Use of a single monitoring technique will likely result in biased results and faulty conclusions.

Assessing the dynamics of amphibian populations provides insight into environmental changes.

Partners:

Department of Defense Legacy Resource Management Program

Purpose/Need:

Amphibians are sensitive indicators of environmental change. Understanding their population and community dynamics in fluctuating environments provides considerable insight into how resource managers can accomplish their mandates. Specific objectives of the project were:

- To develop a landscape-level methodology for assessing the dynamics of amphibian populations in federal installations in the eastern United States.
- To provide a quantitative baseline against which future assessments of amphibian populations and communities on each installation can be evaluated.
- To provide installation personnel tools to monitor these sensitive organisms in the future to detect future population trends.
- To provide realistic management recommendations to installations that allow resource managers to maintain viable amphibian populations.
- To conduct an initial survey of potentially devastating amphibian diseases at Camp Lejeune and Fort Stewart.

Approach:

The following standardized techniques were used in terrestrial habitats:

300 meter-long artificial coverboard transects (30 coverboards) along with ten sections of PVC pipe set upright to provide refugia for treefrogs. Transects were checked monthly (May-October 1999 and February 2000-December 2001) to assess amphibian use of these two types of refugia. The following standardized techniques were used in wetland habitats: weekly nighttime assessments of calling frogs and monthly minnow trap and dip net surveys for adults, tadpoles, and salamander larvae. The latter two wetland protocols were run April-October 1999 and February-October 2000 and 2001. The weekly frog call survey was run May-September 1999 and February-September 2000-2001 when the frogs stopped calling.

Transects of coverboards allow assessments of amphibians in the terrestrial environment seeking cover. PVC pipes are used frequently by arboreal treefrogs for shelter.

A total of 18,250 individual amphibians were captured during the three year project. Of these, 4,614 were captured on Dare County Bombing Range, 3,435 at MCAS Cherry Point, and 10,201 on MCB Camp Lejeune. In addition to the research using standardized monitoring protocols, 3,316 adult and juvenile frogs were marked for determination of movement and distances and patterns of movement among isolated wetlands and between wetlands and terrestrial habitats. Of these, 1,372 were marked on Dare County Bombing Range, 871 at MCAS Cherry Point, and 1,073 on MCB Camp Lejeune.

A potentially serious amphibian disease was discovered on MCB Camp Lejeune in 2000. This disease has caused amphibian population declines in the western United States and species extinctions in the tropics. It does not harm humans and is thus a wildlife problem and a potential management issue. Frogs that are susceptible to this disease are prey for a large number of terrestrial and semi-aquatic predators, and tadpoles regulate energy dynamics of aquatic ecosystems.

Because they are primary consumers and prey for a host of wetland species, loss of these ecologically important animals would have cascading effects and potentially alter natural ecosystem functions.

This Legacy-supported project included disease surveys on MCB Camp Lejeune and on Fort Stewart. All individuals captured for evaluation were analyzed by the National Wildlife Health Center in Madison, Wisconsin (USFWS).

One meter sweeps using standard dipnets in shallow wetlands provided quantitative samples of amphibians, tadpoles, and salamander larvae.

Recommendations/Lessons Learned:

This report summarizes quantitative capture success for each technique in each of the three installations. Amphibian activity is highly seasonal with early breeders, late breeders, and much variation in calling patterns due to weekly weather activity and pond hydrology. Each of the isolated wetlands (e.g., limesinks, vernal pools) studied supports a different suite of species despite the fact that they were separated by as few as 40-50 meters. Even different portions of nearly homogeneous wetland habitat support different combinations of species. These results show that multiple techniques are needed for a full assessment of amphibian populations and communities at multiple sites and at the landscape level.

Recaptures in 2000 and 2001 were seven (0.05%) frogs on Dare County Bombing Range, 14 (1.6%) on MCAS Cherry Point, and 13 (1.2%) on MCB Camp Lejeune. Distances moved ranged from 100-3,140 meters at Dare, 30-2,100 meters at Cherry Point, and 30-790 meters at Camp Lejeune. These results demonstrate that frogs can move considerable distances over the landscape and use both wetlands and uplands extensively. Such information is critical to formulation of effective landscape-level management plans because it supports the concept of management of habitats at the landscape scale.

The disease testing showed the following results:

- The chytrid fungus was positively identified in American bullfrogs, southern leopard frogs, and the broken-striped newt from Camp Lejeune and in American bullfrogs from Fort Stewart.
- Ichthyophonus infections were confirmed for American bullfrogs and broken-striped newts on Camp Lejeune and for American bullfrogs on Fort Stewart.
- Ranavirus infections were confirmed for one American bullfrog tadpole on Camp Lejeune.
- No pathogenic bacterial infections were detected in the amphibian specimens from Camp Lejeune or Fort Stewart.

These diseases may not yet be widespread, as some sites sampled on these two installations supported the diseases and others did not. The fact that no diseases were found in the amphibians sampled on Fort Stewart in 2001, but were in 2002, suggests that there may be annual variation in occurrence and susceptibility. Conclusions about the impact of diseases on Camp Lejeune are difficult to draw. Researchers have three years of baseline data on the infected sites. However, drought conditions that prevailed during the survey make it difficult to determine if the disease is contributing to the observed decline in amphibians caught in 2001.

Conclusions about the impact of these diseases on Fort Stewart cannot be drawn because there are no baseline data on amphibian population size or abundance in the sites confirmed. The effects of the diseases must be evaluated with multi-year studies of amphibian populations and comparisons of infected sites and non-infected sites using standardized techniques. All three diseases have caused individual mortality and population die-offs in other parts of the United States. They do not appear to be correlated with malformations, as no malformed amphibians were found on the three installations, although several captured individuals had missing limbs.

The following general management recommendations apply to all three installations, and may also apply to other military installations in the region.

- Amphibian monitoring is likely to reveal habitat distribution and population dynamic patterns. Understanding the local patterns will allow resource managers to develop realistic management goals and programs. Because species presence or absence changes as habitats change and because these patterns change over time, monitoring of this fauna should be considered a long-term effort. Three years of research provides a baseline data set for evaluation of future changes; however, monitoring must be done for many more years to detect trends.

- The potential for disease introduction is growing and every effort should be made to avoid contamination from exotics or natives from other areas.

The following recommendations are provided from results of the disease survey.

- All installations should be aware of the problem of diseases in amphibian populations and realize that it could have widespread ecological and wildlife effects.

- All installations should be monitoring amphibian populations with standardized techniques so that the impacts of diseases can be evaluated. A comparative approach by monitoring sites known to harbor diseases and those that do not would be valuable. Such monitoring should be conducted for multiple years (e.g., 10+) so that trends can be detected.

- All installations should determine whether these diseases are causing wildlife and ecosystem problems in other locations.

- All installations should follow Declining Amphibian Populations Task Force (DAPTF) guidelines to minimize human transfer of the pathogens among ponds and locations.

Project Publicity:

No publicity was sought for this project.

Technical Reports Produced:

Gaul, R.W., Jr., and J.C. Mitchell. In press. The herpetofauna of Dare County, North Carolina: history, natural history, and biogeography. Journal of the North Carolina Academy of Science.

Making Military Golf Courses More Environmentally Friendly: Southeast Region Demonstration Project

Description of Geographic Setting:

Fort Benning is located in the lower Piedmont Region of central Georgia and Alabama, six miles southeast of Columbus, Georgia. The Post consists of approximately 182,000 acres (73,653 hectares) of river valley terraces and rolling terrain. The moderate climate and various terrain features are well suited for infantry training and support missions. The Post is home to the 40-acre (16 hectare) Lakeside Golf Course.

Abstract:

Modern golf courses have the potential to create environmental problems related to water use, fertilizer and herbicide/pesticide applications, noise pollution, impacts on wildlife habitat, and other land use issues. A one-year demonstration project was conducted at the Lakeside Golf Course in Ft. Benning, Georgia, to develop an outline for an environmental guidebook to help military golf course superintendents improve environmental performance across a number of parameters, such as reducing chemical inputs while increasing biodiversity and wildlife habitat. This model led to completion of a planning guide for military courses that includes the following basic steps: 1) collect baseline data; identify resources, problems, opportunities; 2) develop environmental plan with individual program strategies; 3) implement, monitor, and adjust plan as needed; 4) evaluate results; and 5) develop guidebook outline based on the model and other input.

Partners:

Department of Defense Legacy Resource Management Program; The Center for Resource Management; USEPA; the Golf Course Superintendents Association of America; the PGA Tour; the Golf Course Builders Association of America; the American Society of Golf Course Architects; the USGA; Pebble Beach Resort; Golf Digest Magazine; Friends of the Earth; the National Wildlife Federation; the National Coalition Against the Misuse of Pesticides; Physicians for Social Responsibility; Save the Bay; Sierra Club; North Carolina Coastal Federation; and the National Association of Counties.

Service Branch: Department of Defense

Project Location: Ft. Benning, Georgia

Installation Size: Golf course is 40 acres (16 hectares), Ft. Benning is 182,000 acres (73,653 hectares)

Installation Primary Mission: Conduct a holistic review and analysis of individual soldier institutional and unit training, equipping, and readiness needs. Make recommendations on Warrior Spirit implementation, support of Soldier as a System, individual equipment and training needs.

Project Point of Contact: Mr. Paul Parker • Center for Resource Management • Phone: (801) 466-3600
Email: pparkercrm@aol.com

Purpose/Need:

The game of golf has always included the challenge of competing against oneself and the variables of the course environment. Historically, the game was shaped by the existing environment in which a course was built. As the game has grown in popularity and construction and maintenance technologies improved, the image and demands of the game are now the dominant forces shaping the environment. Course managers and superintendents are expected to provide a pest-free, weed-free, emerald green playing surface in every ecosystem from deserts to rainforests.

Many golf course superintendents rely on intensive inputs of irrigated water, chemical pesticides and fertilizers to meet these expectations demanded by today's courses and golfers. Regulators and citizen environmental groups have raised concerns, protests and in some cases, litigation over possible water contamination, impacts on wildlife habitat, excessive water use, noise pollution, and related land use issues.

In 1995 the Golf & the Environment Initiative (G&E) was formed as a partnership between leading organizations in the golf industry and the environmental community to address these issues in a collaborative way. Working together, these organizations developed the first ever "Environmental Principles for Golf Courses in the United States," a set of consensus guidelines for planning, building, and maintaining golf courses. As part of the G&E, the Department of Defense developed an outline of a prototype environmental guidebook for military golf courses.

Approach:

The overall objective of the project was to develop the concept and outline for an environmental guidebook for military golf courses based on a one-year demonstration project at Ft. Benning. Two advisory committees provided input with representatives from the private golf industry, each branch of the military, several universities, and resource specialists from Ft. Benning.

The Ft. Benning demonstration project focused on developing and implementing an environmental assessment and planning process for the Lakeside Course. Project activities included a player survey, an environmental assessment checklist, site analysis, and the development of ten different program strategies for environmental improvements. The ten different strategies constitute the environmental stewardship plan for the course and include site specific remedial actions for water usage, safety training and awareness, pollution prevention, plant protection and nutrition, wildlife management, conservation and waste management, outreach and education, player satisfaction, environmental planning, and overall goals. The development and implementation of the plan was guided by specific formats and "tools" developed by the project team.

Part of the plan called for creation of 40 acres (16 hectares) of no-mow natural zones and buffers. These areas provide habitat for wildlife and reduced maintenance costs. These areas, along with the renovation of some existing greens and tees with more pest and drought tolerant turf, reduce the amounts of water, pesticides, and fertilizers used and thus have reduced the potential for pollution. In addition to the no-mow zones, wildlife habitat was enhanced with the addition of bird boxes and feeders. Soil erosion and siltation into the lake were reduced through repair of washout areas, natural vegetation buffers to slow runoff, and creation of rock catchment basins and rip rap along stream edges. The level of environmental awareness of golfers and maintenance staff was increased through the use of surveys, clubhouse posters, brochures, and environmental resource signs placed along fairways and tees.

Due to limited budgets and available time, implementation focused on low cost/high benefit measures. In addition to environmental benefits, the project increased communication between the golf course superintendent and the other natural resource specialists on the base.

The guidebook outline that was developed provides a step-by-step process for a golf course superintendent to analyze his/her course's problems and opportunities, and develop a site-specific environmental stewardship plan. Each step of the process is accompanied by specific tools and formats designed to build an environmental plan one step at a time.

Recommendations/Lessons Learned:

The environmental guidebook that was developed based on this test project can be a major factor in helping military golf course superintendents implement environmental improvements. Environmental improvement projects should:

- Highlight low-cost/high benefit projects.
- Have a format that is practical, user friendly, and provides a concise step-by-step process towards improvement.

- Provide means to effectively communicate the environmental stewardship efforts to others (maps, graphics, overlays).
- Provide reference information and sources of expertise.
- Be part of a larger more comprehensive program that includes incentives, recognition, and opportunities for career advancement.

Some barriers to environmental improvement on military courses include:

- Age and design of courses. According to a 1996 Army report, 89% of all Army courses are over 30 years old. Outdated irrigation systems and push-up greens result in inefficient water use and higher levels of pesticide and fertilizer use.
- Limited budgets for capital improvements and environmental projects.
- Environmental achievement is not seen as a path to recognition or career advancement.
- Lack of practical guidance materials, tools, and program incentives.
- Isolation of military golf course superintendents from peers in the golf industry.
- Perception that importance of golf course and its management depends on whether the commanding officer is a golfer.
- Institutional differences between different branches of the military.
- Lack of communication between golf course superintendent and natural resource specialists on the base, community, university, and the golf industry.

Opportunities or unique resources in the military that will support or facilitate greater levels of environmental stewardship include the following:

- Many bases like Ft. Benning have large tracts of land adjacent to the golf courses providing wildlife habitat and a natural vegetation setting.
- Most bases have resource specialists in forestry, wildlife, water, etc.
- Military golf course superintendents will support environmental programs if properly motivated.
- EPA and the golf industry will provide support and recognition for military achievements.
- Golfers who play military courses will support environmental improvements if properly informed and educated.
- Military should provide a guidebook in the context of a comprehensive environmental stewardship program with the following characteristics:
  - recognition and incentives for superintendents
  - environmental certification of courses
  - opportunities for increased training and education
  - greater links to other government and private programs
- Development of the program can build on this case study project but should include broader assessment of other regions, facilities, and branches of the military.
- Linkages with EPA and the golf industry should continue to be pursued to enhance benefits and recognition of military efforts.

Project Publicity:

No publicity has been sought for this project.

Technical Reports Produced:

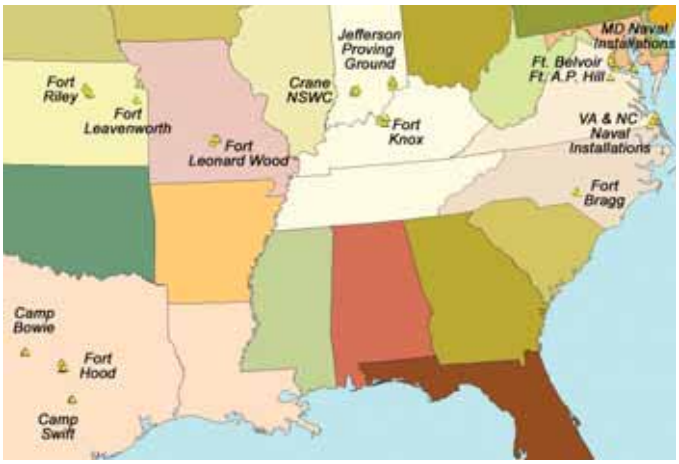
The first ever “Environmental Principles for Golf Courses in the United States,” a set of consensus guidelines for planning, building, and maintaining golf courses, book and 30 minute video was developed.

Environmental Report for the Fort Benning Golf Course.

Management Strategies for Reversing Declines in Landbirds on Military Installations

Description of Geographic Setting:

The U.S. Department of Defense (DoD) manages more than 420 military installations throughout the United States that cover approximately 30 million acres (over 12 million hectares). These installations provide important habitats for many songbird species because they often contain portions of important ecosystems, hotspots of biodiversity, critical breeding habitat, or stopover habitat used during migration.



Map of DoD Legacy-funded MAPS avian demographic monitoring network in the southeastern United States, comprising 78 stations at 13 DoD installations that monitored the effectiveness of management actions intended to reverse declines in landbird populations on military lands.

Abstract:

Natural resource managers on military installations face considerable challenges in balancing the application of federal laws that protect bird populations with the requirements of their military mission. The Institute for Bird Populations (IBP) used funding provided by the DoD Legacy Resource Management Program to provide natural resource managers on military installations with effective tools to reverse recent landbird population declines and allow managers to assess the effects of proposed land management on bird populations. Recently, IBP completed a landscape-scale ecological analysis using data collected from 78 MAPS (Monitoring Avian Productivity and Survivorship) stations operated on DoD installations. From these analyses, avian population management strategies from species-landscape models were developed for ten species of conservation concern that breed on the installations.

Service Branch: Deparment of Defense

Project Location: This project was conducted on 13 military installations (or groups of installations) including 11 U.S. Army properties; Fort Belvoir, VA; Fort A.P. Hill, VA; and Mason Neck National Wildlife Refuge, VA; Fort Bragg, NC; Jefferson Proving Ground (now operated by USFWS as Big Oaks NWR), IN; Fort Knox, KY; Fort Leavenworth and Sunflower Army Ammunition Plant, KS; Fort Leonard Wood, MO; Fort Riley, KS; and Fort Hood, TX. Texas Army National Guard; Camps Bowie and Swift. Department of the Navy; Patuxent River Naval Air Station, MD; Indian Head Naval Weapons Support Center, MD; Dahlgren Naval Surface Warfare Center, VA; Naval Amphibious Base Little Creek Annex Camp Pendleton, VA; Naval Air Station Oceana, VA; Naval Air Station Oceana Auxiliary Landing Field Fentress, VA; Naval Security Group Activity Northwest, VA; and Crane Naval Surface Warfare Center, IN.

Installation Size: Varies

Installation Primary Mission: Military training/weapons storage

Project Point of Contact: Dr. David F. DeSante • The Institute for Bird Populations • P.O. Box 1346 Point Reyes Station, CA 94956 • Phone: (415) 663-2052 • Email: ddesante@birdpop.org

Dr. M. Philip Nott • The Institute for Bird Populations • PO Box 1346 • Point Reyes Station CA 94956-1346 Phone: (415) 663-2050 • Fax: (415) 663-9482 • Email: pnott@birdpop.org

Partners:

Department of Defense Legacy Resource Management Program; The Institute for Bird Populations.

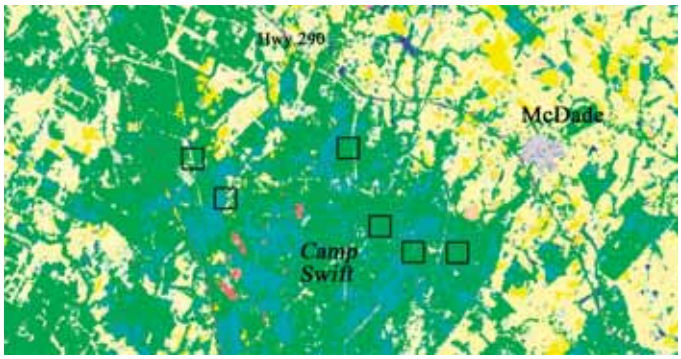
Purpose/Need:

Natural resource managers on military installations face considerable challenges in balancing the application of federal laws that protect bird populations with the requirements of their installations' military mission. This is especially relevant where management activities such as those associated with readiness of military ranges may impact Neotropical migrant birds that breed on DoD installations.

Other incidental activities on military installations such as logging and cattle grazing may also impact breeding bird populations. Ecological models that quantify the effects of landscape pattern and structure on avian population dynamics can help managers meet these challenges. Managers require decision-support tools that will enable them to predict the effects of proposed land use change and habitat management on avian demographics, including population densities, reproductive success, and the direction of population trajectories

Approach:

The Institute for Bird Populations, through its Monitoring Avian Productivity and Survivorship (MAPS) program (1994-2001), effectively monitored 31 land bird species on 13 DoD installations (or groups of nearby installations) across the eastern and central United States during 1994-2001. Of these 31 species, ten were identified that are nationally or regionally listed (as of December 2002) by the U.S.



Map of the National Land Cover Dataset surrounding Camp Swift in southeastern Texas. Open squares mark the locations of MAPS stations at which prescribed fire management is expected to reverse recent declines in painted bunting populations. Extensive patches of managed oak woodland on Camp Swift (dark green) contrast with the privately owned agricultural land (yellows) surrounding the installation.

A MAPS intern carefully examines a recaptured adult wood thrush at Crane NSWC to assess its age, breeding condition, and general health. Extensive morphometric data are also recorded for each bird captured. The wood thrush is classified by the U.S Fish and Wildlife Service as a Bird of Conservation Concern, and is a focal forest dwelling species in this study.

Fish and Wildlife Service (USFWS) as "Birds of Conservation Concern".

IBP combined banding data for these species with data from the National Land Cover Dataset (NLCD 1992) and constructed landscape-scale (1000s of acres) management models for reversing the declines in Neotropical migratory birds and other resident and migratory species. Using a state-of-the-art statistical approach, IBP constructed 44 demographic-landscape models relating to numbers of adults and young, population trend, and reproductive success. These models will be tested, in collaboration with natural resource managers of installations, by monitoring the effects of new or ongoing spatially extensive management actions and comparing them with model predictions.

A prairie warbler (another USFWS bird of conservation concern) awaits release after making its contribution to the 112,000 captures used in this study. Many such early successional species are of management concern on military lands. As a community, they require a managed mosaic of appropriately sized patches of different ages (e.g. grassland, shrubland, or young forest) for successful reproduction.

Species of management concern were identified at 13 DoD installations or groups of nearby installations. Four locations east of the Appalachians (Ft. Belvoir to Ft. Bragg) can most effectively manage and monitor forest birds of conservation concern. Ft. Bragg can also manage and monitor prairie warblers which are common breeders there. Fort Jefferson (now Big Oaks National Wildlife Refuge) and Crane Naval Surface Warfare Center in Indiana, and Fort Knox in Kentucky, support eight species of management concern including three scrub/successional species. Fort Leonard Wood in Missouri and Fort Leavenworth and Fort Riley

in Kansas also support breeding populations of five forest and three scrub/successional species. In Texas, the more scrubby habitats typical of Camp Swift, Fort Hood, and Camp Bowie allow effective management and monitoring of three scrub/successional birds of conservation concern. Overall, nine locations, Fort Jefferson; Fort Knox; Crane Naval Surface Warfare Center; Fort Leonard Wood; Fort Leavenworth; Fort Riley; and the Patuxent River, Indian Head, and Dahlgren installations can effectively manage and monitor between 16 and 22 landbird species each.

Recommendations/Lessons Learned:

Species-landscape models revealed important predictors of avian demographics among the ten species of management concern. Overall, selected models for those species that prefer to nest in forests and woodlands suggest that land managers should conserve large areas of contiguous forest (upwards of 700 ha) in a 1,256-hectare, 2-kilometer radius area. Within those forested areas, canopy cover as well as the density of undergrowth and ground cover clearly should be managed in a manner consistent with published microhabitat management procedures for the target species (e.g., the Nature Conservancy's *Species Management Abstract* database).

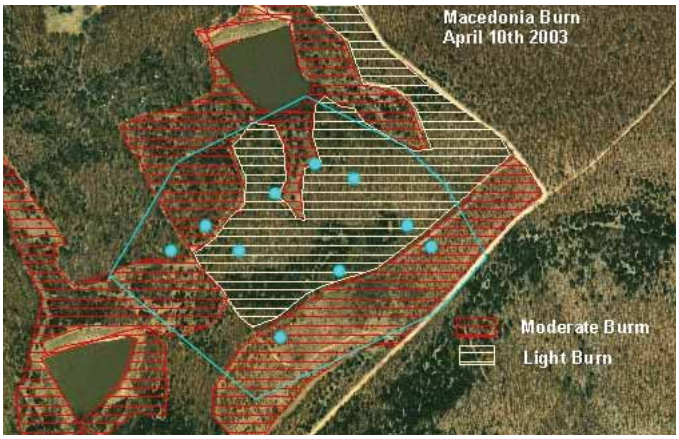
Applying species-landscape models to landbird conservation efforts on DoD installations can be a relatively simple process. A land manager would apply these models in the following manner:

- Identify a target species of management concern in an area of the installation.
- Using GIS, spatially analyze the existing 2-kilometer radius to obtain estimates of spatial parameters relevant to the ecology of the target species.
- From species-landscape models, estimate expected demographic parameters of reproductive success, numbers of adults, numbers of young, and population trajectory.
- Using GIS, simulate the proposed management actions (e.g., deforestation and prescribed burns) within the existing 2-kilometer radius landscape.
- Repeat species-landscape modeling to obtain "new" estimates of demographic parameters.

Management guidelines to conserve species that breed in early successional habitats often require appropriately prescribed fire regimes. A fire specialist at Fort Leonard Wood, Missouri, reduces risk of future wildfire by burning areas of grass and shrub adjacent to a road that is heavily utilized by military vehicles during training exercises. The timing and intensity of this burn is intended to result in a suite of species that is more typical of the native plant community.

- Evaluate the demographic predictions relative to management goals. This process allows managers to assess the likely effects of alternative proposed management actions on the species of conservation concern and support management decisions.

Although the procedure may be straightforward, multiple species effects are inevitable. Management actions that benefit one species may adversely affect another species. For example, although clear cutting reduces wood thrush populations, it may benefit other species that prefer the more open shrubland that subsequently develops. Over decades these habitats succeed towards forests and provide a sequence of habitat types preferred by one or more successional species. To successfully manage populations of successional species of conservation concern, land managers should maintain a mosaic of different aged patches. Management plans for range readiness and



An aerial photograph shows the vicinity of the Macedonia MAPS station (outlined in blue) on Fort Leonard Wood. Superimposed on the photograph are the permanent locations of mist-nets (blue dots) and the extent/intensity (hatching) of a summer 2003 burn that was intended to restore breeding habitat for field sparrows and add to a fire break adjacent to a nearby military range.

sustainment can be formulated to meet this requirement. The models constructed in this research helped formulate guidelines to the potential effects of extensive land management on songbird populations. These include “area effects” on forest birds such as Acadian flycatchers, for which a reduction of the size of forested patches can cause a disproportionate reduction in the population size. For other species, such as field sparrows, these models emphasize the importance of habitat edges as predictors of population size and trajectory.

The NLCD (1992) dataset provides an effective but coarsely scaled tool for constructing species-landscape models. It is likely, however, that improved spatial analyses of alternative high-resolution land cover datasets will increase the usefulness of these models.

Future landbird monitoring efforts on DoD installations should focus on the effects of land management on Birds of Conservation Concern as listed by USFWS. This will require additional clusters of MAPS stations to be established on installations that support abundant or declining populations of those species. IBP intends to improve its models through the development of more sophisticated analysis and modeling techniques. This will include comparing population dynamics derived from avain demographic data collected on military instillations with population dynamics derived from MAPS data collected in the same region on non-military lands.

Project Publicity:

None

Technical Reports Produced:

Nott, M.P., DeSante, D. F., and Michel, N. Management Strategies for Reversing Declines in Landbirds of Conservation Concern on Military Installations: A Lanscape-Scale Analysis of MAPS Data report to the U. S. Department of Defense Legacy Resource Management Program documenting DoD Legacy Project #00103, USACE cooperative agreement DACA87-00-H-003. A downloadable PDF format of the Executive Summary available from www.birdpop.org/downloaddocuments/DoDExec2003.pdf

Radar Ornithology: Avoidance of Bird/Aircraft Collisions and Conservation of Migratory Birds

Description of Geographic Setting:

Because this project was conducted on a wide range of bases, climate varied from tropical to desert and terrain included high, rugged mountains; low coastal plains; high plateaus; and desert.

The BIRDRAD Furuno 2155BB radar transmitter-receiver with 24-inch parabolic antenna. The TR unit is mounted on a mobile cart and cables connect it to the black box unit in the utility trailer

Abstract:

Many military airfields have no radar coverage that could be used to detect dangerous concentrations of birds during the day and after dark when the majority of birds migrate. Base Air Operations need this information as part of their Bird Aircraft Strike Hazard (BASH) abatement programs. Bird movement information is also very useful to installation natural resource personnel, because populations of many migratory birds are in decline and protecting habitat and migration stopover areas is an important conservation task. This study determined that high-resolution, 3-centimeter-wavelength surveillance radar (e.g., BIRDRAD) provides that capability at relatively low cost.

Partners:

Department of Defense Legacy Resource Management Program.

Purpose/Need:

Radar has extremely useful applications for the conservation of migratory birds. Shortly after radar was invented in the early 1940s, ornithologists began using it to study the movements of birds through the atmosphere. In the early 1960s, investigators began using low-powered surveillance radars (airplane and marine units) to monitor the movements of birds within a range of a few kilometers of the radar. Since that time, low-powered (5-25 kW) marine radars have been used to monitor bird movement and migration and to assess the impact of transmission lines, wind turbines, and other man-made structures on bird movements. Researchers have also used high-powered weather and airport surveillance radars to detect migrating birds at ranges out to 240 km, and have used long-term data sets to monitor the decline in migratory birds returning from the tropics.

Service Branch: Deparment of Defense

Project Location: Howard Air Force Base, Panama • Patuxent River Naval Air Station, Maryland
Pt. Mugu Naval Air Station, California • Elmendorf Air Force Base, Alaska
Whidbey Island Naval Air Station, Washington • Cherry Point Marine Corp Air Station, North Carolina

Installation Size: Varies

Installation Primary Mission: Varies

Project Point of Contact: Sidney A. Gauthreaux, Jr. • Department of Biological Sciences • Clemson University
Clemson, SC 296344-0314 • Phone: 864-656-3584 • Email: sagth@clemson.edu

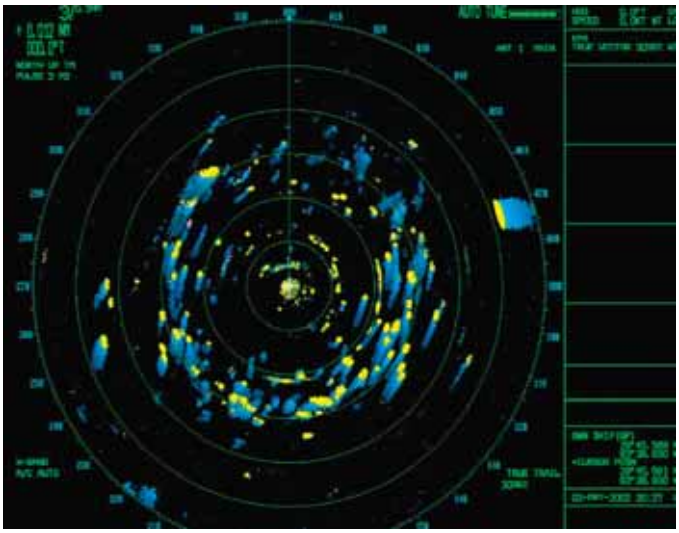
Approach:

With funding from the DoD Legacy Resource Management Program, researchers used a Hi*Def Accura frame grabbing board (Foresight Imaging) to capture the video signal from the FR-2155BB radar. The board was mounted in a personal computer and allowed the manual capture of any radar image as a .bmp file. This was made possible by using the Imaging Development Environment for Applications (IDEA) software bundled with the frame grabbing board. The software is a comprehensive set of hardware-independent function calls, ActiveX controls, and software tools for board configuration, video control, image capture, video streaming, memory management, and more. Image-Pro Express software (Media Cybernetics) is used to automate the process when necessary. The operator sets the time intervals for image capture and designates the directory and folder for storage of image files.

The new unit is also equipped with a 24-inch parabolic antenna. By decreasing the width of the antenna from one meter as in the earlier unit to 24 inches in this unit, the conical beam width increased from 2.5° to 4°. The first of the new BIRDRAD units with a frame grabbing board and a 24-inch antenna was deployed to Pt. Mugu Naval Air Station, California, in December 2001. Over the next year and a half, four additional units were deployed to Elmendorf Air Force Base, Alaska; Whidbey Island Naval Air Station, Washington; Cherry Point Marine Corp Air Station, North Carolina; and Patuxent River Naval Air Station, Maryland. These units were tested for their accuracy and efficiency in monitoring the movements of birds.

Recommendations/Lessons Learned:

This study showed that it is possible to use surveillance radar to study the movements of migrating birds in the atmosphere at different spatial scales. At a spatial scale within a range of six kilometers, high-resolution BIRDRAD units can detect the departure of migrants from different types of habitat within a few kilometers of the radar. The radar operator can also sample the flight speeds of targets in an attempt to classify birds by their velocity. At a larger spatial scale (10-60 kilometers), Doppler weather surveillance radar (WSR-88D) can be used to measure the density of birds in the radar beam as they begin a migratory movement within 60 kilometers of the radar. Within minutes of the onset of nocturnal migration, the distribution and density of echoes in the radar beam can provide information on the geographical sources of migrants on the ground (migration stopover areas), and satellite imagery can be used to identify the topography and habitat type that characterize these areas.



Sample BIRDRAD image. The range is three nautical miles and range marks are .5 nautical miles. The antenna is elevated to 30° above the horizontal so that the altitude of the birds (smaller targets) and the aircraft (large echo on right edge of display) is half the range. Note the graded blue echo trails, indicating moving targets. Current targets are colored yellow.

At a continental scale, the national network of WSR-88D radars can be used to monitor bird migration over the United States on an hourly basis at different altitudes, dependent on distance from the radar. The latter achievement is significant because it provides a means of monitoring the seasonal and yearly variation in the patterns of migration at different altitudes for different geographical regions and the nation as a whole.

Installations wishing to implement radar ornithology need to recognize the time it takes to get authorization to use BIRDRAD units at military airfields. An extensive series of tests and evaluations must be conducted before the radars can be sited and used.

Project Publicity:

Many national newspapers and television (CNN) coverage.

Technical Reports Produced:

USDA Forest Service Gen. Tech. Rep. PSW-GTR-191.2003. Radar Ornithology and the Conservation of Migratory Birds.

Pulling Together Initiative: A Public/Private Partnership for Invasive and Noxious Plant Management

Description of Geographic Setting:

Variable.

Abstract:

One of the greatest threats to the biological diversity, ecological stability, and economic well being of an increasing number of areas in the U.S. is the silent spread of invasive and noxious plant species. The Pulling Together Initiative (PTI) provides a means for federal agencies to be full partners with state and local agencies, private landowners, and other interested parties in developing long-term weed management projects within the scope of an integrated pest management strategy. The goals of PTI are to prevent, manage, or eradicate invasive and noxious plants through a coordinated program of public/private partnerships and to increase public awareness of the adverse impacts of invasive and noxious plants. Department of Defense (DoD) funds are used to support conservation projects that benefit DoD's military and stewardship mission goals. To be eligible for funding, projects must occur on or adjacent to DoD land, be implemented in conjunction with DoD land managers, and directly benefit terrestrial and aquatic ecosystems and native fish, plant, and wildlife resources.

The running buffalo clover is an endangered plant that is very susceptible to competition from non-native noxious weeds.

Partners:

Department of Defense Legacy Resource Management Program; the National Fish and Wildlife Foundation; Bureau of Land Management; National Park Service; Animal and Plant Health Inspection Service; U.S. Forest Service; and the U.S. Fish and Wildlife Service.

Service Branch: Department of Defense

Project Location: 26 installations and sites throughout the United States.

Installation Size: Varies

Installation Primary Mission: Varies

Project Point of Contact: Jonathan Mawdsley • Manager of Project Administration
1120 Connecticut Ave., NW, Suite 900 • Washington, D.C. 20036 • Phone: (202) 857-0166
Email: jonathan.mawdsley@nfwf.org

Purpose/Need:

One of the greatest threats to the biological diversity, ecological stability, and economic well being of an increasing number of areas in the U.S. is the silent spread of invasive and noxious plant species. The habitats of two-thirds of all threatened and endangered species are threatened by invasive and noxious species. Experts estimate that invasive and noxious plants have infested over 100 million acres (40 million hectares) and continue to increase by 8 to 20 percent annually. In the Pulling Together Initiative (PTI), the terms “invasive” and “noxious” are broadly defined to include, but are not limited to, aggressive, harmful, poisonous, undesirable, or weedy plant species. While not as conspicuous as ambulatory invasive species, these plants have spread across millions of acres in this country, supplanting native plants, disrupting ecosystem structure and function, infesting agricultural crops, and causing billions of dollars in lost revenue and control costs. Natural areas, including parks, preserves, wilderness areas, wildlife refuges, forests, rangelands, and urban green spaces, are all adversely impacted by invasive and noxious plants.

Simply controlling one area of invasive and noxious plants without actively managing adjacent lands will not achieve long-term recovery of the impacted areas. Therefore, to stop the spread of noxious and invasive plants while controlling existing populations, multi-jurisdictional weed management efforts are needed. It is essential that these cross-boundary partnerships include local involvement in the decision-making process. These collaborative efforts should share expertise, resources, and funding to efficiently and effectively address invasive and noxious plant problems in a coordinated manner.

Carefully controlled prescribed fires are an important component of native grassland restoration and maintenance.

Approach:

Initiated in 1996, the Pulling Together Initiative provides a means for federal agencies to be full partners with state and local agencies, industry, private landowners, and other interested parties in developing long-term weed management projects within the scope of an integrated pest management strategy.

The PTI provides support on a competitive basis for the formation of local Weed Management Area (WMA) partnerships. WMA partnerships are financed by funds from federal agencies together with matching funds from state, local, and private partners. Proposal submission is invited and encouraged nationwide. Successful projects serve to raise public awareness and increase interest in further partnership projects. Instead of being a permanent source of funding, this initiative is an opportunity for local agencies and partners within a local area to initiate working partnerships, conduct invasive and noxious plant control, demonstrate successful collaborative efforts, and build on those successes to develop permanent funding sources for the maintenance of WMAs from the involved parties. The PTI facilitates a coordinated, national approach to funding and implementing effective, long-term invasive plant management at the local level.

Recommendations/Lessons Learned:

To date, the National Fish and Wildlife Foundation has awarded 26 grants totaling just over $1.0 million in DoD funds, which have been matched by over $1.4 million in contributions from project partners. Collectively, these projects have removed invasive vegetation from 6,830 acres (2,764 hectares) on DoD installations, restored 86 miles (138 kilometers) of vital shoreline habitat, and developed management plans to provide long-term control of invasive weeds on an additional 167,000 acres (67,583 hectares) of DoD installations.

To view guidelines for application submission visit www.nfwf.org/programs/pti.htm

Project Publicity:

The National Fish and Wildlife Foundation distributed news releases in January 2004 during its National Invasive Weed Awareness Week on Capitol Hill.

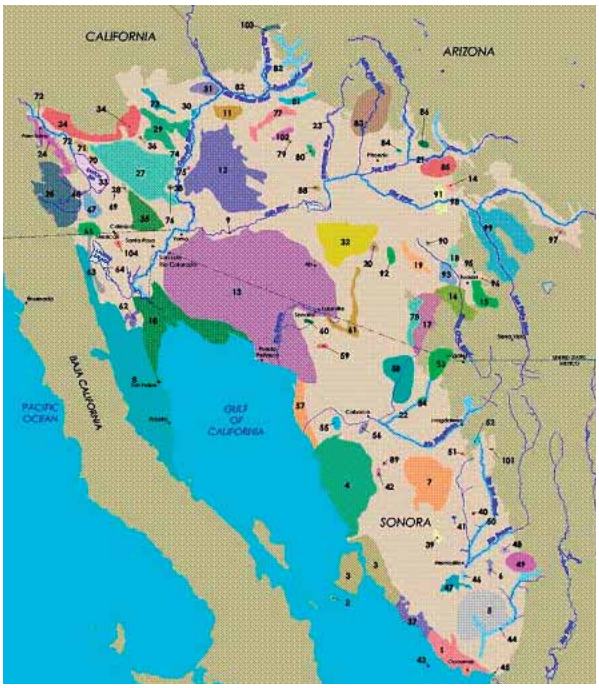
Technical Reports Produced:

The program has not completed an overall report; however, each project that is funded has created a report. Additional information can be found at: http://www.nfwf.org/programs/pti.htm#use

Sonoran Desert Ecosystem Initiative: Shared Management Framework, Goals, Standards, and Responsibilities

Description of Geographic Setting:

The Sonoran Desert Ecoregion encompasses 55 million acres (22 million hectares) in southwestern Arizona, the southeast corner of California, northeastern Baja California, and the majority of Sonora, Mexico. The Arizona and California portions of the Sonoran Desert include over three million acres of Department of Defense (DoD) lands. This project focuses on the Arizona portion of the Sonoran Desert. The hottest of our North American deserts, this area has a distinctly bimodal rainfall pattern that produces high biological diversity.



Conservation areas within the Sonoran Desert Ecoregion. Area 12 encompasses part of the Yuma Proving Ground and Areas 13 and 32 encompass most of the Barry M. Goldwater Range.

Abstract:

The Sonoran Desert Ecosystem Initiative (SDEI) evolved from an earlier Legacy Program effort that focused on conservation opportunities within the Sonoran Desert Ecoregion. The interest of the Department of Defense (DoD) was to identify a shared blueprint for allocating conservation responsibilities throughout the ecoregion. In part, this interest was based on DoD's concern with the potential for an increase in the federal conservation burden and associated mission impacts in the Southwest as human population growth and associated development progress and continued species impacts and endangerment seem imminent. An ecological analysis of conservation priorities, completed in 2000, provided the blueprint by identifying a network of 100 large conservation areas and primary threats to biodiversity within the ecoregion.

Service Branch: Department of Defense

Project Location: Sonoran Desert, Southwest Arizona

Installation Sizes: 2.56 million acres (1 million hectares): (Barry M. Goldwater Range, 1.73 million acres [700,106 hectares]; Yuma Proving Ground, 0.83 million acres [335,889 hectares])

Installation Primary Missions: Training and testing

Project Points of Contact: John A. Hall, Sonoran Desert Program Manager • The Nature Conservancy
1510 East Fort Lowell Road • Tucson, AZ • Phone: (520) 547-3439 • Email: john_hall@tnc.org

Nina Chambers, Sonoran Desert Project Manager • Sonoran Institute • 7650 East Broadway Blvd., Suite 203
Tucson, AZ • Phone: (520) 290-0828 • Email: nina@sonoran.org

From that assessment, three main program areas were identified for implementation: 1) site-based conservation planning, 2) ecosystem monitoring and coordinated management, and 3) invasive plant management.

This case study shows the accomplishments and lessons learned related to implementation of these three components, primarily since 2002 as part of the SDEI. To address the above challenges, the SDEI was designed to provide a proactive approach to conservation planning that focuses on conserving native biodiversity and ecological processes within a federal land management context, encourages coordination of management activities across jurisdictional boundaries to address mutual resource management objectives, and facilitates partnerships to increase an agency's ability to accomplish its mission while meeting its stewardship mandates.

Partners:

Department of Defense Legacy Resource Management Program; the Nature Conservancy (Conservancy); Sonoran Institute (Institute); Bureau of Land Management (BLM); National Park Service, U.S. Army's Yuma Proving Ground; Luke Air Force Base; Marine Corps Air Station Yuma; Bureau of Reclamation; Natural Resources Conservation Service; U.S. Fish and Wildlife Service; Arizona Department of Agriculture; Arizona Department of Transportation; Arizona Game and Fish Department; Arizona State Land Department; the University of Arizona; Natural Resource Conservation Districts; Yuma Conservation Gardens; Pacific Biodiversity Institute (natural community mapping, descriptions, and assessment); NASA Sustainability and Global Change Program (population growth model); Northern Arizona University (recreation impact assessment); and U.S. Geological Survey (invasive plant data management system development). In addition, numerous experts from agencies and universities have assisted by providing their expertise and review of this project. Several graduate and undergraduate student interns have also worked on the project.

Purpose/Need:

Federally managed lands dominate the U.S. portion of the Sonoran Desert. Collectively, these lands are potentially adversely impacted by human population growth-related impacts of increased development, water usage, and recreation. Because it is a rapidly growing region, the extent of these impacts on the region's biological resources is likely to intensify. These human-related disturbances also accelerate the spread of invasive plants, which is one of the most serious threats to the persistence of the Sonoran Desert's native ecosystems. In addition, as the landscape becomes fragmented and otherwise degraded by incompatible human activities, the effects of long-term drought on desert species are exacerbated.

Approach:

To address the above challenges, the SDEI was designed to provide a proactive approach to conservation planning that focuses on conserving native biodiversity and ecological processes within a federal land management context, encourages coordination of management activities across jurisdictional boundaries to address mutual resource management objectives, and facilitates partnerships to increase an agency's ability to accomplish its mission while meeting its stewardship mandates.

The SDEI is a multiple spatial scale, complex project with many interrelated activities. The project encompasses a regional perspective, which provides an appropriate information context, and incorporates the needs and opportunities identified by all partners. The common threads to the project include multi-partner collaboration and activities soundly based in science. The regional perspective is provided by a Legacy-funded ecological analysis of conservation priorities, completed in 2000, that identified a network of 100 large conservation areas (mostly falling between 5,000 to 500,000 acres in size) and primary threats to biodiversity within the Sonoran Desert Ecoregion. Moreover, from that analysis, three main program areas were identified for implementation, most recently as part of the three-year Sonoran Desert Ecosystem Initiative:

1) Site-based conservation planning using a biodiversity management framework,

2) Ecosystem monitoring and coordinated management, and

3) Invasive plant management.

(1) Site-based conservation planning using a biodiversity management framework

The Conservancy has developed a planning framework for conserving and managing biodiversity on federal lands that has been tailored to meet the resource planning needs of different land management units and

agencies within the Sonoran Desert. The purpose is to encourage a more holistic and proactive approach to natural resource planning that facilitates the long-term conservation and management of native species and ecological systems, including associated ecological processes. Because ecological boundaries rarely correspond to jurisdictional boundaries, the framework also identifies opportunities for coordinated management of biological resources held in common between different land managers. The framework is intended to achieve efficiency in what resources need to be managed while capturing the full expression of the biodiversity of an area.

The biodiversity management framework has been developed or is under development for three areas within the Sonoran Desert: 1) Barry M. Goldwater Range; 2) Sonoran Desert National Monument (adjoining the Barry M. Goldwater Range); and 3) the Kofa Complex (includes the Yuma Proving Ground, Kofa National Wildlife Refuge, and BLM lands). For the Goldwater Range, the framework provided an information baseline to help inform development of the Range's Integrated Natural Resources Management Plan (INRMP).

For the Sonoran Desert National Monument, the BLM has contributed funds to support biodiversity management framework development. The combination of Legacy and BLM funding has enabled the Conservancy and Institute to expand the scope of the framework to include social and economic factors influencing natural resource management. Recreational use of wildlands is increasing in the region and is likely to continue to increase on the monument as the area around it becomes developed. The Institute contracted Northern Arizona University to conduct a rapid assessment of recreation impacts on the monument and to train BLM staff in this assessment methodology. The initial assessment will serve as baseline for future monitoring of the change in recreation impacts.

To assess population growth around the monument, the Institute contracted with NASA to produce a growth projection model. The model enables creation of potential growth scenarios based on past (or projected) population growth rates, land use and zoning policies, and patterns of development. These scenarios enable the BLM and local government officials to plan for development impacts. A series of community workshops was held jointly by the BLM and Institute to present the results of the growth model and local socioeconomic trends. These workshops formed the basis of discussion with communities about their vision for collaboration with the BLM and the new monument.

The Conservancy contracted Pacific Biodiversity Institute to map, describe, and assess the condition of the natural communities (ecological systems) of the Sonoran Desert National Monument. Under the biodiversity management framework, natural communities function as a "coarse filter" for capturing the management needs for the majority of species when the communities themselves are managed appropriately. Species that fall through the coarse filter, such as wide-ranging species, are specifically targeted for management action. Framework information is still under final development, but is available to the BLM for incorporation into the resource management plan for the Sonoran Desert National Monument.

For the Kofa Complex, the Conservancy applied the initial steps of the framework to develop a preliminary assessment of biodiversity values for the area. The goal was to provide the Complex's federal land managers a landscape-scale view of the biodiversity resources of the area that could inform their individual resource management plans, as well as to provide managers cross-boundary ecological data to enhance the significant levels of inter-agency resource management coordination already occurring in the area.

Additional funding from Yuma Proving Ground has facilitated the application of the preliminary assessment information to the update of its INRMP. The INRMP takes an ecosystem management approach, which fits well with the use of the biodiversity management framework information. The process of updating (and implementing) the INRMP relies on local partnerships and management of shared resources. As part of this coordination, a collaborative planning workshop is being planned that will bring together military and federal land managers with city and county officials to address growth issues. The Sonoran Institute and others will provide skills training to ensure that local planners have the tools needed to effectively plan for and address growth and its impacts.

(2) Ecosystem monitoring and coordinated management

The ambitious vision of this component is to create a regional framework for ecosystem monitoring that will detect and describe changes occurring over time across the region, provide land managers with the data needed—ideally at multiple scales—to make informed and coordinated management decisions, and provide the public and policy makers with information to understand the changes that are occurring. As a result, land managers will be able to make better decisions related to maintaining the long-term ecological integrity

of the Sonoran Desert ecosystem. Much of the initial effort has focused on building partnerships, sharing information, and identifying opportunities for collaborative management. Recently, additional funding has been leveraged through the National Park Service, and progress has been made in describing the conceptual framework and monitoring components, identifying potential indicators of change, and building partnerships and interest in implementing ecosystem monitoring.

(3) Invasive plant management

Invasive species are one of the main threats to native biodiversity in the Sonoran Desert. Because these species and their impacts are such a wide-spread problem, a collaborative approach is needed to address the threat. A series of training workshops on invasive plant management issues, funded by a previous Legacy Program award, led to interest in forming volunteer, Cooperative Weed Management Areas (CWMAs). Legacy funds have enabled the Institute and Conservancy to help establish two CWMAs in the western Sonoran Desert: the Borderlands CWMA and King of Arizona CWMA. In addition, the members of these two groups decided that there should be an umbrella coordinating body, which became the Sonoran Desert Invasive Species Council (SDISC).

The SDISC consists of 24 distinct agencies or organizations, 22 of which (including three DoD installations) have signed a memorandum of understanding formally agreeing to work together. A five-year strategic plan was developed for the SDISC and each CWMA developed an annual operational management plan that includes collaborative management (prevention, control, and restoration), research/data collection, and outreach. The SDISC meets semi-annually.

Collectively, the members of the SDISC have treated and/or restored thousands of acres. Assessment plots have been established to monitor the effectiveness of control strategies and the rate of spread of key species. Inventories of invasive plants have been conducted, including the Legacy-funded survey of the Sonoran Desert National Monument as part of the natural community condition assessment work.

The Conservancy contracted the U.S. Geological Survey to develop a data management system for invasive plants that could be used by all members of the SDISC, and ultimately other CWMAs in the region, to facilitate data sharing and improve coordination. The objective is to standardize data collection and management, while remaining flexible to meet the differing capacities of participants to manage and use data. The system will consist of an Access-based data manager, web-based data input and interactive mapping tools, and access to a regional database managed by the Survey. Participants can submit their data to the regional database and download the data attributable to all CWMA members.

Finally, the Institute has led efforts for education and outreach and, together with partners, has produced several publications, given presentations, and issued press releases to increase general public awareness about invasive species.

Recommendations/Lessons Learned:

The broad scope of this project, numerous partners involved, and extraordinary opportunities provided by the Sonoran Desert as a laboratory have afforded some valuable lessons. Formal compilation of these lessons is underway, but the following are some preliminary thoughts.

1. Start with sound science. This project was built on an ecological analysis of the Sonoran Desert Ecoregion that described opportunities for conservation, flagged areas and biotic elements of greatest conservation significance, and assessed threats to the region's biodiversity. That regional context was extremely valuable in identifying and forming partnerships whose efforts could contribute to the "big picture." From that starting point, information has been collected and analyzed at finer scales to inform natural resource management decision-making at key areas of biodiversity significance throughout the region. Good information that addressed specific land manager needs was the starting point for finding common ground and achieving results.

2. Success comes from looking beyond boundaries. A regional context for management decisions is critical and identifies opportunities for coordinated management of shared resources that cross-jurisdictional boundaries. Proactively addressing these opportunities creates shared responsibilities and benefits. Collaboration is not always easy to initiate, but once partnerships are formed the benefits of efficiency, shared information, and accelerated results are widely evident and self-reinforcing.

3. Identify appropriate partners based on common needs and interests. Partnerships should be based on common interests and building complementary skills and resources. Partnerships are successful only when they provide benefit to all participants, so involving the appropriate partners and identifying their needs is critical. Partnerships also need to be inclusive of a broad range of stakeholders, who can bring to the table a diversity of skills and perspectives, and be open to new members as issues change or a project matures.

4. Success builds success. As the project began to show benefit to partners, those partners helped leverage funds to expand and support the project. This kind of buy-in is critical to the sustainability of the work beyond being a "project" with a limited timeline of usefulness and has multiplied the benefit from the DoD investment.

5. Involve the public for lasting support. Public involvement and incorporation of public values create the foundation for sustainability and long-term support of federal land management activities. Whether it is local citizens living near federal lands, county and city officials, or visitors who volunteer time to remove invasive plants, the local public can strongly influence the degree to which federal lands can be successfully managed.

The most rewarding and successful aspects of this project include: the breadth of the work—spanning millions of acres of Sonoran Desert and the interconnected themes of site conservation, ecosystem monitoring, and invasive plant management; the opportunities and connections afforded by working with diverse partnerships across a large landscape; and all the spin-off projects that have contributed to its richness and impact.

Project Publicity:

This project has had many products and publications in addition to exposure in the region through presentations and briefings.

Technical Reports Produced (since 2002):

A Field Guide to Invasive Plants of the Sonoran Desert. Sonoran Institute (and many partners). 2002.

Community Workshops: Sonoran Desert National Monument and Phoenix South Planning Areas. Final Report. Sonoran Institute and Bureau of Land Management. 2003.

The Natural Communities and Ecological Condition of the Sonoran Desert National Monument and Adjacent Areas. Pacific Biodiversity Institute. 2003.

Sonoran Desert National Monument Recreation Impact Inventory of Dispersed Sites. Final Report. Northern Arizona University. 2003.

Preliminary Assessment of Biodiversity Values and Management Framework Adaptation for the Expanded Kofa Complex and Yuma Resource Management Area in Southwestern Arizona. The Nature Conservancy. 2004.

GIS-based, Three-dimensional Population Growth Modeling and Cumulative Impact Analysis: Sonoran Desert National Monument and Phoenix South RMP. Blueline Consulting. 2004.

Conservation Elements of and a Biodiversity Management Framework for the Sonoran Desert National Monument. The Nature Conservancy and Sonoran Institute. In preparation.

NIPS (Non-Native Invasive Plants) Data Manager User's Manual. U.S. Geological Survey and The Nature Conservancy. In preparation.

National Public Lands Day

Description of Geographic Setting:

These projects are site-specific; therefore, the topography is different for each. Camp Ripley Military Reservation, Minnesota, has been active in this program and is a good sample installation. It contains trails with vegetation surrounding a wetland and an area of native prairie and forest.

Volunteers perform trail maintenance as part of National Public Lands Day.

Abstract:

Many public lands throughout the nation are faced with backlogs of maintenance needs, and most could benefit from additional construction and labor projects. There simply aren't enough funds to complete all needed projects. National Public Lands Day (NPLD) provides Americans with a dramatic and productive opportunity to pitch in and help improve their public lands. The goal of NPLD is to improve the quality of public lands and to educate the public about natural resource issues and stewardship. Funds are available annually for base-level projects that support the goals of NPLD for any Department of Defense (DoD) site. Military installations that permit public use of facilities for recreation are eligible to apply for DoD Legacy funds, which may be used for tools and equipment, materials, and enhancements such as trail materials, interpretive signs, and information kiosks. This project is set for a specific day in September each year, but can spread over a few days depending on weather conditions and other factors. The results at every DoD site that has participated have been very positive and successful.

Partners:

Department of Defense Legacy Resource Management Program; and community volunteers.

Service Branch: All service branches—Army, Air Force, Marine Corps, Navy.

Project Location: Installations that participated in 2003 included: Arizona: Fort Huachuca Heritage Park, Camp Navajo • Arkansas: Cottonshed Park, Millwood Lake • Bahamas: Naval Undersea Warfare Center Detachment AUTEC Andros Island • California: Beale Air Force Base • Georgia: Fort Gordon, Fort Stewart & Hunter Army Airfield Hawaii: Fort Ruger, Battalion 407 • Indiana: Naval Surface Warfare Center Crane • Michigan: Fort Custer Training Center • Minnesota: Camp Ripley • Mississippi: Fort Leonard Wood, Whiteman Air Force Base • Nevada: Stead Training Site • New Jersey: Laurel Pond/Ft Dix, Fort Dix • North Carolina: Grove of Honor • Oklahoma: McAlester Army Ammunition Plant Pennsylvania: Carlisle Barracks, Fort Indiantown Gap • Puerto Rico: Camp Santiago Training Site • South Carolina: Poinsett Electronic Combat Range • Tennessee: Volunteer Training Sites • Texas: Fort Hood Belton Lake Outdoor Recreation Area • Virginia: Fort Lee, Fort Pickett, Naval Station Norfolk, Dam Neck Annex, Fort Monroe, Fort Belvoir, Langley Air Force Base Lighter than Air Pier • Washington: Fleet & Industrial Supply Center Puget Sound • West Virginia: Camp Dawson

Installation Size: Varies by installation

Installation Primary Mission: Varies with installation

Project Point of Contact: Patti Pride—NEETF • Director of National Public Lands Day • 1707 H Northwest, Suite 900 • Washington, D.C. 20006 • Phone: (202) 261-6474 • Email: pride@neetf.org

Purpose/Need:

Many public lands throughout the nation are faced with backlogs of maintenance needs, and most could benefit from additional construction and labor projects. There simply aren't enough funds to complete all needed projects. National Public Lands Day (NPLD) provides Americans with a dramatic and productive opportunity to pitch in and help improve their public lands. On NPLD thousands of volunteers gather at national parks and forests, reservoirs, monuments, and other public areas to improve and enhance the resources of those special places. Volunteers work with public land managers on needed projects that could not have been accomplished without NPLD.

These volunteers build bridges and trails, plant stream banks, restore lakes and wetlands, remove invasive plants, improve wildlife habitat, repair cultural resources and recreational facilities, and carry out hundreds of other priority projects. They also learn about the importance of public lands to the nation's environmental, economic and social health and about specific environmental issues facing local managers. Importantly, they get a first hand perspective of the problems and issues public land managers face each year.

The main goal of the project is to bring volunteers together to make military lands usable to the public, focusing on the disabled. At Camp Ripley, for example, they have built fishing piers and ramps, have made the trails more accessible, and created ways to make it possible for the disabled to recreate.

Volunteers have a great time building wood duck nesting boxes.

Installing wood duck nesting boxes at Camp Riley, Minnesota.

Approach:

NPLD can be instituted any number of different ways, but the best approach is to involve the local community and start early. NPLD will provide a manual to any installation that would like to participate.

Funds are available annually for base-level projects that support the goals of NPLD for any DoD site. The goal of NPLD is to improve the quality of public lands and to educate the public about natural resource issues and stewardship. All military installations that permit public use of facilities for recreation are eligible to apply for DoD Legacy funds. Funds may be used for tools and equipment, materials, and enhancements such as trail materials, interpretive signs, and information kiosks.

Coordinated by the National Environmental Education & Training Foundation (NEETF), NPLD is a public/private partnership that garners nearly 60,000 volunteers annually. In 2003, these volunteers contributed $8 million worth of improvements to 375 sites in all 50 states, the District of Columbia, Puerto Rico, Japan, and Germany. NEETF provides approved sites with a checklist/manual, promotional posters and brochures, a press kit, and items of appreciation for volunteers. NEETF also works with each site to help develop an effective environmental education component to the project.

Efforts conducted in previous years include:

- Camp Navajo, Arizona. Protected 400 old-growth trees from potential fire.
- Fort Ruger, Hawaii. Planted 200 trees and 300 plants, removed 2,000 pounds of invasive species.
- Camp Ripley, Minnesota. Built 1/2 mile of hiking trail and collected 125 pounds of native prairie grass seeds.

- Camp Santiago Training site, Puerto Rico. Built 1/2 mile of hiking trail and planted 81 trees and 20 bushes.
- Camp Dawson, West Virginia. Planted 85 trees.
- Fort Leonard Wood, Missouri. Built seven miles of trails, removed 1,700 pounds of trash, built 24 purple martin birdhouses and 40 bat houses.
- Laurel pond/Fort Dix, New Jersey. Built two miles of trails, put in 2,130 plants, and collected 200 pounds of trash.
- Carlisle Barracks, Pennsylvania. Rebuilt one mile of trail, installed 500 plants and collected 100 pounds of trash.
- Beale Air Force Base, California. Planted 200 trees, built 30 nesting boxes for bluebirds, 30 for wood ducks, and 12 for owls.
- Langley Air Force Base, Virginia. Planted 5,000 eel grass plants in a restoration project on a tributary to the Chesapeake Bay.
- Fleet and Industrial Supply, Washington. Seeded Olympic oysters in Little Clam Bay as part of Puget Sound restoration.

National Public Lands Day gives volunteers a chance to pitch in and help complete a variety of important projects on public lands.

Recommendations/Lessons Learned:

There is a lot of competition for volunteers and attention during specific times of the year, because of school fundraisers, etc. The organizing and recruiting of volunteers and materials should begin as soon as funding is established.

Seize the opportunity: Educate volunteers about public lands. NPLD offers volunteers a unique opportunity to learn about the importance of their public lands. It presents a "teachable moment." One of the key objectives of the day is to build local understanding of and support for public land managers and the issues affecting their sites.

Form a steering committee to work with agency staff to plan and organize the event. Some suggestions for the initial meeting of the steering committee:

- Decide the scope and direction of the day.
- Help decide on projects for the day.
- Develop a work plan for the day.
- Logistics for the day.
- Determine the number of hours and the number of volunteers needed.
- Plan the environmental education component.
- Determine the need and quantity of meals.
- Determine need for entertainment.
- Determine how volunteers will be recognized (certificates, letters, gifts, etc).
- Decide on any additional committees or task forces that will be needed.
- Develop a "rainy day" plan.

Project Publicity:

This project has been covered by: USA Today cover and article, Wall Street Journal article, L.A. Times article, and The Washington Post ran six articles about the day itself urging people to go to the website and volunteer.

Technical Reports Produced:

A technical report is produced yearly for each site with an extensive evaluation of the site-specific project.

This report is published on the Department of Defense Legacy website.

Field Evaluation of Chemical Methods for Brown Tree Snake Management

Description of Geographic Setting:

Guam is the largest and southernmost of the Mariana Islands in the West Pacific. It has a total land area of 209 square miles (54,131 hectares), and a tropical climate that receives about 70 inches (178 cm) of rainfall per year. The topography varies on the island; flat limestone plateau in the northern end, mixed rock transitional area in the central portion, and dissected volcanic uplands in the south.

Abstract:

Brown Tree Snakes (BTS) have caused serious ecological, economic, and social impacts on the Island of Guam. Accidentally introduced to Guam after World War II, BTS have flourished and become a serious socioeconomic problem. They caused the decline and extinction of birds and lizards, numerous electrical power outages, loss of domestic animals, and human health problems. There is concern that snakes could be transported to other snake-free islands, such as Hawaii, and cause the same destruction. This project, headed by USDA/Wildlife Services/National Wildlife Research Center (NWRC) investigated a number of different chemical control methods for incorporation into an integrated program to control BTS on Guam and prevent their dispersal. Methyl bromide, a fumigant, and acetaminophen, an oral toxicant, have been registered with the EPA for BTS use. Data for two other fumigants, sulfuryl fluoride and magnesium phosphide (phosphine) are being submitted to private companies for potential EPA registration. Three repellents—anise oil, clove oil, and cinnamon oil—have been identified and approved for chasing snakes out of cargo. No effective, practical, alternative to live mice was identified for use in traps; however, dead mice were shown to be effective bait for delivery of a toxicant. Aerial techniques for delivering toxic bait were shown to be effective for managing BTS populations in remote areas on Guam, but more efficient delivery techniques are needed.

Service Branch: Department of Defense

Project Location: Island of Guam

Installation Size: 135,680 acres (54,908 hectares)

Installation Primary Mission: N/A

Project Point of Contact: Dr. Kathleen A. Fagerstone, Research Program Manager • USDA/WS/National Wildlife Research Center • 4101 LaPorte Avenue • Fort Collins, CO 80521-2154 • Phone: (970) 266-6161 Email: Kathleen.A.Fagerstone@aphis.usda.gov

Partners:

Department of Defense Legacy Resource Management Program; U.S. Department of Agriculture/Animal and Plant Health Inspection Service/Wildlife Services, Guam; U.S. Department of the Interior/US Geological Survey; Guam Department of Agriculture; Andersen Air Force Base, Guam; U.S. Naval Forces, Marianas, Guam.

Purpose/Need:

The BTS is an exotic pest species that was accidentally introduced to Guam from its native range in the New Guinea area, probably as a stowaway in cargo after World War II. Having no natural predators on Guam, the BTS population irrupted and expanded across the island. Up to 13,000 snakes per square mile (13,000 per 259 hectares) have been estimated in some forested areas of Guam, which may be the highest snake density anywhere in the world. The snake is a major threat to biodiversity on islands in the Pacific region and other areas at risk, such as the southern United States. BTS have directly caused or been a major factor in the extirpation of most of Guam's native birds, and have caused drastic declines in populations of fruit bats and lizards. They have also damaged agricultural interests (preying on poultry), killed pets, and poisoned, but not killed, numerous children. In addition, snakes crawling on power lines frequently cause power outages that are a significant economic burden to civilian and military activities.

An integrated pest management program has been developed to try to address these issues. An operational program using traps and cargo sniffer dogs at commercial and military cargo shipping facilities deters the dispersal of snakes. However, there also is a need to clear snakes from large tracts of land necessary to sustain the reintroduction of endangered species. This National Wildlife Research Center (NWRC) project investigated a number of different chemical control methods for incorporation into the integrated pest management program to control BTS on Guam and prevent their dispersal.

Approach:

The DoD Legacy Resources Management Program provided funds to the NWRC for the first sustained, systematic research effort to identify and develop BTS chemical control agents and the associated delivery systems. These funds have focused research on fumigants, toxicants, repellents, and attractants for BTS control.

Three commercially available fumigants, methyl bromide, sulfuryl fluoride, and magnesium phosphide, were evaluated in simulated cargo containers using USDA Plant Protection and Quarantine procedures. All three fumigants were effective against the BTS. U.S. EPA registration was obtained for methyl bromide and registration is pending for sulfuryl fluoride and magnesium phosphide. Acetaminophen was found to be an effective oral toxicant in both laboratory and field tests using dead mice as bait. Acetaminophen is also registered with EPA for bait station and aerial applications.

Testing under simulated cargo conditions has shown that three naturally occurring ingredients, cinnamon oil, clove oil, and anise oil are effective snake repellents. Snakes will retreat when sprayed directly with these oils and will exit cargo or other confined spaces when these oils are introduced to the area. Although these oils are exempt from the requirements of EPA registration, their use is authorized by a technical note from USDA/Wildlife Services.

Attractants have been tested under both laboratory and field conditions and the goal is to replace live mice used in traps and dead young mice bait with artificial matrices that are more convenient to use. Several advances in attractant chemistry have been made but a practical product has not been developed. Chemical constituents of dead mouse odor have been identified but are difficult to reconstitute and the *Enterobacter agglomerans* bacterium has been identified as being responsible for producing the decomposition odors from dead mouse skin that is attractive to snakes.

The BTS team is currently concluding field evaluation of operational BTS control with the oral toxicant, acetaminophen, identified during initial laboratory and field screening. The final phase of the BTS project is to identify the role of chemical control agents in an integrated management plan, improve aerial delivery procedures, and develop an artificial bait matrix.

Recommendations/Lessons Learned:

This project received its final year of funding in FY 2003. Methyl bromide, a fumigant, and acetaminophen, an oral toxicant, have been registered with the EPA for BTS use. Data for two other fumigants, sulfuryl fluoride and magnesium phosphide (phosphine) are in the final stages of being submitted to private companies and subsequent EPA registration. Three repellents (anise oil, clove oil and cinnamon oil) have been identified and approved for chasing snakes out of cargo. No effective

practical alternative to live mice was identified for use in traps; however, dead mice were shown to be effective bait for delivery of a toxicant. Aerial baiting techniques for toxic baits will be necessary to manage BTS populations in remote areas on Guam. Research completed in FY02 demonstrated the effectiveness of aerial baiting, but more efficient delivery techniques are needed.

Project Publicity:

Researchers were interviewed about BTS research on Guam by KUAM TV, 20 October, 1998.

The Wall Street Journal published an article entitled: "Guam scientists test unlikely cure for epidemic of brown tree snakes," by Craig Smith, 1 July, 1999.

National Geographic published an article in the Earth Almanac Section entitled: "Common pain reliever-Rx for a biological migraine?" April 2000.

Technical Reports Produced:

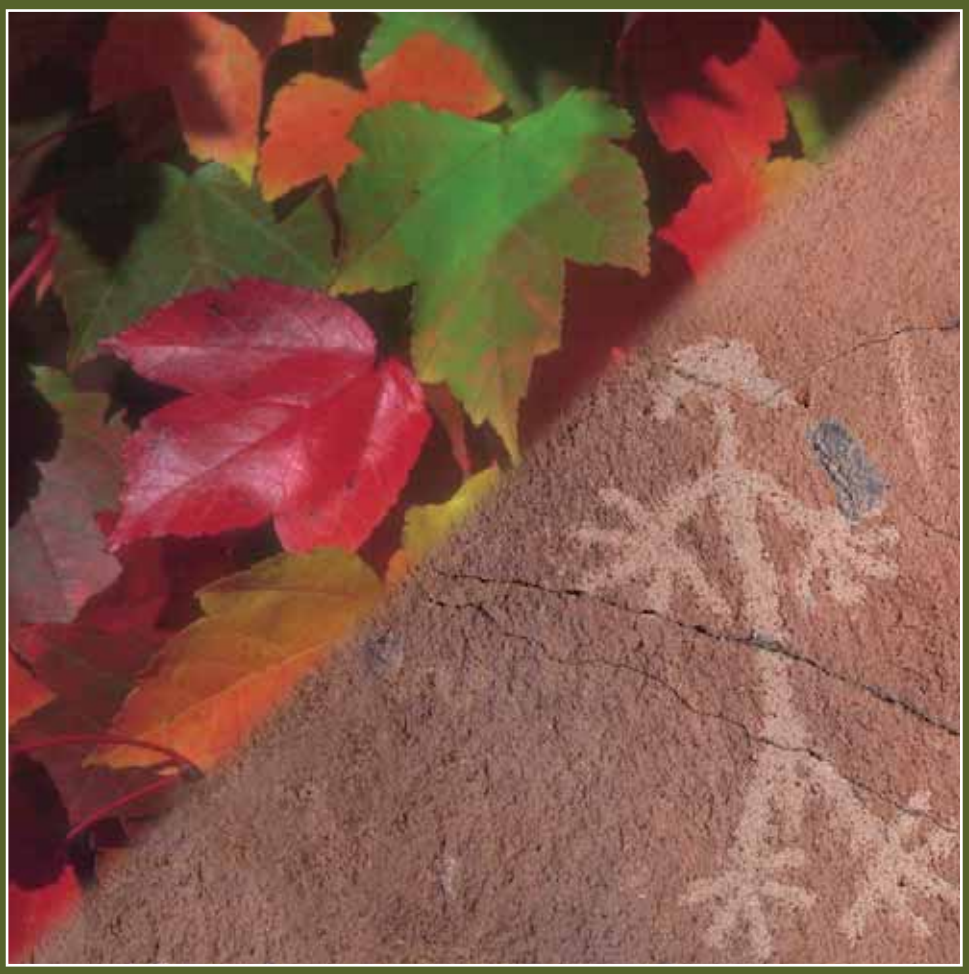
Final project report for the Department of Defense Legacy program.

Savarie, P.J., D.L. York, J.C. Hurley, S. Volz, and J.E. Brooks. 2000. Testing the dermal and oral toxicity of selected chemicals to brown treesnakes. Proceedings of the Vertebrate Pest Conference 19:139-145.

Savarie, P.J., J.A. Shivik, G.C. White, J.C. Hurley, and L. Clark. 2001. Use of acetaminophen for large-scale control of brown treesnakes. Journal of Wildlife Management 65:356-365.

Shivik, J.A., P.J. Savarie, and L. Clark. 2002. Aerial delivery of baits to brown treesnakes. Wildlife Society Bulletin 30(4):1062-1067.

Clark, L., and J.A. Shivik. 2002. Aerosolized essential oils and individual natural product compounds as brown treesnake repellents. Pest Management Science 58:775-783.



D o D

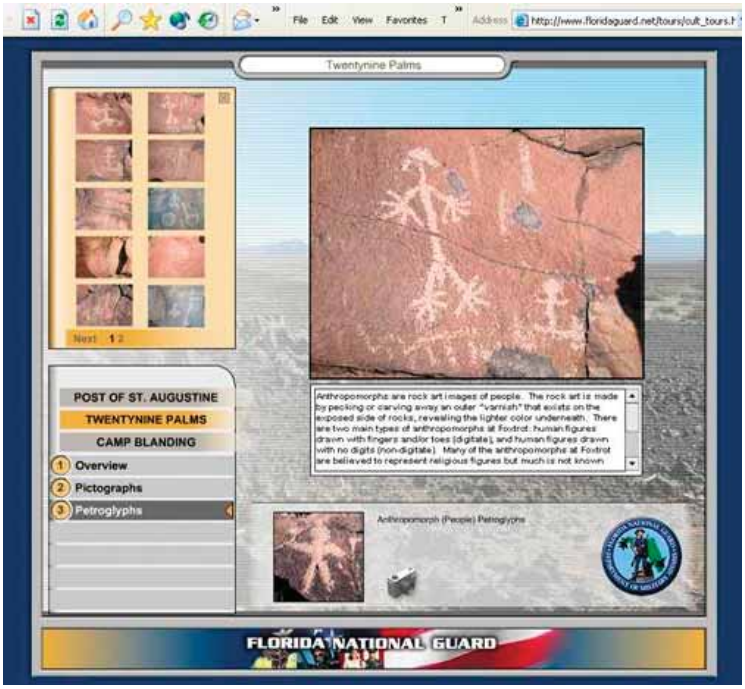
Cultural Resource Conservation Projects

Web-based Virtual Tours Highlight Military Treasures

Description of Geographic Setting:

National Guard Post of St. Augustine—the post lies within the southern limits of the 16th century city of St. Augustine, Florida, facing the Matanzas River. The elevation is approximately ten feet (three meters) above sea level. The area has been developed for and has been in military use for centuries. There are 15 buildings on the compound, including the St. Francis Barracks, which was initially built and occupied in the 16th Century as the Covento de San Francisco.

Camp Blanding Joint Training Center—this is the Florida Army National Guard's primary training site and contains mostly undeveloped land, with a sparsely developed 3,000 acre (1,214 ha) cantonment area. Camp Blanding was densely developed as a primary training depot for American servicemen during World War II. Today, many relics of WWII buildings and roads remain, some of which are spotlighted in the project.



Many examples of historical Native American rock art at Twentynine Palms, California, are shown on the virtual tours.

Service Branch: Department of Defense

Project Location: Post of St. Augustine and Camp Blanding Joint Training Center (Florida National Guard), and Twenty-nine Palms Foxtrot Petroglyphs Site (U.S. Marine Corps).

Installation Size: Post of St. Augustine—5.7 acres (2.3 ha). Camp Blanding Joint Training Center—73,000 acres (29,542 ha). MAGTFT, Twentynine Palms—598,400 acres (242,164 ha)

Installation Primary Mission: Florida National Guard Post of St. Augustine—mission is train Florida soldiers and airmen to maintain readiness to respond to the needs of the President and National Command Authority. The Army Guard has infantry, artillery, air defense artillery, signal units, special forces, aviation assets and support units.

Marine Corps Air Ground Combat Center's—two-fold mission is to operate live fire combined arms training that promotes readiness of operating forces; and to provide facilities, services, and support, responsive to the needs of tenant commands, Marines, Sailors, and their families.

Project Point of Contact: Amelia A. Wiley • NEPA Manager, Environmental • Florida Army National Guard
Camp Blanding Joint Training Center • Route 1, Box 465 • Starke, FL 32091 • Phone: (904) 682-3450
Fax: (904) 682-3157 • Email: amy.wiley@fl.ngb.army.mil

MAJ Mark Widener, Environmental Protection Officer • CFMO-Environmental • Florida Army National Guard
2305 State Road 207 • Robert F. Ensslin, Jr. Armory • St. Augustine, FL 32086-9369 • Phone: (904) 823-0277
Fax: (904) 823-0189.• Email: mark.widener@fl.ngb.army.mil

Twentynine Palms—located in the Mohave Desert in California, Twentynine Palms was established in 1952 during the Korean War. Since then, hundreds of thousands of Marines have prepared for war here in the challenging terrain and desert climate. The post went through several name changes, and in 2000 was redesignated as Marine Air Ground Task Force Training Command, (MAGTFT) Twentynine Palms, California. The Foxtrot Petroglyph Site on the base is well known, and cultural resources awareness has often been focused on this important Native American Rock Art site. Efforts to protect the site from vandalism and graffiti were initiated in 1995 and are ongoing.

Abstract:

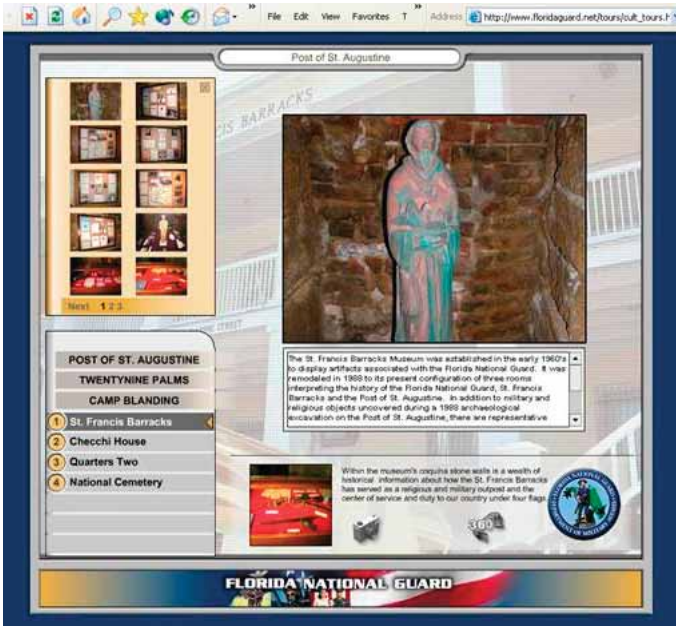
The Florida Army National Guard (FLARNG) has developed web-based virtual tours that highlight rich and diverse treasures on Department of Defense (DoD) installations. The virtual tours can be found on the Web at: www.floridaguard.net/history/read.asp?did=2590. The tours demonstrate heritage tourism through the history, landscape, and culture of three diverse military sites. The web pages, which are currently part of the FLARNG website on the Heritage Center page, will be integrated into DoD's DENIX website. The pages are fun to navigate and are filled with discussions, both in audio and print, about the cultural heritage of FLARNG and Twentynine Palms. The site is fully compliant with Americans With Disabilities ACT (ADA) standards. In addition to the heritage tourism component, the web site also contains Camp Blanding natural resources virtual tours. These tours contain photographs and videos, and highlight some of Camp Blanding's natural resource activities, including a prescribed burn, a red cockaded woodpecker relocation, and a visit to Kingsley Scrub (northernmost population of Florida scrub jays). This portion of the project was paid for by environmental awareness funds.

Partners:

DoD Legacy Resources Management Program; Marine Air Ground Task Force Training Command, (U.S. Marine Corps); Florida National Guard; Jardon and Howard Technologies, Inc. (contracted to produce website, performed photography, technical and production work).

Purpose/Need:

Heritage tourism is an integral component of Executive Order 13287 on preserving America. Military heritage is strongly linked with cultural and historical assets within all branches of the armed forces.



The virtual tour provides excellent views of significant cultural features such as the centuries-old St. Francis Barracks at the Post of St. Augustine.

The primary goals of this project were to demonstrate the diversity of cultural resources found on American military installations, to demonstrate the importance of these resources, and to promote pride in our country's history. A secondary goal was to demonstrate the diversity of both cultural and natural resources at Camp Blanding. The project identified unique history and landscape and cultural resources of three diverse military sites:

- The Florida National Guard's Post of St. Augustine, including the St. Francis Barracks;
- The Florida National Guard's Camp Blanding Joint Training Center; and
- The U.S. Marine Corps' Twentynine Palms Foxtrot Petroglyphs Site.

By providing information on diverse resources—from centuries-old historic buildings to Native American rock art to bottle-lined pathways created by German Prisoners of War—this project provides valuable information to the interested public.

Approach:

The three installations were contacted for input on appropriate topics and cultural resources to highlight. Jardon and Howard Technologies, Inc. was contracted to produce the website, photograph the sites, and complete the technical and production work. This included ensuring that the sites were ADA compliant.

A point of contact was established for each installation involved in the project. Jardon and Howard Technologies

(JHT) coordinated directly with each installation to schedule video and photo shoots, as well as gather any additional media for the website. Additionally, the main point of contact at Camp Blanding was kept informed at all times.

Once a content outline was developed for the website, a shooting schedule was created for the gathering of the necessary media. The schedule was aggressive, having the Jardon and Howard Technologies (JHT) team at an installation shooting for a week, then back in their offices doing production for a week, then back out at a different installation for week, and so forth until all the media was gathered. Video and still photography was gathered using both digital and traditional methods. The 360 degree images were gathered using a digital camera with a special "fish-eye" lens, allowing the photographer to take one photograph in one direction, rotate the camera 180 degrees and take a second photograph. Later, the two photographs were digitally "stitched" together to create the continuous 360 degree view. Concurrently to gathering the media, the graphical interface was developed from aerial or basic line drawings provided by each installation.

Beulah Cemetery, located on Old Cemetery Road east of the CBJTC cantonment area, is one of six cemeteries on Camp Blanding. This culturally significant cemetery is highlighted on the web tour.

Once the media was gathered and the graphical interface approved by the FLARNG & Marine Corps installations, the pieces of the website began coming together. JHT added music and voiceover narration to the video footage, and touched up the photographs as necessary to best highlight the natural and cultural resources. The actual website was programmed using Macromedia Flash MX. An identical text-only site was created to comply with ADA guidelines.

JHT posted the completed draft website on their development server, allowing the installations involved in the effort to review the website and make any recommendations for changes before the website went live.

The virtual tour contains image maps of each site, such as this map of Camp Blanding. With these maps, visitors can see their areas of interest highlighted within the overall context of the installation.

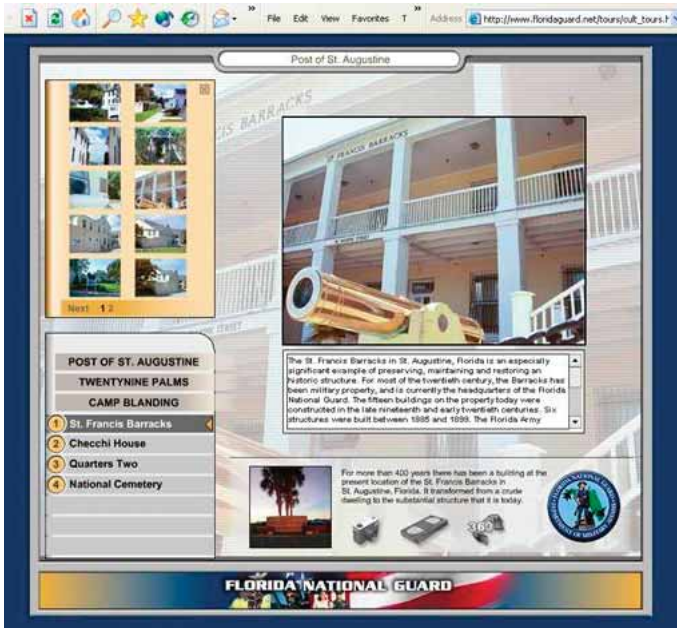
The purpose and need were met by creating web pages with 360-degree virtual tours, videos, and still photos of a variety of cultural resources on the three study sites, as well as natural resources on Camp Blanding. Image maps were created for website visitors to navigate around each installation. Visual images were supported with audio and written text. Some of the topics that clearly demonstrate diverse and unique cultural and natural resources include:

- The museum in the St. Francis Barracks at the Post of St. Augustine.
- The National Cemetery at the Post of St. Augustine.
- The Parade Field at the Post of St. Augustine.
- The National Register-eligible Historic District on Camp Blanding.
- An archeological survey being conducted at Camp Blanding.
- A WWII POW camp and bottle path at Camp Blanding.
- A prescribed burn at Camp Blanding.
- Red cockaded woodpeckers being relocated to and released at Camp Blanding.
- Various scenes of Native American Rock Art at Twentynine Palms.

The result is a colorful and fun web product on the FLARNG website, which will be linked to/from the DoD DENIX website that invites the public to take a tour of diverse and rich places and activities through space and time without leaving their computer. The site can be visited at: www.floridaguard.net/history/read.asp?did=2590

The web pages, which are currently part of the FLARNG website on the Heritage Center page, will be integrated into the DoD DENIX website. The pages are fun to navigate and are filled with discussions, both in audio and print, about the cultural heritage of FLARNG and Twentynine Palms. The site is fully compliant with ADA standards.

In addition to the heritage tourism component, the site also contains Camp Blanding natural resources virtual tours. These products are also 360-degree tours, photographs and videos, and highlight some of Camp Blanding's natural resource activities, including a prescribed burn, a red cockaded woodpecker relocation and a visit to Kingsley Scrub, with the northernmost population of Florida scrub jays. This portion of the project was paid for by environmental awareness funds.



The virtual tour provides excellent views of significant cultural features such as the centuries-old St. Francis Barracks at the Post of St. Augustine.

Recommendations/Lessons Learned:

Following are some guidelines for making a project similar to this a success:

1. It is critical to find a good contractor with experience in creating web-based videos, virtual tours, and websites. Potential contractors should have products available on-line, so you can assess their creativity, technical skill, and ease of use of their formats. Choose a contractor that has created a product similar to what you envision.

2. Gather an internal team of subject matter experts. Brainstorm with them about possibilities for tours and videos. Make sure your web manager is also part of the team. He or she knows the protocols and techniques for managing your installation's website and also may have some creative ideas.

3. Make an outline of the places/activities you wish to depict and think about how they might best be displayed on the Internet. Actions and activities are best shown in video; while interesting, unique, or beautiful places (indoors or outdoors) are best shown in 360-degree and still photographs.

4. Spend a lot of time and effort writing good text. You and the subject matter experts at your installation know more than anyone about the history and diversity of the place and its unique cultural and natural resources. It's very effective (and makes for a unique video) if the subject matter experts are willing to go on video and explain the importance of the site.

5. Be flexible. Be ready to deviate from your outline. For example, cultural resource surveys were not originally part of the plan, but it just so happened that one was being conducted on Camp Blanding, so a video was created and became an interesting part of the project.

Project Publicity:

The virtual tour will be linked to the DoD DENIX website, so that it will receive DoD visitors. A news release will be distributed through FLARNG's public affairs office after a link to the site is established on DENIX.

Technical Reports Produced:

The introductory page to the website (www.floridaguard.net/history/read.asp?did=2590) contains a summary of the project. There is also a lot of informative text on the individual web pages.

The Built Environment of Cold War Era Servicewomen

Description of Geographic Setting:

Any military installation.

Abstract:

The history of servicewomen in the U.S. military has been well documented, but little attention has been paid to the physical accommodation of women in the military, despite the significant impacts it has had on our country's military installations' spatial organization and design. These physical accommodations are potentially eligible as historic properties and cultural resources. At the present time, no historic contexts or guidelines exist for identifying or evaluating the eligibility of properties associated with Cold War era servicewomen. This study fills this gap in knowledge and facilitates compliance with the National Historic Preservation Act of 1966 (as amended) (NHPA). In the second year of the project, researchers will develop and field test the guidelines on specific installations to identify and evaluate historic properties associated with Cold War era servicewomen.

Fort McClellan, WAC Center Beauty Shop, 1954 (US Army Women's Museum, File: UA WAC School-Facilities/Buildings/Grounds VI-A-17).

Partners:

Department of Defense Legacy Resource Management Program; U.S. Army Women's Museum, Ft. Lee; Air Force Historical Research Agency, Maxwell AFB; U.S. Army Corps of Engineers Office of History, Alexandria, VA; Naval Historical Foundation, Washington, DC; Marine Corps Historical Center, Washington, DC; and the Women in Military Service for America Memorial Foundation, Inc., Arlington, VA.

Service Branch: Department of Defense

Project Location: All active duty military installations on which servicewomen have been stationed or trained.

Installation Size: N/A

Installation Primary Mission: N/A

Project Point of Contact: Susan I. Enscore, Ph.D. • Dawn A. Morrison, Ph.D. • ERDC-CERL • Champaign, IL 61822
Phone: (217) 352-6511 • Email: Susan.I.Enscore@erdc.usace.army.mil • Dawn.A.Morrison@erdc.usace.army.mil

Purpose/Need:

The history of servicewomen in the U.S. military has been well documented in several notable sources; however, little attention has been paid to the physical accommodation of women in the military, despite the fact that physically accommodating servicewomen has significantly impacted the built environment of our country's military installations. These physical accommodations are potentially eligible as historic properties and cultural resources, in that they are reflective of women in American society and the American military during the Cold War era. Sections 106 and 110 of the National Historic Preservation Act of 1966 (as amended) (NHPA) require, respectively, federal agencies to take into account the effects of their undertakings on historic properties and to develop and implement plans for the identification, management, and nomination of cultural resources. Currently, no historic contexts or guidelines exist to identify or evaluate the eligibility of properties associated with Cold War era servicewomen.

Approach:

The service-wide historic context was largely based upon archival research. An historic context is a written history focusing on shared themes (such as the built environment or civil war battlefields). It presents information from various primary and secondary sources to detail the subject's development over time. Researchers began by compiling a literature review of sources dealing with the history and experiences of women serving in the military throughout the Cold War. They then examined and analyzed historic photographs, plan maps, drawings, and other associated primary documents, as well as selected oral histories. They further produced an historic continuum of gender-based regulations and construction mandates.

Researchers used all of these resources to create an historic context, which they will rely upon in the second year of the project to devise guidelines for identifying and evaluating historic properties and cultural resources. The guidelines are suggestions for how to implement the historic context when evaluating properties related to servicewomen to determine significance. Guidelines will be field tested in the second year of the project, and the methodology for this testing is currently being developed.

Recommendations/Lessons Learned:

Initially, physically accommodating women in the military followed two overriding design themes: privacy and protection. This necessitated new design plans for new construction as well as for retrofitting and converting existing barracks, support facilities, work and training areas, and leisure spaces. Regulations were enacted that significantly altered the built environment of military installations, from the spatial organization of structures and facilities (e.g., requiring at least 150 feet between female and male barracks, incorporating beauty parlors into company groupings, providing garden spaces, and designing reception or "date" rooms for female leisure), to the structural design of buildings (e.g., stairs instead of ladders for fire escapes, closed corridors between buildings and latrines, privacy partitions within latrines, increased square footage per individual, amenities such as electrical outlets, wardrobes, bathtubs, ironing boards, and cooking facilities in female living spaces), to the interior design of buildings (e.g., paint for interior walls, partitions between sleeping areas, frosted glass for windows/doors, Venetian blinds for windows instead of no treatment or curtains, allowing rugs, bedspreads, and personal items).

Fort Des Moines, Barracks Row, World War II. (Women in Military Service for America Memorial Foundation, Vertical Photo File, Collection of Kris Morrison).

Over the course of the Cold War, gender-based regulations continuously evolved, mandating different requirements for the accommodation of female personnel. As regulations were modified to reflect the changing role of women in the military, they eventually evolved into one standard for both men and women in terms of physical accommodations for housing, training, working, and leisure (although many of these activities were still segregated). For example, the motel-type or dormitory style barracks design first instituted service-wide in the 1970s evolved from design plans originally crafted for accommodating servicewomen during the

late 1940s and 1950s. By the end of the Cold War, the physical imprint of women could be seen throughout America's military installations. In fact, many unique elements originally designed to accommodate women are still evident in our country's military landscape even though the buildings or infrastructure they were built into no longer serve their original purpose (e.g., coed barracks buildings that were originally designed as female barracks).

The project could be easily expanded to cover U.S. Coast Guard servicewomen. Additionally, similar studies focusing on OCONUS facilities, ships and maritime vessels, and the military service academies could be conducted using the same methodological framework established in the current study.

In the second year of the project, research will focus on specific installations for purposes of developing and field-testing the guidelines for identifying and evaluating historic properties associated with Cold War era servicewomen. Installations will be selected on the basis of a combination of existing facilities, historical documentation on those facilities, and ability of the property to reflect standards, values, etc. for their service as a whole. The intent is to select two installations per service—one for recruit training and one for assignment duty. (Initial findings indicate that physical accommodations at recruit training stations vary significantly from those provided at assignment duty stations, therefore necessitating separate guidelines.)

Project Publicity:

Currently, plans are being made to present a program on the project in conjunction with Women's History Month activities in March 2005. The presentation will be made at the U.S. Army Engineer Research and Development Center (ERDC), Construction Engineering Research Laboratory in Champaign, IL, and to the ERDC Cold Regions Research and Engineering Laboratory in Hanover, NH. This project will be the subject of a paper (and published in the Proceedings) at the Conference of Army Historians in July 2004. A poster on the project will be presented at the Department of Defense Conservation Conference in August 2004.

Technical Reports Produced:

None.

Guidelines for Documenting and Evaluating Historic Military Installation Districts

Description of Geographic Setting:

As part of this project, the guidelines set forth in this National Register bulletin are being demonstrated at a Navy and a National Guard site: Washington Navy Yard (WNY) and Camp Edwards. The WNY is an urban, waterfront location on the Anacostia River in Washington, DC. In more than two centuries of existence, WNY has experienced physical growth and significant changes in mission. Established as a storage and shipbuilding facility in the middle of the nineteenth century, WNY became a heavy industrial plant in the early twentieth century. More recently, much of it has been diverted to non-Navy uses and it has emerged as a major administrative center with considerable historical presence. Many of the installation's old industrial buildings have been modified for new purposes or replaced by more modern structures.

The Washington Navy Yard during the 1936 Potomac River flood.

Camp Edwards is part of the Massachusetts Military Reservation (MMR). It is a coastal and partially forested military training facility located on the upper western portion of Cape Cod, in Barnstable County, Massachusetts. It includes parts of several local towns, and covers about 22,000 acres (8,900 hectares). The MMR is located over an aquifer that provides drinking water for 200,000 year-round and 500,000 seasonal residents of Cape Cod. Historically, the National Guard's Camp Edwards comprised the entirety of the MMR; in its current incarnation, Camp Edwards includes approximately 578 acres (234 hectares) within the 5,500 acre cantonment/industrial area in the southern part of the reservation. The 5,500 acre (2,225 hectares) industrial area in the southern part of the reservation is where the U.S. Coast

Service Branch: Deparment of Defense

Project Location: Washington Navy Yard, Washington D.C. (Navy) and Camp Edwards, Massachusetts (National Guard).

Installation Size: Washington Navy Yard—66 acres (26.7 ha), Camp Edwards (part of the Massachusetts Military Reservation) 15,000 acres (6,070 ha).

Installation Primary Mission: Washington Navy Yard—administration and housing for U.S. Naval officers.

Massachusetts Army National Guard Training Site at Camp Edwards—provides premier regional training center serving the needs of the military and public safety responders, while continuing as environmental stewards and community partners.

Project Point of Contact: Suzanne Keith Loechl • Land and Heritage Conservation Branch •ERDC/CERL PO Box 9005 • Champaign, Illinois 61826-9005 • Phone: (800) USACERL, ext. 7397 • Email: s-loechl@cecer.army.mil

Susan Enscore • Land and Heritage Conservation Branch • ERDC/CERL • PO Box 9005 Champaign, Illinois 61826-9005• Phone: (800) USACERL, ext. 7306 • Email: s-enscore@cecer.army.mil

Guard, Army National Guard, and Otis Air National Guard Base operate aircraft runways, maintenance areas, housing, and support facilities. The other users of the MMR include the Air National Guard (Otis Air National Guard Base) in the cantonment/industrial area, two U.S. Coast Guard installations, one in the cantonment/industrial area and one in the northern training area, the U.S. Air Force 6th Space Warning Squadron, and a 750 acre (300 hectares) Veterans Administration Cemetery. Collectively, these agencies use the cantonment/industrial area to operate aircraft runways, maintenance areas, housing, and support facilities. The northern 14,700 acre (5,950 hectares) training area known as Camp Edwards is used primarily by the Army National Guard, and it contains the 2,200 acre (890 hectares) impact area and, associated military training ranges and maneuver/bivouac areas.

Abstract:

The United States military has made its mark on the U.S. landscape in a variety of ways, including battle-fields, airfields, frontier trails, and military installations. Although many installations are self-contained communities, their impact extends well beyond their boundaries. They influenced nearby towns and urban centers both economically and socially. Currently, the Department of Defense (DoD) has no consistent method for evaluating and documenting the significance of historic military installation districts. This Legacy project will result in the publication of a National Register Bulletin for documenting and evaluating historic military installation districts. The existing National Register Bulletins, while useful, do not adequately address the unique military installation landscape. The DoD will benefit greatly from these guidelines that address the unique characteristics of military installation districts and provide a method for evaluating, documenting, and making decisions about National Register eligibility. The bulletin will encompass information about military installation planning in the cantonment areas and its relationship to town planning. It will also include information on the WorldWide Web, security and force protection, archival record groups, previous military studies, and bibliographic information. The bulletin will also provide the needed necessary framework for the DoD to continue to study and document military installation development, which will be useful for future theme and context studies and will demonstrate the military's investment in its heritage.

Washington Navy Yard, D.C. 18 December 1918

Partners:

Department of Defense Legacy Resource Management Program; National Register of Historic Places.

Purpose/Need:

There are over 14,000 historic properties in the DoD that are listed on or eligible for the National Register of Historic Places. With 36 million acres (14.5 million hectares) to manage, the DoD has no consistent method for evaluating and documenting historic military installation districts. The existing National Register bulletins, while useful, do not adequately address the military installation landscape. Military installations developed in distinctive ways; they are remarkably consistent on one end of the spectrum and strangely anomalous on the other end. The common thread is their association with a military mission. Some were influenced by national trends in town planning and landscape architecture; other military planning efforts influenced planning principles of the day. Through the Integrated Cultural Resource Management Plan (ICRMP) process, historic properties on military installations are assessed and reviewed every five years to determine eligibility for the National Register. The DoD needs a process that addresses the unique characteristics of military installation districts and provides a method for evaluating, documenting, and making decisions about eligibility that is consistent with the Secretary of Interior's standards. As a follow-up to the bulletin, theme and context studies can help examine trends in military installation development and planning.

The use of the multiple property nomination, typically prepared for an area describing the important historical developments and themes (Historic Contexts) for that

community, is of particular value when addressing military installations, as many building types are repetitive in both design and function. This is true both within an installation and across installations. Knowledge of similar resources would help better understand the national and local significance of historic resources. Additionally, the military is a strong user and proponent of GIS and satellite imagery. A discussion concerning the availability and uses of these data to researchers will be part of this bulletin. The bulletin will also provide an abbreviated chronology on the history of military installation development, as well as an extensive bibliography.

The guidelines developed for the National Register bulletin are being applied at two DoD installations. The Navy and National Guard are facing significant challenges with regard to their historic landscapes. Waterfront planning and urban design issues at WNY are at the forefront in the Navy. Many complex issues connected with the significance of existing landscape, hardscape, and monumental features have arisen because the landscape architects lack an appropriate historic context or guidance for understanding the military landscape. The impetus for waterfront improvements is strong around the country and many other naval installations could benefit from these examples.

Camp Edwards, MA is one of only a few moderately sized training facilities in the United States, and one that has served as a training facility since WWII with little interruption in function. Camp Edwards represents a potentially significant historic military installation district. Progressive encroachment and alteration of land use at Camp Edwards are gradually impacting the integral features, making the need for documentation and assessment more critical with each passing year. A Camp Edwards historic district evaluation will also serve as a model for other National Guard and Army installations.

Approach:

The U.S. Army Corps of Engineers Construction Engineering Research Laboratory (CERL) is working directly with the National Register of Historic Places and the services to create a bulletin that is consistent with existing National Register bulletins and satisfies DoD and service needs. A draft of the bulletin will be reviewed by the National Register and their reviewers as well as DoD and service representatives. Once the first edits are reviewed and incorporated into the bulletin the final draft will be sent out for a final review. Images will be incorporated and the final bulletin will be published in the same format as existing National Register bulletins.

Recommendations/Lessons Learned:

The availability of a broad guidance document for evaluating eligibility of military installation districts will eliminate the multiplicity of approaches applied to this task in the past. Conducting evaluations in a consistent manner provides the opportunity to assess eligibility systematically. In turn, this provides determinations that are based on solid research and can be used by other installations to compare historical properties on a larger scale. In the end, higher quality eligibility determinations are produced at a reduced cost in both time and funding.

Project Publicity:

No publicity was sought for this project.

Technical Reports Produced:

The CERL is in the process of editing the technical note draft based on the National Register of Historic Places and service recommendations.

Antiterrorism Measures for Historic Properties

Description of Geographic Setting:

This project covers the full variety of topography, vegetation, and climate to be found at Department of Defense (DoD) installations in the continental United States and overseas.

Historic-type iron perimeter gate becomes dangerous blast debris if not securely cabled to properly anchored fence. State Department blast test video furnished by the Protective Design Center.

Abstract:

As military installations implement measures to protect critical infrastructure against terrorism, they are finding that historic properties pose special problems. Installations must meet specific DoD minimum antiterrorism standards, and this often requires substantial alterations to historic properties. It is important that, wherever feasible, the DoD standards be met using methods and materials that do not degrade the qualities that make these properties historically significant. The Engineer Research and Development Center—Construction Engineering Research Laboratory (ERDC-CERL) was tasked to study this problem and provide solid, economically viable recommendations on how to resolve the competing demands of antiterrorism standards and cultural stewardship. The project is currently underway so final results are not yet available. Because the work impacts installation security operations and procedures, some technical data produced in this study may be subject to distribution restrictions imposed by DoD regulations.

Partners:

Department of Defense Legacy Resource Management Program; the following organizations are providing invaluable technical assistance during the course of the research: U.S. Army Engineer District, Omaha—Protective Design Center, Omaha, NE; U.S. Army Engineer District, Seattle—Center of Expertise for the Preservation of Historic Buildings and Structures, Seattle, WA; U.S. Army Corps of Engineers, Engineer Research and Development Center, Geotechnical and Structures Laboratory, Survivability and Protective Structures Research Domain, Vicksburg, MS; Air Force Research Laboratory, Materials and Manufacturing Directorate, Airbase Technologies Division, Force Protection Branch, Tyndall AFB, FL.

Service Branch: Deparment of Defense

Project Location: The study is applicable to all DoD installations.

Installation Size: All DoD installations and bases are covered.

Installation Primary Mission: The study is applicable to all DoD missions.

Project Point of Contact: Julie L Webster, RA • US Army Corps of Engineers • Engineering Research & Development Center-Construction Engineering Research Laboratory (ERDC-CERL)
PO Box 9005 • Champaign, IL 61826-9005 • Phone: (217) 373-6717 • Fax (217) 373-7222
Email: Julie.L.Webster@erdc.usace.army.mil

Purpose/Need:

Attacks on civilians, military personnel, and infrastructure over the past decade have made it necessary to develop new processes and methods to secure U.S. assets against terrorists. As installation personnel implement these new antiterrorism measures, they are finding that historic properties may present special challenges. To ensure these assets remain in compliance with the National Historic Preservation Act and associated mandates, it is important that, wherever feasible, DoD antiterrorism standards be met using methods and materials that do not degrade the qualities that make these properties historically significant. The Engineer Research and Development Center-Construction Engineering Research Laboratory (ERDC-CERL) was tasked to study this problem and provide solid, economically viable recommendations on how to resolve the competing demands of antiterrorism standards and cultural stewardship. The guidance produced by this research will conform to Unified Facilities Criteria (UFC) 4-010-01, DoD Minimum Antiterrorism Standards for Buildings (also referred to here as the AT standards), and it will explicitly support agency compliance with the National Historic Preservation Act (NHPA)—especially with applicable portions of the Secretary of the Interior's (SOI) Standards for the Treatment of Historic Properties.

Approach:

The DoD was initially canvassed for referrals to staff or individuals with expertise or experience concurrently addressing antiterrorism requirements and NHPA compliance. The intent was to study specific examples of conflicts that surfaced at the execution level. Of even greater interest were successes reported from the field. Because post-9/11 updates to the AT Standards were not approved until September 2002, experience with implementing them on historic properties thus far is limited. To broaden the knowledge base beyond DoD, project team members engaged other government stakeholders such as the National Park Service (NPS), General Services Administration (GSA), and State Historic Preservation Offices (SHPO).

While some Antiterrorism/Historic Preservation (AT/HP) information is mutually beneficial to state and federal agencies, inherent differences in resource type, location, utilization, and occupancy make some comparisons difficult. For instance, most DoD historic properties are located within the controlled perimeter of a military installation, whereas many GSA properties are sited in open urban and suburban areas. Additionally, DoD historic properties may be mission-critical for national defense purposes while NPS properties are not likely to have any national defense role. These differences in mission and operations result in differing philosophies and approaches to the problem of protecting properties against terrorism. The differences do not, however, prevent agencies from sharing practical information on the selection and implementation of specific historic property retrofits. When addressing "historic brass tacks," everyone has a common goal. But at the same time, preservation personnel need to understand the imperatives of the AT standards and work collaboratively with AT experts to find solutions acceptable to all stakeholders.

The project is currently underway, so final results are not yet available. The objective of the project is to develop guidance that will conform to UFC 4-010-01, DoD Minimum Antiterrorism Standards for Buildings while supporting agency compliance with the NHPA and SOI Standards for the Treatment of Historic Properties. The guiding principles for these methods will be good life-safety design and life-cycle cost-effectiveness, and as such, the methods also should be highly applicable to any antiterrorism property upgrade that requires attention to public image.

Recommendations/Lessons Learned:

Cultural Resource Management (CRM) staff should:

- Become familiar with the DoD minimum AT standards so they understand when they apply and to what extent. The standards are revised continually when substantive improvements are made, so keep current; the next update is expected this fall.
- Be aware of current and upcoming functional assignments to historic properties. How a building is used and occupied dictates its required level of protection under the AT standards. Strategic master planning and astute real property utilization may significantly reduce AT and HP compliance conflicts.
- Not assume that rehabilitation of historic properties to meet the AT standards will be more costly than replacing them. A valid cost analysis must consider the substantial indirect or hidden life-cycle costs of new construction (disposal of demolition rubble, lead and asbestos abatement, integration into utility networks, mission disruption, etc.).

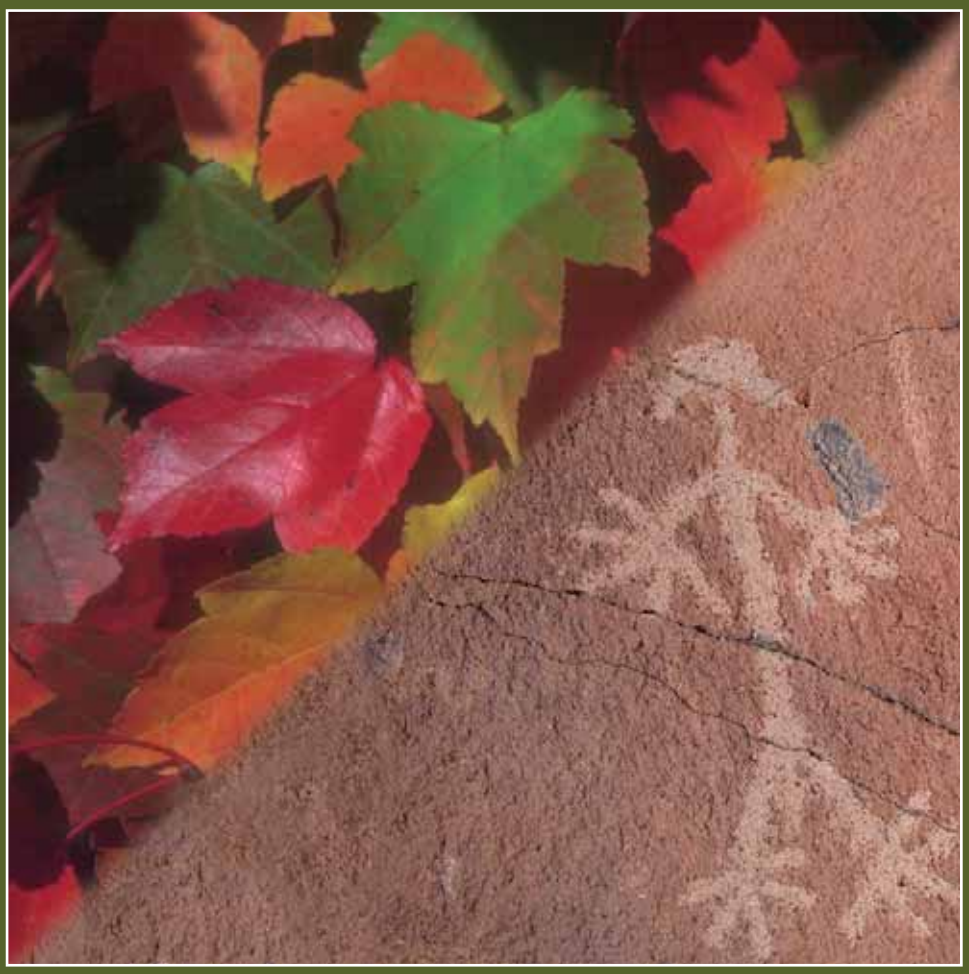
- Be proactive and seek collaboration with AT personnel on any retrofit necessary to bring historic properties into compliance with the AT standards.
- During retrofits, focus on the desired end state. The AT standards include flexibility in terms of implementation, providing multiple alternatives for achieving the required level of protection. For example, manned access control points may be favored over engineered vehicle barriers.
- Stay informed on new antiterrorism technologies being developed and tested. DoD will soon begin making test results available at www.sewg.dtic.mil. The site should include information on any new AT retrofit products that have been certified to meet DoD performance standards.
- Understand that most AT/HP design solutions are excellent life-safety features for any existing building.

Project Publicity:

Because the work impacts installation security operations and procedures, some technical data produced in this study may be subject to distribution restrictions imposed by DoD regulations.

Technical Reports Produced:

The project is currently underway, so the final technical report is still about a year away.



DEFENSE LOGISTICS AGENCY

Natural Resource Conservation Projects

Evaluating and Enhancing the Performance of Reefs Constructed from Military Armored Vehicles

Description of Geographic Setting:

This project reviewed 60 constructed reef sites along the coasts of the Atlantic Ocean and the Gulf of Mexico, from New York through Louisiana. Most of the fieldwork was completed off the coasts of Florida, Georgia, and South Carolina. The majority of the reefs were located in shallow water coastal sites, although some were over 90 feet deep. These sites included sand covered hard bottom, sand, and silt-sand substrates.

Abstract:

Constructed reefs have been used for hundreds of years to improve local fishing and diving opportunities. A wide variety of reef construction materials have been used; however, the performance of these reefs is highly variable depending on the materials and sites selected. Since 1994, more than 1,200 military armored vehicles (MAVs) were placed at over 60 reef sites along the Atlantic and Gulf of Mexico coasts, extending from New York to Louisiana. MAV reef performance was evaluated by visual fish censusing and stakeholder surveys. The three types of experimental sites included bare unenhanced bottom (Bare), MAV reefs, and MAV reefs enhanced with Fish Attraction Devices (MAVFAD). MAV reefs dramatically increased target bottom fish abundance compared to nearby unenhanced seabed. Compared to other materials, MAVs generally had significantly greater numbers of key target species, especially snapper and grouper, but these differences were highly variable and depended on the reef materials as well as differential fishing pressure. MAV reefs provided effective habitat for many target recreational species including snapper, grouper, sea bass, hogfish, and sheepshead. Most managers found MAV reefs to be effective and stable, and most would like to receive more MAVs under the same type of DoD subsidized program. MAV reefs were generally very popular with fishers and divers.

Partners:

Department of Defense Legacy Resource Management Program; Aquabio, Inc.; state, county, and local groups supported part of the work, including preparation and placement of military armored vehicles; special help with monitoring was provided by Pinellas, Hernando, Pasco, Sarasota, and Bay counties in Florida; and state programs in Georgia, South Carolina, and Delaware. The College of Marine Science, University of South Florida, also provided special assistance.

Service Branch: Defense Logistics Agency

Project Location: Reef sites extended from New York to Louisiana. The bulk of fieldwork was off the coasts of Florida, Georgia, and South Carolina.

Installation Size: N/A

Installation Primary Mission: N/A

Project Point of Contact: Dr. Daniel J. Sheehy Aquabio • 350 Massachusetts Avenue, #142 • Arlington, MA 02476
Phone: (781) 646-3190 • Email: dsheehy@aquabio.com

Fish aren't the only life forms that use armor vehicle reefs. The main barrel of a tank provides excellent habitat for the epibenthic community.

Purpose/Need:

During the last ten years, constructed reefs have increasingly been used for habitat mitigation and restoration as well as natural resource conservation. Reefs have been used to compensate for adverse impacts of proposed coastal development, restore habitats damaged because of physical injury or the release of pollutants, or to reduce pressure on natural reefs and create refuges to help conserve fish or shellfish stocks. These applications may prove useful for DoD activities that have either historic or ongoing coastal impacts. For many mitigation, restoration, or conservation projects, prefabricated units designed specifically for marine enhancement have been introduced. Due to inherent design flexibility, this technology can provide greater stability and effectiveness per unit bottom area than most scrap material reefs. However, properly selected, prepared, and configured obsolete DoD materials, such as Military Armored Vehicles or ships, may also be appropriate for these purposes depending on the sites, target species or life stages, and life-cycle cost.

Mitigation—Constructed reefs have been used to mitigate impacts associated with power plant outfalls, port and harbor development, airport construction, highway construction, etc. In some cases, these reefs have been specified as mitigation under the National Environmental Policy Act (NEPA). This mitigation technology may have application in areas where DoD training, operations, ranges, or other activities have unavoidable impacts on coastal natural resources or associated recreational fishing/diving activities. They may also be used as part of mitigation banking programs.

Restoration—Constructed reefs are also being used for restoring habitat damaged due to past physical impacts and chemical or oil contamination. Recently, as part of Natural Resource Damage Assessment (NRDA) projects, prefabricated reef modules have been used to structurally restore coral reefs injured due to vessel grounding and have been proposed as part of the restoration for NRDA injuries due to contaminated sediments in California and Massachusetts. They have also been proposed for other grounding sites or sites where contaminated bottom sediment impacts the food webs for fish, birds, and marine mammals. As the pace of military littoral operations and training increases, unavoidable vessel grounding and petroleum releases may be more frequent. Constructed reefs are potential tools for restoring injured natural resources.

Conservation—Constructed reefs can help take the user pressure off natural reefs and thus aid in their conservation. When constructed reefs are integrated with the creation of special management areas that restrict fish take or certain types of gear, they can also assist in the recovery of over fished stocks or threatened or endangered species. At least two of the fish species encountered in this study are considered "at risk" by the American Fisheries Society. The use of special management areas or harvest refuges for conservation management may be especially important to the snapper-grouper reef fish complex identified as target species throughout much of the south Atlantic and Gulf of Mexico coasts. Existing military restricted zones, which are de facto special management areas, may provide some unique opportunities for this type of integrated conservation management. Reef-enhanced restricted or special management areas may provide collateral long-term benefits to fish populations and off-site fisheries that far outweigh direct adverse impacts.

Dr. Dan Sheehy inspecting an M-60 tank turret shortly after placement in the Gulf of Mexico.

Approach:

MAV reef performance was evaluated by: 1) visual census of fish occupying reef and reference areas, 2) visual assessment and Multibeam survey of reef

Retired Navy ships such as this old aircraft carrier can be sunk in favorable locations to become constructed reefs. Imagine the amount of physical habitat an entire ship will provide!

structural conditions, 3) survey of state, county, and city reef program managers and researchers, and 4) interviews (mail, in-person, or telephone) with selected end users identified through fishing and diving points of contact. These four approaches were designed to assess biological performance, fishery management utility, potential failure modes, and general user responses.

Based on initial surveys, Fish Attraction Devices (FADs) were added to some existing MAVs to determine their potential value in improving fish abundance and forage. The FADs tested were temporary and inexpensive structures used in an attempt to increase the abundance of mid-water fish. MAV units with the FAD enhancements were monitored along with unenhanced units at each test site to evaluate whether or not the enhancements significantly altered fish abundance and/or species composition.

To augment direct field observations, reef program managers and end users were surveyed to obtain their opinions and observations. Managers from all states and all but one Florida county (Dade) responded to a detailed written survey form and provided considerable information about local placement and performance of MAV reefs. End users were interviewed on site, at local boat ramps and docks, and in local fishing and dive shops in areas where field surveys were conducted. End user mail surveys using postcards were also conducted throughout the range of reef placements.

Recommendations/Lessons Learned:

MAV reefs dramatically increased target bottom fish abundance compared to nearby unenhanced seabed. When compared to other scrap materials, MAVs generally had significantly greater numbers of key target species, especially snapper and grouper, but these differences were highly variable and depended on the nature and dispersion of the reef materials as well as differential fishing pressure. MAV reefs provided effective habitat for many target recreational species, including snapper, grouper, sea bass, hogfish, and sheepshead. Differences between MAV and Bare bottom and MAVFAD and Bare bottom were highly significant for both bottom and midwater target species. Differences between MAV and MAVFAD were highly significant for midwater species and significant for grouper, but not for total bottom fish.

Results demonstrate that MAV reefs were stable and effective. Abundance and biomass of target species was significantly greater than nearby featureless bottom, better than most traditional scrap material reefs, and often equivalent to designed and prefabricated reefs. Reefs were exceptionally stable and can be effectively used in high-energy shallow areas not suitable for other types of reef materials.

The primary performance problems that were observed were mainly due to how the armored vehicles were placed rather than their inherent properties. Their performance as reefs could be enhanced by improving unit spacing and orientation and by securing accurate location data. Future site selection should avoid soft sediment areas and consider high-energy sites where other types of reef materials are not appropriate.

This project can be duplicated on installations with appropriate obsolete property, such as armored vehicles, ships or boats, aircraft, concrete precast items or structural steel configurations. This could result in opportunities for constructive reuse of material, can assist local natural resource agencies, and promote recreational fishing and diving.

Large goliath grouper (est. 400 lbs) finds habitat under the belly of an M-60 Tank

In most cases it is important to work with local groups and technical experts to select sites and obtain the appropriate permits. Permits should be acquired by and in the name of state or local cooperators. In general, responses to the survey of managers indicated that they found the MAV reefs to be effective and stable, and most would be more than willing to receive more MAVs under the same type of DoD-subsidized program. However, it is clear that the REEF-EX program would not continue without the current government subsidy, which covered materials, preparation, and placement.

It is important to know that not all materials are cost effective and that material preparation and placement procedures are critical to reef construction.

Project Publicity:

Aquabio, Inc. did not directly seek publicity as part of this study. Technical and general presentations were made at conferences to inform the DoD community and as part of efforts to gain local cooperation.

Technical Reports Produced:

None