

## **Establishing American Chestnut Test Orchards on two Tennessee Army National Guard Installations**

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### **Background:**

American chestnut (*Castanea dentata*) was once one of the dominant trees in the eastern forests of the United States. In addition to providing an unparalleled food source for wildlife and holding an irreplaceable position in forest ecosystems, American chestnut seeds and lumber played a significant role in many rural Appalachian economies. Its fast growing and rot resistant wood made it the primary hardwood timber species in the 19th and early 20th centuries. The first occurrence of the Asian chestnut blight (*Cryphonectria parasitica*) in the United States was documented in 1904 in New York City. By 1950, this keystone species on an estimated nine million acres of eastern forest had all but vanished as a result of blight infection. Since 1983, the American Chestnut Foundation (TACF) has led and managed an intensive breeding program aimed at instilling blight resistance into American chestnut trees. One of the most essential resources needed for this breeding program is land for the seed orchards where the hybrid chestnuts can be grown. The Tennessee Army National Guard (TNARNG) has small areas on its training sites that are not actively used for military training, and so a cooperative agreement was developed with TACF to establish seed orchards at two of its facilities: VTS-Milan and VTS-Catoosa.

### **Methods:**

**Seed Source:** Several different approaches are being taken in the effort to restore American chestnut (*Castanea dentata*). One of these, the backcross method, seeks to instill resistance to the chestnut blight into American chestnuts by initially hybridizing 100% American chestnuts with blight resistant Chinese chestnut (*Castanea mollissima*) and then conducting a series of backcrosses with 100% American chestnut trees. Within each generation, only trees exhibiting both blight resistance and phenotypically American chestnut traits are used to produce seed for the following generation. Most of the backcross individuals planted on TNARNG orchards are of the third backcross generation (BC3). Once BC3 trees reach reproductive age (usually at 5-7 years), blight-resistant individuals are intercrossed with other blight-resistant BC3 trees, producing the BC3F2 generation. Another intercross between two BC3F2 individuals produces the BC3F3 generation; this is the final cross in this breeding design. It is expected to yield highly blight-resistant trees that will be used in large-scale forest test plantings.

TACF provided all seeds used in TNARNG orchards. American chestnut Backcross 2 (approximately 7/8 American chestnut) and Backcross 3 (approximately 15/16 American chestnut) comprise over 90 percent of the trees in the orchards. The remainder of trees planted are controls including: F1 generation chestnuts (50% American, 50% Chinese), 100% American chestnuts, 100% Chinese chestnuts, and, at VTS-Catoosa, 100% Allegheny chinquapins (*Castanea pumila*), a close relative of American chestnut that exhibits some susceptibility to the blight, but has not been affected to the same degree as its cousin.



**Site Selection:** Two test orchid sites were selected:

- **Volunteer Training Site-Catoosa, Tunnel Hill, Georgia (VTS-Catoosa):** This site is located in a small training area at the northern end of the facility across a public road from the rest of the site. Due to its size, location, and lack of internal roads or facilities, this training area is of limited training use and was chosen by the training site manager as the preferred orchard site. The site consisted of a relatively young (30-50 years) closed canopy forest dominated by red oak and yellow poplar, with a substantial thicket of very young loblolly pine in one corner.
- **Volunteer Training Site-Milan, Tennessee (VTS-Milan):** This three-acre site is located in the northern portion of the facility between a tank trail and the boundary fence along a state highway and is bisected by a power line. Owing to the obstacles, small size, and high visibility from the road, the area is not conducive to training use and was offered by the training site manager as the first choice for installing a chestnut orchard. The area was an established open field, maintained by periodic bush hogging and dominated by fescue, broomstraw, Japanese honeysuckle, and a variety of herbaceous and graminoid species.

**Orchard Preparations:** Site preparations at the two sites included:

- Soil testing to determine pH and other chemical properties and for the presence of the fungal pathogen, *Phytophthora cinnamomi*

- Prescribed burning at VTS-Milan to remove dense layer of thatch and to control woody shrubs and vines
- Clearing approximately one acre of forest at VTS-Catoosa
- Construction of eight foot tall fences to protect chestnuts from deer
- Marking and cultivation of planting rows



**Planting the Orchards:** One day prior to planting, the positions of each tree were measured off and marked with wooden stakes that would later support and anchor the 24-inch protective tree tubes. The tops of the stakes were painted different colors in order to designate which seed type went into which position within the row. This helped to minimize confusion for volunteers and to ensure that orchard records were accurate. VTS-Milan was planted on 18 April 2009 and VTS-Catoosa was planted 25 April 2009, using volunteers from the TNARNG, TACF, students from the University of Tennessee at Chattanooga, and members of the community. A variety of different tree stock backcross varieties saplings and seeds were planted at each site, including controls within the backcross rows at every tenth position. A total of 760 chestnut seeds and seedlings were planted at TNARNG facilities.



**Results:**

Since being awarded funding from the Department of Defense Legacy Program in FY 2008, two backcross orchards have been prepared and planted on TNARNG properties, consisting of 760 chestnut seeds and seedlings. These young trees have completed their first season of growth. Year-end surveys were performed at each TNARNG orchard in October 2009, noting germination rates, survival, vigor, and general health of seedlings. These data are being used to determine the number and pedigree(s) of trees that will be added to the orchards in 2010. VTS-Milan has well over an acre of fenced land on which additional seeds or seedlings may be planted. Trees may also be added in future years at the orchards wherever a seed fails to germinate and/or gaps are created by dead or culled trees. Annual monitoring and routine maintenance will continue annually, noting the survival, health, and size of each tree. After five to seven years of growth the trees will be inoculated with blight to test for resistance. If trees show susceptibility to the blight, they will be culled from the orchard. Blight-resistant BC3 trees will be crossed with other BC3s from different orchards to produce the first intercross generation.

**Conclusion:**

The orchards on the VTS-Catoosa and VTS-Milan are a small part of a massive project whose long-term goal is to reintroduce to its native range an American chestnut with the ability to resist the blight and thrive again. Success in this project will enhance ecosystem quality and biodiversity on TNARNG lands and other forested properties throughout the range of this historically and biologically important species and enrich the training environment for military generations to come.

## **Habitat Mapping at Camp Atterbury using GPS-based Underwater Video**

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### **Background**

Established by the U.S. Army just prior to the United States' entry to World War II, Camp Atterbury Joint Maneuver Training Center (CAJMTC) today occupies 33,132 acres of federally owned property in portions of Johnson, Brown, and Bartholomew Counties, Indiana. It is located approximately 35 miles south of Indianapolis. The installation was closed following World War II but was licensed to the Indiana National Guard (ING) in the early 1950's and today provides training to thousands of regular and reserve forces, particularly in support of the ongoing actions in Afghanistan and Iraq.

The CAJMTC contains approximately 23,000 acres of forested habitat, an estimated 200 acres of wetland and open water, and 170 stream miles of intermittent and perennial streams. Open-field or grassland habitat are scattered throughout and account for the remaining land mass (with the exception of the cantonment area). The installation is managed at the ecosystem level for forestry, cultural resources, agricultural outlease, water quality, threatened and endangered species management, pest management, spill response, clean air, noise abatement, prescribed burning, and wildfire management. The overarching management goal is to sustain desired military training while maintaining ecosystem viability. Maintaining optimal environmental conditions on training lands is essential for the continued success of the military mission at CAJMTC.

Numerous floral and faunal surveys indicate CAJMTC is home to 700 species of plants, 28 species of mammals, 89 known or probable breeding bird species, 17 species of reptiles, 19 amphibian species, 41 fish species, 45 species of butterflies, and 22 native species of freshwater mussels. Surveys indicate the presence of 26 sensitive wildlife species on or in the vicinity of CAJMTC and seven state listed plant species on the installation. Of these species only one, the Indiana bat (*Myotis sodalis*), is a federally listed endangered species.

Specific to freshwater mussels, a 1990 survey found shell material of 35 native species of freshwater mussels in the entire Sugar Creek watershed including “fresh dead” shell material of the proposed threatened or endangered rayed bean (RB) (*Villosa fabalis*) in three of the five most downstream sites of the survey. A 1998 survey for freshwater mussels identified 22 native species (and one exotic species) of freshwater mussels via live or “fresh dead” specimens within tributaries, creeks, and rivers of CAJMTC. This included one “fresh dead” specimen of the RB from Sugar Creek. Given the findings of these surveys it is unlikely that CAJMTC currently supports a reproducing population of the RB. Further investigation into the presence of the RB may be warranted due to the diminutive nature of the species and the proposal for listing as a federally threatened or endangered species. New habitat mapping techniques discussed below may help focus further survey efforts to appropriate stretches of Sugar Creek and Driftwood River allowing funds to be better allocated by permitting more intensive study of potential habitat rather than large scale surveys of the entire riverine system.

Assessment of the RB, and possible impacts to it by the ING, proved difficult in the past. However, the development of a new technique by the University of Tennessee for habitat mapping using Geographical Positioning System (GPS) based underwater video has greatly enhanced the ability of the ING to ensure adequate monitoring of the species.

### **Methods:**

The research project involved the development of aquatic threatened and endangered species habitat maps on the Driftwood River at Camp Atterbury utilizing GPS-based underwater video mapping and image georeferencing techniques. Previously used on streams in several national parks, approximately 14 miles from Edinburg to Catherine Creek have been mapped for the RB and other aquatic species at Camp Atterbury. The study established a protocol for a Department of Defense (DoD) wide technique for large-scale aquatic habitat mapping and determination of optimum habitat for threatened, endangered, and sensitive species.

Canoe and kayak-mounted above and underwater cameras and underwater laser pointers were utilized to capture georeferenced images of aquatic attributes. Aquatic attributes include:

- River characteristics (pool, riffle, run)
- Substrate classification
- Depth
- Substrate heterogeneity
- Embeddedness



These GIS-based river habitat classifications were utilized to develop species-specific optimal habitat maps for estimating habitat quality and aquatic species populations. The maps allow the opportunity to identify aquatic species habitats and revisit the sites to determine changes in river habitat due to military impacts.

The Underwater Video Mapping System (UVMS) was developed to examine underwater ecosystems and record their location using a differentially corrected global positioning system (GPS). A Wilderness Systems Tarpon 100 kayak was used to float the thalweg (the deepest continuous line along a waterway) section of the creek or river. Mounted to the hull of this kayak are two hull-mounted underwater video cameras (one aimed straight down and one aimed at an angle to the substrate) and two underwater laser pointers. An additional video camera was mounted to the bow, acquiring above water footage. A weather proof case located at the rear of the kayak housed three digital video recorders, a receiver, and a video mapping system.

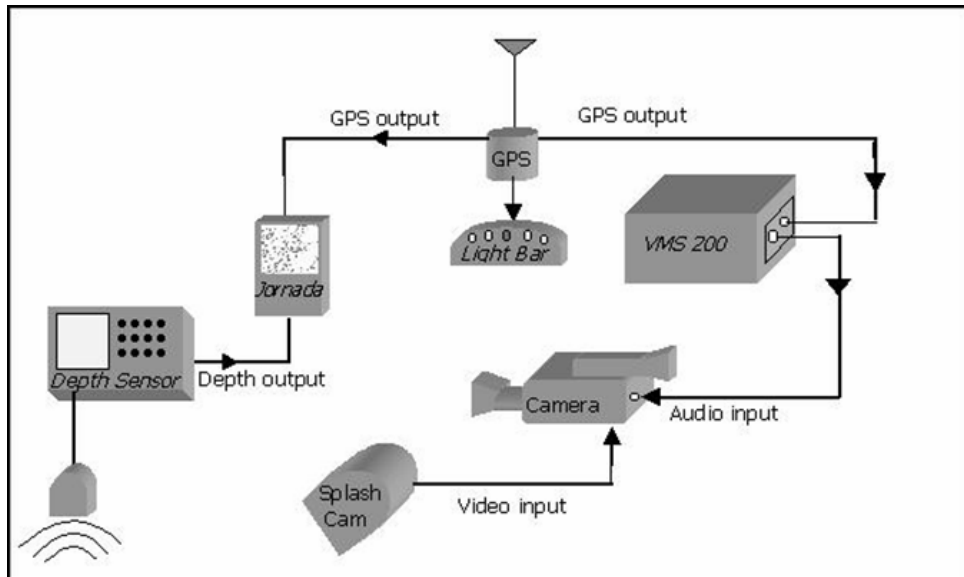


Digital video recorders were used to collect the georeferenced digital video images. River depth measurements were recorded utilizing the two parallel lasers providing both a depth indicator and a measurement scale visible in the underwater images. In addition, a flush-mounted depth sensor is used to record depth every two seconds along the float path through the main section (thalweg) of the river.

A drop down camera and a canoe-based UVMS was utilized to georeference all the digital images by recording the digital GPS position on each video frame.

The video mapping system creates “video maps,” and interactively displays pictures or video footage of the mapped locations. The system includes hardware that embeds GPS data on the left channel of the videotape and software that automatically builds maps using the videotaped data. It can be used with an external camera and records the GPS position on each frame of the digital videotape, thus georeferencing images.

The digital recorder recorded the underwater image and the GPS data. The serial data recorder recorded the depth measurement from the depth sensor, as shown in the diagram below.



## Results

The video mapping system technology was utilized to georeference the images. This technology embeds the GPS location on the audio track of the video image. Thus each video image had a GPS location and is "georeferenced." The georeferenced attributes were classified by reviewing the digital images and field notes. GIS river habitat maps were developed in ArcGIS 9 program.

Above water video images are viewed to define river characteristics (pool, riffle, run) based on Environmental Protection Agency guidelines. Observations of underwater video are used to define substrate classification, embeddedness, and substrate heterogeneity. River depth is obtained from the underwater lasers. Base GIS maps were developed in ArcGIS 9.1. Background aerial photography maps were utilized in the GIS project.




This technique is not designed as a method to intensively study a short river section. Instead, it provides continuous river habitat mapping along extended river sections. It can also be used to identify river sections requiring more intensive surveys. The use of this technique allowed for the characterization of various stream attributes and habitat descriptors, including flow characteristics of the river (pool, run, and riffle), embeddedness of the substrate, substrate components, river depth, and substrate heterogeneity.

Underwater video mapping provides a continuous and permanent georeferenced video record of the river sections surveyed. The video media can be reevaluated as needed. It also provides a database to monitor environmental changes and future military impacts.



## Conclusion

Protecting natural resources while maintaining quality military training and testing areas are critical to sustaining military installations. Understanding the impact of military training on unseen aquatic habitat is needed to ensure seldom seen underwater habitat receives the same management considerations as more visible terrestrial environments. Underwater video habitat mapping involves conducting surveys of large river and creek reaches (sections) to develop large scale aquatic habitat maps. Key attributes mapped include river characteristics, depth, substrate, embeddedness, and substrate heterogeneity. This technology provides a valuable tool for the management of the natural resources at Camp Atterbury and could have equally valuable application to other DoD installations requiring the characterization, mapping, and monitoring of underwater habitats.

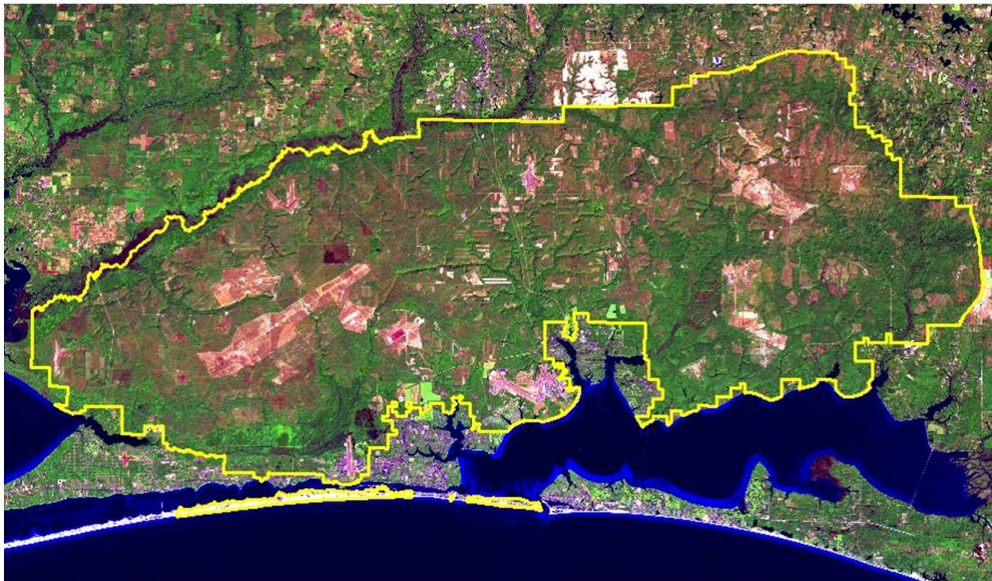
Flow Characteristics of the River		
habitat parameter	description	example pictures
pool	Areas characterized by smooth undisturbed surface, generally slow current, and deep enough to provide protective cover for fish (75 to 100% deeper than the prevailing stream depth).	 Lat: 36.350826 N Lon: 84.730981 W UTC: 05 Apr 2004 19:45:00
riffle	Area characterized by broken water surface, rocky or firm substrate, moderate or swift current, and relatively shallow depth (usually less than 18 inches). Shallow section in a stream where water is breaking over rocks, wood, or other partly submerged debris and producing agitation.	 Lat: 36.509337 N Lon: 84.634933 W UTC: 14 Jun 2004 19:13:41
run	Fast-moving section of a stream with defined thalweg and little surface agitation. Runs are deeper than a riffle and shallower than a pool.	 Lat: 36.326184 N Lon: 84.783725 W UTC: 05 Apr 2004 16:01:54

# Improving and Protecting Endangered Species with Aerial Herbicide Applications at Eglin AFB, Florida

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## Background

The 464,000-acre Eglin Air Force Base (Eglin), located on the Gulf of Mexico along Florida's northwest coast, is home to the U.S. Air Force's Air Armament Center, the mission of which is the development, acquisition, testing, and deployment of all air-delivered weapons. The base and its numerous ranges support extensive testing and training operations not only for the Air Force but for the Army, Navy, allied nations, and private commercial enterprises.



Eglin's natural setting is diverse, biologically rich, and of enormous importance in supporting the military mission. Its extensive forests, bayous, freshwater streams, grasslands, coastal shorelines, and dunes support 12 threatened or endangered species, the protection and recovery of which are major elements of the base natural resources program. The primary objective of the Eglin natural resources program is to enhance mission flexibility and success through the careful management of a number of natural resources programs, including commercial forestry, ecosystem restoration, fire management, and fish and wildlife management, as well as hunting, fishing, and outdoor recreation programs.

Perhaps Eglin's endangered species of greatest importance is the federally-listed red-cockaded woodpecker (RCW) (*Picoides borealis*). This species has been the subject of extensive and pioneering conservation work at Eglin for nearly three decades. During that time, Eglin's RCW populations were rescued from the brink of extinction and transformed into the healthy and sustainable levels they demonstrate today. Maintaining the special habitat needed by the RCW, while simultaneously providing the military community with necessary training ranges, is a continuing challenge.



Several years ago, Eglin's natural resources managers needed to enhance RCW habitat in areas where maintenance by fire was not sufficient to establish and maintain adequate habitat. Cooler or less-frequent fires in those areas allowed the growth of scrub oaks, resulting in a midstory that encroached upon the more-open habitat preferred by the RCW. Furthermore, the midstory limited the effectiveness of prescribed fire by suppressing grasses and other groundcover species that create the fine fuels needed to carry fire.



Elsewhere, Eglin managers needed to reduce erosion near endangered Okaloosa darter (*Etheostoma okaloosae*) streams, while helping maintain and improve military ranges near these streams for mission needs. Traditional range maintenance methods were high disturbance roller-drum chopping and brush-hogging. Roller-drum chopping precipitated erosion and introduced sediment into nearby streams, negatively impacting the darter's habitat. Furthermore, both mechanical methods must be repeated every 1-2 years due to continuous re-sprouting. Of Eglin's 55,000 acres of maintained ranges, 22,000 acres needed to be chopped or brush-hogged repeatedly, an arduous and very expensive task.

On other ranges, unexploded ordnance (UXO) prevented range maintenance and all ground-access, reducing test range viability and flexibility. When brush-hogs or chainsaws cannot be used due to UXO hazards, clearings grow up, blocking lines-of-sight needed for precision observations made with cameras. Hence, vegetation obstruction can significantly reduce range capability.

To address the problems discussed above, Eglin's natural resources managers investigated the use of the aerial application of herbicides. That undertaking was met with a myriad of challenges, large and small.

## **Methods:**

**Preparation:** The first decision in the development of this project was to select the granular herbicide Velpar ULW, manufactured by DuPont. We were experienced with the efficacy and environmental impacts of hexazinone, the herbicide's active ingredient. Hexazinone has been used on Eglin since the 1980s, and has been the subject of several U.S. Fish and Wildlife Service (USFWS) consultations. Additionally, Velpar ULW had a special EPA-label for use on Eglin.

Next, Eglin performed the required National Environmental Policy Act (NEPA) documents, and USFWS consultations. As required by Air Force Instruction 32-1074 (*Aerial Application of Pesticides*), a statement of need was prepared by a Category 11 (Aerial) professional pest management officer with the Air Force Reserve's Aerial Spray Squadron, Youngstown Air Reserve Base, Ohio. The package was approved and certified by our major command's pest management consultant.

We obtained useful information on our proposed action and contract from many sources, including the U. S. Army at Fort Stewart, GA, the Air Force Forester, Naval Facilities Engineering Command, the Oregon Region Bureau of Land Management (BLM), the Department of the Interior's Aviation Management Directorate, and the British Columbia Ministry of Forests. Nearby Blackwater State Forest and our DuPont technical representative provided essential technical information, such as application rates suitable for forested RCW habitat, sources for the required application device, and maximum effective wind speed.

We contacted the Department of Defense (DoD) Commercial Airlift Division (USAF Air Mobility Command/A3B) to assess the need for the DoD certification of the civilian aircraft/company we intended to use for the spraying. They determined that none was needed since the aircraft would not be carrying DoD personnel or cargo.

We used a Geographic Positioning System (GPS) to delineate the sites, using range roads and stream buffers as exterior boundaries. Pond buffers, sensitive area buffers, buildings, and unvegetated areas were entered into the GPS database as interior boundaries or exclusion areas.

**Coordination:** Ensuring the safety of flying operations was of the highest importance. We worked with Eglin's mission scheduling and the Eglin Test Wing's Range Operations and Control Center, to ensure there were no scheduled conflicts with air space, ground space, ranges,

or explosive/munitions safety profiles. For example, high-flying observation unmanned aerial vehicles (UAVs) were allowed above our low-altitude profile, but we were worked in between higher-priority hot missions. Communication and frequencies were scheduled for critical elements.

Eglin advertised for a small business set-aside to do the spraying work through the Federal Business Opportunities (FedBizOpps) program. Companies with the required equipment were contacted to inform them of the potential contract. A local company was awarded the contract.

The GPS coordinate and projection information were shared with the contractor to ensure compatibility with the on-board GPS.

**Execution:** The helicopter used for the operation was trucked to the site, allowing for as early a start as possible and a smaller air space profile. The early start was critical due to the frequency of high winds. On some days application was shut down after 0930 due to excessive winds.

Weather was of prime importance. We obtained National Weather Service (NWS) spot forecasts for specific lat/longs, times, and terrains, to supplement standard NWS and Air Force forecasts and Air Force weather station reports. For current weather conditions, we made on-site observations using a Kestrel pocket weather station as did the helicopter ground crew.



**Boundaries:** An applicator's consideration of the spray boundaries is critical, even when using GPS coordinates. An applicator must carefully evaluate the potential for drift and volatility, even with a solid herbicide. An on-board GPS helped the pilot determine boundaries, fly straight application lines, track altitude, determine spray swath, and calibrate the application rate. However, even with GPS, considerable pilot skill and effort are necessary to track

obstacles, verify the applicator is still working properly, fly straight lines, maintain constant speed, ensure swath width is uniform, and keep the elevation stable. Additionally, for this granular herbicide, additional time was required for the herbicide to clear the application device--the pilot has to flip the switch prior to reaching a GPS boundary. To assist with this multi-tasking, having the GPS boundary coincide with a road is a great visual-assist for a solo pilot.

**Sensitive Areas:** Pilots often treat the areas adjacent to sensitive-area boundaries first. This initial swath will be recorded on the helicopter's GPS, and subsequent application lines can stop application at the outer edge of the initial swath, rather than at actual boundary. To protect winding stream habitats from non-aquatic herbicides, we advise establishing a straight-line boundary, outside the buffer, rather than creating a winding boundary adjacent to the stream buffer. This ensures a conservative buffer for non-aquatic herbicide.

**Calibration:** The helicopter's GPS is used to calibrate flow rate of the herbicide. For Velpar ULW, DuPont performs annual patterning for application devices to help ensure uniformity of granules on the ground.

### **Results:**

Aerial herbicide application of Velpar ULW improved 1,835 acres of RCW habitat and 4,742 acres of range. It increased the capabilities of UXO ranges by allowing observations of test and training missions; and it provided longer-term maintenance for non-UXO ranges. The operations treated approximately 450 acres per day, including days when hot missions or weather precluded operations.

For both the RCW and ranges, the herbicide facilitated future maintenance by fire, by promoting fine fuels that carry fire. Additionally, there was no erosion or soil disturbance. The aerial work resulted in a more uniform dosage/concentration than ground-applied solids, and thus was safer for non-target species such as longleaf pine. Finally, the cost of the treatment was considerably less than manual application (\$42/acre vs. \$92/acre).

### **Conclusion:**

Aerial application of the herbicide Velpar ULW on areas of Eglin's reservation has proven its worth in contract costs, increased effectiveness of range maintenance, increased range viability, and improved longleaf habitat for species such as the RCW. The herbicide reduced the midstory vegetation and increased habitat openings. Groundcover and native pine species were favored, which allow increased fire management.



# **An Innovative Approach to Protecting Endangered Species Habitat by Controlling Invasive Weeds at F.E. Warren AFB, Wyoming**

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## **Background**

As in much of the West, a substantial problem with invasive weeds has developed at F. E. Warren AFB (WAFB) in Cheyenne, Wyoming. Historically, controlling invasive weeds has been successfully accomplished through the application of herbicides. However, herbicides are expensive as is the labor to apply them. And, applying herbicides may have negative impacts on non-target species and on the environment. For those reasons, all Department of Defense installations operate under a mandate to reduce the use of herbicides whenever possible.

The weed control problem at WAFB is more challenging due to the presence of the federally listed (threatened) Colorado butterfly plant (*Gaura neomexicana* ssp. *coloradensis*) and the recently delisted (in Wyoming) Preble's meadow jumping mouse (*Zapus hudsonius preblei*). WAFB has a long history of providing protection for these two species, but base efforts to reduce the impact upon them by various invasive weeds had become overwhelming and threatened to constitute a taking under the Endangered Species Act.

## **The Solution**

In the summer of 2007, WAFB contracted with a South Dakota livestock management operation to provide a herd of 500 goats. From early June to early August, the goats grazed 285 acres of riparian areas and adjacent uplands. The 285 acres were divided into sections of varying size along Crow Creek, and the herd grazed in each section for periods ranging from one to three weeks.

The goats devoured the targeted invasive weeds, including Canada thistle, Dalmatian toadflax, and leafy spurge. Through careful planning and timing on the part of base personnel, the goats were allowed to graze only in sections where the protected Colorado butterfly plant was still a low ground cover. As soon as the butterfly plants began to bulk up and flower, the goats were moved to other areas.

The goats posed no apparent threat to the Preble's meadow jumping mouse. Historically, the area was grazed with cattle which kept the willows under control. When grazing was discontinued the willows out-competed the butterfly plant and also negatively affected the mouse habitat. Hence, selective grazing by the goats is a desirable control option for invasive weeds.

Prior to moving the goats into a new section, the herder was required to broadcast native seed. As the herd moved through each area, the germinating seeds were then fertilized "naturally" by the goats. The immediate change to the landscape was dramatic. Fields that were once covered with vast, thick stands of weeds were virtually weed-free fields of prairie grass.



## Results

When compared to the traditional weed control methods of mowing or herbicide application, this integrated pest management approach enabled the base and the Air Force to realize a cost savings in excess of \$150,000. The cost to hire one full-time herder and 500 goats to graze the 285 acres was just under \$40,000. In comparison, the cost for herbicide treatment, including manpower, equipment, and Trimec 959, would have been approximately \$56,000, plus some of the areas requiring weed management could not be treated with herbicides due to the presence of the protected Colorado butterfly plant. If the area had been mowed, one season of mowing would have cost over \$125,000. The price for the native seed mix (over three thousand pounds) provided to the goat herder, was \$15,000 and would have been an incurred expense regardless of the control method employed. Early informal discussions with the consulting botanist from the University of Wyoming indicate the population of Colorado butterfly plant increased over 100 percent in 2009 after the habitat was grazed.



WAFB is committed to environmental stewardship, both in terms of protection of threatened species and its mandate to reduce herbicide application. The possibility of "employing" goats each year to control weeds is giving WAFB some much needed hope that the weed problem may finally have a workable, economical, and environmentally sound solution. Although the weeds will sprout again next year due to their extensive root systems and seed banks, the weeds will eventually subside and die with continued grazing. The native plant species will out-compete the



weed species and, over time, native grasses will be restored to WAFB's open spaces and the overall biological diversity will be increased.

## **Conclusion**

Using goats to control invasive weeds can provide an economical and environmentally sound alternative to traditional control methods such as mowing and herbicide treatment. This is especially important when endangered species are present in the treatment area. This successful grazing program at WAFB has set an excellent example within the surrounding communities and earned special recognition from the City of Cheyenne's Weed, Pest, and Vector Control Office.

## Regal Fritillary Butterfly Conservation at Fort Indiantown Gap, Pennsylvania

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### Background

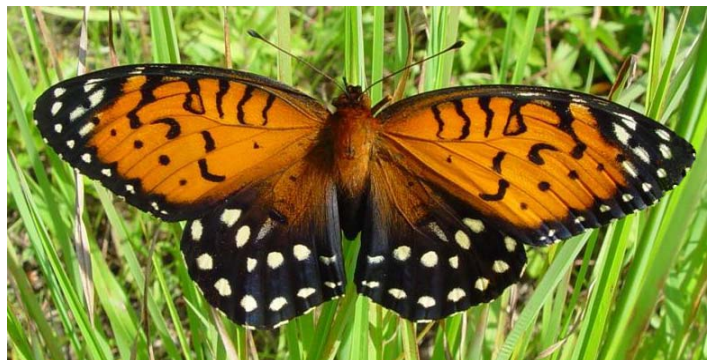
Established in 1931 as a training site for the Pennsylvania National Guard (PNG), Fort Indiantown Gap (FIG) has a long and varied history of supporting our nation's military forces. Following transfer to the U.S. Army during World War II, it became one of the nation's most important training sites but during the Cold War its direct military use diminished and by the 1970's and early 1980's it served mainly as a resettlement camp for Vietnamese and Cambodian refugees and for Cuban aliens. Today military operations have expanded significantly and the site provides year-round training to units of the PNG and other military and civilian users. Training includes a tactical maneuver area for mechanized infantry and armor units, ranges for individual and crew-served weapons training, and an air-to-ground bombing and strafing range.



Located within two mountain ranges in Southeastern Pennsylvania, the FIG occupies approximately 18,000 acres and is an area of exceptional environmental significance. It contains 13 forest communities, extensive grasslands and savannas, five wetland

communities, and a rich biological diversity, including 50 species of concern. Of the latter, the regal fritillary butterfly (*Speyeria idalia*) is perhaps the most significant. Historically it ranged from Nova Scotia south to North Carolina and west to Wyoming. Though locally common in the past, there has been a severe contraction of the butterfly's range over the last four decades, especially in the East. Only one viable population (800-1,200 adults) remains east of the Mississippi River and resides at FIG. A second, nonviable eastern population (around 100 adults) is found at Radford Army Ammunition Plant in the Appalachian foothills of Virginia. The regal depends on grassland habitats that have persisted at these two areas due primarily to military activity. One of the last known populations in Pennsylvania outside of FIG was observed at Gettysburg National Military Park (GNMP) in 1983.

In preparation for its return to FIG in the late 1990's, the PNG prepared environmental assessments (EAs) to determine the potential impacts of the development of an expanded tactical vehicle training complex, installation of a multi-purpose training range, and improvements to the cantonment area and airfield. The decision to comply with the National Environmental Policy Act (NEPA) for those proposed actions by only preparing EAs, as opposed to a much more comprehensive Environmental Impact Statement (EIS), resulted in a lawsuit from an environmental organization. The suit alleged that the environmental assessments inadequately addressed the impacts to the regal fritillary butterfly. The parties settled the lawsuit in May 1998 when the PNG announced its intention to prepare a base-wide EIS following the transfer of the post from the Department of the Army to the PNG. The PNG also agreed to prohibit training on 219 acres of prime training lands to research the habitat requirements of the butterfly and to stave off increased regulations. Following the final decision to proceed with the necessary improvements to the FIG training ranges, the installation began preparing an Integrated Natural Resources Management Plan (INRMP), as required by the Sikes Act and DoD directives. The new INRMP laid out a framework for the conservation of the regal fritillary butterfly on FIG. As early as 1992, the populations of the regal fritillary on FIG had been monitored in cooperation with The Nature Conservancy of Pennsylvania. By 1998 the PNG had established several Regal Research Areas (RRAs) for the evaluation of the health and general status of the species. Additionally, the PNG initiated habitat restoration and conservation measures at FIG grasslands that included seed collection and propagation of regal host and nectar plants, seeding, prescribed fire management, manual removal of weedy species and mowing, selective herbicide treatments, and brush removal. Since active management of regal habitat began, there has been a continued increase in regal population size at all RRAs. The success of these efforts had positive benefits not only the regal fritillary but to the military training mission as well since as the regal population increased and became more secure, the restrictions on military training could be reduced.



Following the success of regal habitat management and conservation programs at FIG, it occurred to the PNG that there may be merit in supporting efforts to repatriate (returning a native species to an area from which it has been extirpated) the regal fritillary to other suitable habitats in Pennsylvania. Such a program could potentially reduce the regal's risk of extinction while increasing the availability of the FIG grasslands (ranges and maneuver areas) for military training. The PNG therefore successfully proposed to the DoD Legacy Resource Management Program a project to assist with the repatriation of the regal fritillary to the Gettysburg National Military Park.



### **Initial Objectives**

The overall project objective was to attempt repatriation of the regal fritillary to GNMP by The Nature Conservancy of Pennsylvania and PNG staff. Specific project objectives included:

- Increase native grass cover (FIG-ecotype little bluestem grass)
- Enhance larval food plant abundance (arrow-leaved violet, *Viola sagittata*)
- Increase native nectar plant abundance by growing milkweeds, field thistle, and wild bergamot from seed collected at FIG
- Gain knowledge for future repatriation attempts of the regal fritillary, as well as other related grassland species. If successful, repatriation would reduce the risk of extinction, improve grassland quality at GNMP, and increase military training flexibility

### **Initial Methods**

Two locations at GNMP were selected as potential repatriation sites based on historical occurrences of the regal fritillary and similarity to currently occupied habitats at FIG. Restoration included planting 300 violets and 600 native nectar plants in mid-summer 2005. To repatriate the regal fritillary, six gravid females were transported from FIG to GNMP in September 2005. The butterflies were enclosed in mesh cages placed on violet plots for three to four days. Weather conditions were ideal and egg laying behavior was observed. The sites were surveyed during the summer of 2006 with the presence-absence technique used to locate adult regal fritillaries at FIG.

## **Initial Results**

While the initial repatriation attempt did not produce any observed adult regal fritillaries the results of this pilot project provided data and lessons on repatriation methods to re-establish regal fritillary populations and closely related species at historically occupied sites. Lessons learned included:

- A more thorough restoration and land management plan is needed before additional repatriation work is attempted
- Multiple years of releasing may be necessary to compensate for unusual weather conditions
- A captive rearing program to release individuals at different life stages should be employed in conjunction with the caged female technique used in 2005

## **Restoration and Repatriation: The Present and Future**

After the initial repatriation attempt at GNMP was deemed unsuccessful in 2006, FIG staff decided to take a step back and look at the methodology. It was during this time period that The Nature Conservancy of Pennsylvania transferred its research role to the Pennsylvania State University. The overall goal was still sound but the objectives needed to be re-evaluated. In 2007, a new list of objectives was created that were more holistic in terms of habitat identification, restoration, repatriation, and cooperation.

## **New Objectives**

- Identify multiple potential repatriation sites with willing partners
- Restore or reclaim grassland sites over the long-term with more intense techniques
  - Increase native warm-season grass coverage
  - Increase host plant abundance
  - Increase other native grassland vegetation abundance
- Repatriate regal fritillary using multiple methods
- Create viable satellite populations
- Decrease encroachment pressures at FIG
- Use knowledge from this project to help guide efforts to conserve other species of concern as well as the regal for partners and other military installations.

## **Results So Far**

To date, three Pennsylvania state parks and two national parks are participating in this project, and a fourth state park is undergoing administrative review. Two other conservation areas have been identified as willing partners: Lehigh Valley Gap Nature Center and the Albany Pine Bush Reserve.

Funding for these projects has been shared between the Pennsylvania Wild Resource Conservation Program and the DoD Legacy Resource Management Program, and USFWS State Wildlife Grant Program. Partners include The Nature Conservancy, Ernst Conservation Seed, Pennsylvania Bureau of State Parks, National Park Service, Pennsylvania Native Plant Network,

and the Environmental and Horticultural Center at Milton Hershey School. Currently, due to the Anti-deficiency Act (31 U.S.C. § 1341) the FIG is prohibited from expending appropriated funds allotted for regal fritillary conservation outside of FIG. Utilizing funds from other sources that do not have these limitations (DoD Legacy, Pennsylvania Wild Resources Conservation Program, and USFWS State Wildlife Grant Program) will allow FIG and cooperators to conserve the regal elsewhere.

FIG personnel have planted over 10,000 violet and nectar plant plugs to date. Along with volunteers, the staff continues to collect native wildflower seed from the partner locations and the region for further plant material development. Seeds are grown by commercial growers and in partner greenhouses. A groundbreaking agreement with Ernst Conservation Seeds in 2003 allowed FIG-ecotype little bluestem seed and other species to be commercially grown and are now available for conservation use. This agreement returns five percent of annual commercial production seed for repatriation projects in lieu of royalties and Ernst provides seed cleaning and processing for hand-collected seed from the field.



Rearing efforts will begin in earnest in 2010 by a number of local experts. By 2011, regal larvae and pupae may be available for the first repatriations since the 2004 effort. Reared fritillaries are meant to supplement the cage method and provide multiple life-stage introductions to overcome some common undetectable issues such as the natural occurrences of pathogens.



The project has demonstrated that there are still many remnant grassland sites in the Northeast and that these sites can be rehabilitated/restored for the benefit of multiple species of conservation concern. The process requires time and effort to remove invasive vegetation, plant native grass seed, and for native grass to establish in a field. In addition, several years are needed to collect native seedstock (not available commercially or in required quantity), in order to increase the amount of seed by planting live plant materials.



This will increase the amount of seed available to FIG and its partners and allow time for these plants to mature and start producing seed. Partnering must take place on many levels and with many land management, nursery, and technical expert organizations. Most partners are unfamiliar with the native grassland restoration process, butterfly ecology, and require detailed management plans.

**Conclusion:**

The innovative conservation efforts on behalf of the regal fritillary butterfly by the PNG and its partners demonstrate the dramatic benefits that can be achieved for the enhancement of rare species and also for reducing military training land encroachment and conflicts. This example may encourage DoD natural resources managers to investigate other cases where similar repatriation efforts with other threatened, endangered, or sensitive species could be employed with equally mutual benefits to the species and the accomplishment of the military mission.



# **Habitat Assessment and Restoration in Support of the Military Mission and Natural Resources Conservation**

By

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## **Background**

The Sikes Act directs the Department of Defense (DoD) to ensure that natural resources programs do not cause a “net loss in capacity to support the military mission.” But the DoD also has a historic obligation to preserve the natural resources on its lands, as was expressed by U. S. Marine Corps Major General Michael Lehnert: “A country worth defending is a country worth preserving.” Keeping those two quotes in mind, the Hill AFB (HAFB) natural resources program has pioneered a process of measuring what we call Functional Lift Capacity and Habitat Trading that helps military planners meet current and future training and testing needs without compromising environmental values.

Functional Lift Capacity refers to an assessment of what restoration measures would be required to enhance (or lift) a given degraded habitat to a higher and more pristine condition. Habitat Trading refers to the process whereby the habitat of a given area required for a new military mission is assessed in terms of its current environmental condition. That assessment is then used to determine what restoration of other degraded sites (Functional Lift Capacity) would be required as mitigation for the use of the new habitat. Through this program, the natural resources staff can provide military commanders with an assessment of the impacts of new proposed mission requirements on the land and allow for the selection of options to accomplish those new mission requirements with the least negative impact. By utilizing the process described here, the capacity of the natural resources to support ever changing military missions can occur, resulting in a true integration of natural resources and military operations without degradation to either.

## **Methods**

**Model Development:** The HAFB natural resources team has pioneered the development of several models that can quantify and provide indices that measure the functional capacity (natural variability) of the habitats within ecosystems. These models have been tested for over



five years on the diverse ecosystems (ranging from high alpine to un-vegetated mudflats) found on the nearly one million acres of HAFB and the Utah Test and Training Range (UTTR) in Utah, Nevada, and Wyoming.

The management process began by obtaining satellite imagery and soil survey data for classifying the various vegetative groups. These vegetation groups were then delineated into 20 different habitat types found on HAFB and UTTR managed lands. The next step was to develop detailed habitat descriptions for each of the 20 habitat types. Nested inside the habitat types are 15 different soil types, and within the various soil types are a total of 30 separate ecological sites. These ecological sites were developed by the Natural Resources Conservation Service (NRCS) and are used as a comparison to what should be a “theoretical best” condition for each site.

The natural resources team then created a series of three habitat models that provide measurable evaluation indices. These models are known as Range Health Index (RHI), Wildlife Community Index (WCI), and Floristic Quality Index (FQI). These indices determine the functionality and health of the areas that are to be traded and restored. Management sites are created and are given a specific identification number, site name, and description. The NRCS ecological site designations for individual locations are identified and provide a “theoretical best” baseline data for purposes of comparison and provide the basis for functional lift or habitat trading. The RHI, WCI, and FQI provide an index, with scores ranging from .01 to 1.0, which would reflect the overall health of these habitats, and are described below.

- **RHI** measures the presence and percent cover of native plant species within a habitat. It provides a quantitative evaluation of the vegetative health of the rangeland habitats. The overall health is evaluated by conducting plant transects using the point-step method. The RHI value is determined from native plants and vegetative cover present. The total vegetative cover from a site is compared to the “theoretical best” cover of the ecological site supported from NRCS data and written in the habitat descriptions for HAFB and UTTR properties. The RHI formula produces a final index score of .01 to 1.0. The higher the index value the healthier we consider the site.
- **WCI** provides an evaluation of the vegetative community used as forage and structure by wildlife species within a habitat and is calculated from four variables used in this model to evaluate wildlife habitat in a community context. The model measures four habitat variables. These variables are used to determine the cover and forage value. The cover index evaluates the quality of cover (perches, nesting, protection, shelter) available within an assessment site. The forage index evaluates the quality of forage (food) within an assessment site. All four variables evaluate how well the cover and forage areas are interspersed to maximize forage opportunities while minimizing predation risks. The model was developed by comparing 13

different habitat suitability models previously developed (i.e. golden eagle, ferruginous hawk, burrowing owl, loggerhead shrike, sage sparrow, western meadow lark, pronghorn antelope, black tail jackrabbit, desert cotton tail, Townsend ground squirrel, kangaroo rat, and desert side-blotched lizard). The WCI formula produces a final index score of .01 to 1.0. The higher the index value the healthier we consider the site.

- **FQI** measures the encroachment or invasiveness of plant species within a habitat and was developed with the rationale that some species of plants have a greater value to the ecosystem while other plants are more of a detriment. Each plant species is given a Conservation Coefficient (CC), a 1-10 value based on its potential for aggressive invasion of habitats. The list of coefficient numbers was developed from field experience of the HAFB natural resources manager and the NRCS range conservationist. Native plants are generally given a higher CC while introduced invasive species are given a lower CC. The number of seeds a species can place into the soil's seed bank and the longevity of the seed's viability are factors used to determine the species potential rate of encroachment and are used to determine the species' ranking. Plant transects are run through the survey site to identify present plant species and their status as being native or introduced. A mathematical formula gives an index value for that survey site. The FQI formula produces a final index score of .01 to 1.0. The higher the index value the healthier we consider the site.

**Data Capture:** The NR team has developed an effective natural resources management tool using a tablet personal computer with built-in Global Position System (GPS) and Geographic Information System (GIS) software. The tablet contains 22 electronic field forms, with associated protocols, habitat descriptions, and maps. This technology has maximized the resources and efficiency in the field and has eliminated many hours of redundant data input, saving the HAFB natural resources program valuable hours and money. (Time savings = 1920 hours annually; the equivalent of one full time position each year). After data are gathered in the field they are downloaded into a central database. The resulting output from the central database is a specific site report with field data, site photo, and location map. The database can also be queried to compare multiple sites or sites within different habitat types.

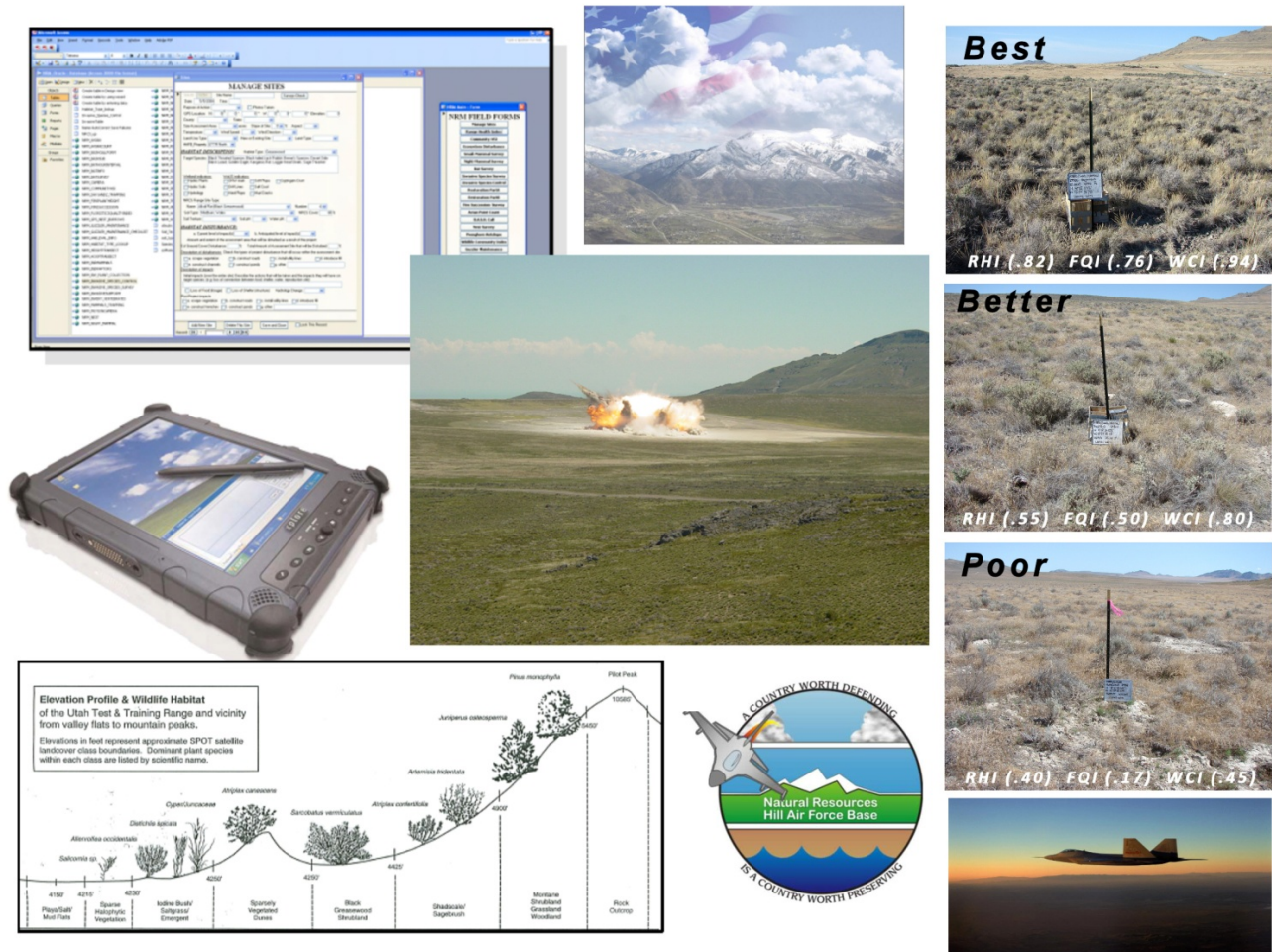
## **Results**

The index values of these three field models are used to determine the functional capacity of an ecosystem. The index data gathered from these models are used to provide scientific evidence to justify the mitigation process of providing lift to HAFB and UTTR habitats. In addition, data are applied to a specific project site to determine the extent of habitat trading or site regeneration.

These data are analyzed with geo-based enabled applications that provide natural resources personnel the ability to conduct query based “What If” scenarios on predicted impacts to the environment from military missions. The next phase of this management strategy is to develop state and transition models that will predict the causes and effects of these degraded sites.

### Conclusion

This overall habitat trading method allows HAFB natural resources managers to use an Avoid-Minimize-Mitigate approach of supporting mission required disturbance, while providing regeneration to previously disturbed areas and preservation of more pristine areas. Our holistic approach provides the ability of meeting the Sikes Act requirement of "no net loss in capacity to support the military mission" while simultaneously meeting Air Force General Joseph W. Ralston’s admonition to "preserve both the natural diversity of military training areas and our opportunity to train the way we plan to fight now and in the future." We believe that our habitat trading process could be applied at many other DoD bases or ranges.



## **Innovative Conservation Law Enforcement and Compliance at Marine Corps Base, Camp Pendleton, CA**

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### **Background**

Marine Corps Base Camp Pendleton's (MCBCP) mission is to operate a training base that promotes the combat readiness of the operating forces and the mission of other tenant commands by providing training opportunities, facilities, services and support responsive to the needs of Marines, sailors and their families. MCBCP is the Marine Corps' premier amphibious training base and its only west coast amphibious assault training center.

MCBCP occupies over 125,000 acres of coastal southern California in the northwest corner of San Diego County. Aside from nearly 10,000 acres that is developed, most of the base is largely undeveloped land that is used for training. MCBCP is situated between two major metropolitan areas: Los Angeles, 82 miles to the north, and San Diego, 38 miles to the south.

The Environmental Security Office (ES) is the lead organization on MCBCP for natural resources compliance and management. Branch departments within ES work in specialized areas, including: wildlife management, spill response, hazardous waste, environmental planning, archaeology, air quality, and waste water compliance. This comprehensive environmental law enforcement organization has played a key role in maximizing the conservation of natural resources at MCBCP.



## **Natural Resources**

MCBCP possesses a rich assemblage of habitats and natural communities that are fast disappearing to development in the adjacent densely populated portion of southern California. The base's coastal plains, valleys, and rolling mountain foothills support diverse soil types, plant communities and wildlife species. Over 800 plant species, hundreds of invertebrates, more than 50 mammalian, 30 reptilian, 10 amphibian, 300 avian, and 60 fish species have been identified on MCBCP. Sixteen federally threatened or endangered species are found on, or transit through, MCBCP.

## **Public Access and Recreation**

The Marine Corps allows access to natural resources to the extent appropriate and consistent with the military mission, safety and security requirements, and the sustainability of natural resources. Further, it is Marine Corps policy that "a program for outdoor recreational developments will be created in consultation with the Department of the Interior and appropriate state agencies" (HQMC 1998).

## **Conservation Law Enforcement Organization**

The Resource Enforcement and Compliance Branch (RECB) is staffed with federal conservation law enforcement officers, a wildlife biologist, and biological technicians. It is responsible for ensuring that fish and wildlife regulations are enforced on MCBCP in accordance with federal and state laws, Marine Corps Orders, annual base bulletins, and other applicable regulations. The RECB has federal conservation law enforcement officers to enforce state and federal fish and game regulations and administer the base's hunting, fishing, camping, and other outdoor recreational programs. Those officers are deputized by the US Fish and Wildlife Service (in accordance with a memorandum of agreement signed in 2003) to enforce federal conservation laws such as the Endangered Species Act, the Migratory Bird Treaty Act, and the Bald and Golden Eagle Protection Act.



The chief game warden is MCBCP's law enforcement official for federal and state laws and regulations pertaining to fish, wildlife, and natural resources and employs deputy game wardens as required. Game wardens are authorized to conduct searches pertinent to fish, wildlife, and natural resources, in accordance with federal and state laws, Standard Operating Procedures for Legal Matters (Base Order P5821.1), and other base regulations.

Duties of the RECB staff include:

- Enforcement of natural resources regulations
- Enforcement of campfire restrictions
- Administration of the hunting, fishing, and undeveloped camping programs
- Patrolling the base
- Implementing habitat conservation programs
- Resolving wildlife conflict
- Recovering injured wildlife and road kills
- Confiscating exotic pets per Base Order P5000.2J
- Performing educational outreach and instruction
- Monitoring the base's resident bison herd

Natural resources related recreation programs managed by the RECB include hunting, fishing, and camping programs.

### **Examples of Conservation Compliance and Law Enforcement Actions**

The MCBCP Integrated Natural Resources Management Plan (INRMP) provides a framework for the integration, implementation, and enforcement of comprehensive natural resources management programs. Several actions outlined in the INRMP have proved to be especially effective in helping MCBCP accomplish its vital military mission while simultaneously ensuring compliance with natural resources laws and DoD, Navy, and USMC environmental policy. Among these initiatives are:

- **Environmental training, education, and awareness programs**
  - **Example:** The Training Branch within ES offers a monthly briefing to the training (S3) and logistics (S4) representatives from units on base. The subject matter is consistently related to environmental compliance; however, technical specialists serve as guest speakers to talk about rotating topics ranging from management of hazardous waste to cultural resources, game management, endangered species, environmental planning, storm water management, clean air, and vegetation management.
  - **Example:** Annually, a representative from the Wildlife Management Branch gives a slide presentation to units that regularly train near the nesting habitat and colonies of two federally listed species, the western snowy plover and the California least tern. The briefing covers life histories of the birds and details the requirements listed in the Range and Training Regulations (P3500.1M) to avoid causing impacts to federally listed species and their habitats.



- **Example:** The RECB offers a free monthly basic hunter safety course, which is a pre-requisite for obtaining a hunting license. The branch has three state certified hunter safety instructors. The course covers and tests students on basic hunter safety and also provides an introduction to the hunting opportunities and regulations for the base.
- **Example:** The ES office updates and distributes the environmental operations map book twice a year to help trainers, construction supervisors, and other users on base understand the locations of and requirements for working near sensitive natural resources. The map book includes 24 pages of maps and regulations to help users identify possible environmental conflicts during planning stages.
- **Publishing conditions of biological opinions in Base Orders**
  - **Example:** Requirements from biological opinions (BOs) are included in the base's Range and Training Regulations so that Marines have easy access to the pertinent requirements from an authoritative source that they recognize. A typical example of a requirement from a BO that was included in the Range and Training Regulations to help promote compliance for the federally endangered California least tern: "Between 1 March and 15 September, all activities involving smoke, pyrotechnics, loud noises, blowing sand, and large groupings of personnel (14 or more) shall remain at least 300 meters away from fenced or posted nesting areas. All other activities shall be kept at least five meters from these areas."
- **Information management and Geographic Information Systems (GIS)**
  - **Example:** ES operates and maintains the Environmental Incident Reporting System which is a database for recording and distributing records of environmental non-compliance aboard the base. The database accepts spatial data as well as photos and text to document the incident. Queries and maps can be created showing the history, type, and location of incidents by category including: National Environmental Policy Act (NEPA) non-compliance, Endangered Species Act (ESA) violations, hazardous waste spills, etc. When an incident record is created by a technical specialist, a link to the record can

be instantly e-mailed to enforcement and management personnel for proper action.

- **Environmental inspection and compliance**
  - **Example:** A NEPA compliance inspector regularly monitors and records the compliance and non-compliance of construction and maintenance crews that are performing work subject to NEPA. The inspector checks to see that site supervisors have copies of the NEPA documents authorizing their activities near sensitive natural and cultural resources and that the supervisors understand their specific requirements to comply with federal natural resources laws.
- **Enforcement mechanisms**
  - Issuing a letter of offense to a violator's commanding officer
  - Issuing field citations to all offenders, issuing base citations (DD 1408) to active duty personnel, issuing federal citations (DD 1805) to civilian personnel
  - Arrest and detainment
  - Search and seizure
  - Revoking or suspending hunting, fishing, and camping privileges

### **Examples of Law Enforcement Activities**

- **Public education and outreach initiatives**
  - **Example:** All hunters must attend a hunter's safety brief annually prior to hunting on base. The brief describes check-in/check-out procedures, hunter safety, legal hunting methods, unauthorized hunting behavior, etc.
- **Investigating and reporting incidental takes (e.g., western snowy plover)**
  - **Example:** In 2007, a base game warden investigated the destruction of three eggs in a federally threatened western snowy plover nest. After a thorough investigation, the warden discovered that a contractor had accidentally destroyed the nest. The contractor was riding an ATV while performing an authorized geologic survey, ignored warning markers that were installed to protect the nest, and inadvertently ran over the nest destroying the eggs. Because a programmatic BO was in place, the take was tallied as an incidental take and charged against the base's annual limit of three plovers per year.
- **Control of feral animals**
  - **Example:** A base game warden identified and apprehended a person that was maintaining an illicit cat feeding station on base. The warden conducted an investigation and performed a stakeout to catch the person in the act of depositing food for the cats. The cat feeding station was near a nesting colony for endangered California least tern. Feral cats have been previously caught hunting in the colony. The feeding station was also visited by wild animals such as skunks, creating wildlife conflicts in an adjacent housing area.



- **Recovery of endangered species remains**
  - **Example:** The carcass of a blue whale had washed ashore on the base and decayed so that only bones were left. The weathered bones lay undisturbed for several years on Cocklebur Beach. In December of 2007, a game warden on patrol found that the bones had been removed and started an investigation. Soon after, an anonymous caller notified base game wardens that a unit on base had recently collected some very large bones that were on display at their building. All whales are protected under the Marine Mammal Protection Act and blue whales also receive ESA protection because they are federally endangered. Unpermitted persons may not possess the parts of a listed species, so base game wardens confiscated the bones and counseled the unit.
- **Preventing recreational off-road drivers**
  - **Example:** Base game wardens regularly discover tire tracks and damage caused by unauthorized, recreational off-road drivers. Vernal pools and riparian habitats are sensitive resources that can be easily damaged by off-road drivers. The apprehended drivers receive base citations and letters of offense. On one occasion in 1998, when active duty Marines served as the base game wardens, the wardens coordinated a sting operation with Marine motorcycle scouts. Unauthorized civilian motorcyclists had been seen trespassing in a training area at the edge of the base and riding their motorcycles. Working with the Marine motorcycle scouts, base game wardens apprehended the trespassers when they arrived to ride their bikes on Marine Corps property. The violators were issued a letter of disbarment from the base.



## **Conclusion**

MCBCP has established a comprehensive compliance and enforcement program for natural resources conservation. The base's program is proactive, by necessity, because of the many listed and sensitive natural resources found on base and its very active training program. It demonstrates the critical role that a natural resources law enforcement program can play in ensuring the conservation of biological diversity and critical ecological functions on military lands while allowing for diverse and numerous training operations that fulfill a critical role in national security.



# **Navy Eelgrass Mitigation Banking in San Diego Bay, California – An innovative approach to meeting mission requirements while providing long-term protection to a critical species in a threatened ecosystem**

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## **Background:**

Two species of eelgrass (*Zostera marina* and *Z. pacifica*) are marine vascular plants (Angiosperms) that occur in bottom bays and estuaries of the northern hemisphere. In southern California, eelgrass is generally distributed sporadically in bays and estuaries and within shallow offshore beds. Eelgrass beds provide key biological functions within the shallow bays and estuaries where they serve as habitat and nursery areas for commercially and recreationally important open ocean marine fish and invertebrates. Eelgrass beds also provide critical structural environments for resident bay and estuarine species. In addition to providing important habitat for fish, eelgrass is considered to be an important resource supporting migratory birds, particularly during migration. Eelgrass is a major source of primary production in nearshore marine systems, supplying the base of detrital-based food webs. Several organisms directly graze upon eelgrass or consume epiphytes and epifauna supported by eelgrass plant structures, thus contributing to the system at multiple trophic levels. Eelgrass also improves water quality by facilitating nutrient cycling, oxygenating the water column, trapping suspended particulates, and reducing erosion by stabilizing sediment.



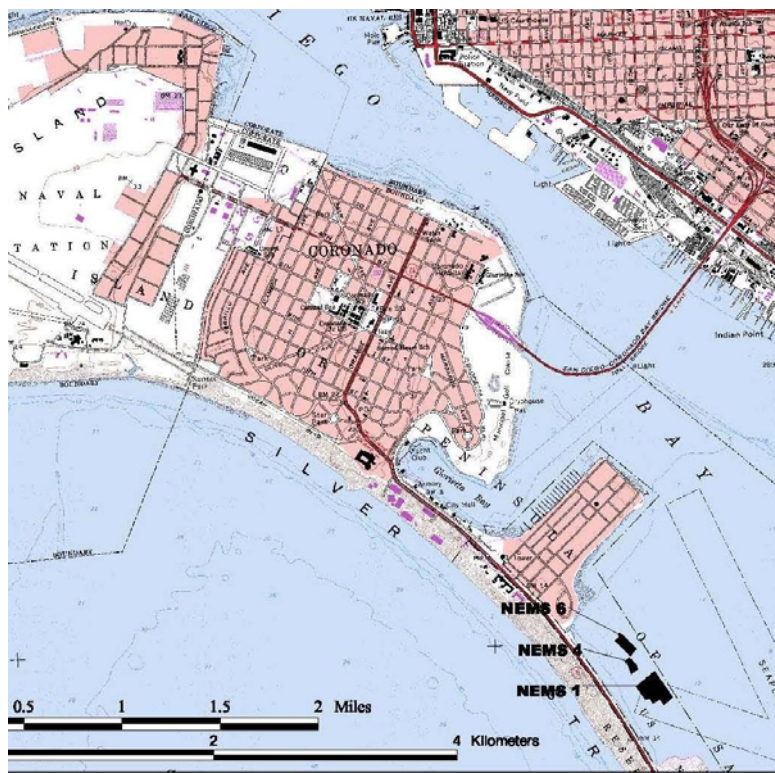
Dredging and filling of coastal wetlands, degradation of water quality, and loss of suitable habitat by other means has resulted in a fragmented distribution of eelgrass habitat in southern California. Current estimates indicate that less than 5,000 acres of eelgrass exist throughout southern California, with over 70 percent of the eelgrass being represented in only a handful of locations along the coast.

Due to eelgrass' vital role in the marine environment, coupled with the estimated losses due to human activities, eelgrass has been designated as Essential Fish Habitat under the Magnuson Stevens Fisheries Conservation and Management Act. This increased level of resource protection impacts U.S. Navy shore-side facilities and mission related activities within the San Diego Bay.

In an effort to ensure the Navy's ability to continue its military operations in the San Diego Bay region, while simultaneously enhancing the habitat of a critical marine ecosystem, the Navy established an innovative Eelgrass Mitigation Banking Program.

### Methods:

Construction and mission requirements dating to 1987 in the San Diego Bay region required the Navy to mitigate for eelgrass habitat loss. Over the years the Navy established six Navy Eelgrass Mitigation Sites (NEMS) for this purpose. As required by the terms of the regulating agencies, the Navy established a detailed eelgrass monitoring program, as a requirement under the San Diego Bay Integrated Natural Resources Management Plan, for each NEMS to ensure that the specified area of eelgrass beds were being properly maintained. San Diego Bay eelgrass has therefore been monitored through regular baywide surveys completed in 1993, 1999, 2004, and 2008 by the Navy in cooperation with the San Diego Unified Port District. These surveys have been conducted using a combination of methods including sidescan sonar and singlebeam sonar. These monitoring programs revealed that over time the NEMS thrived and eventually produced eelgrass beds larger than those required by the mitigation under which they were initially established. Given the additional eelgrass areas documented through the monitoring programs, the Navy undertook to establish the NEMS as "assets" in an Eelgrass Habitat Bank through which the Navy could obtain mitigation credits for future construction projects and mission impacts.

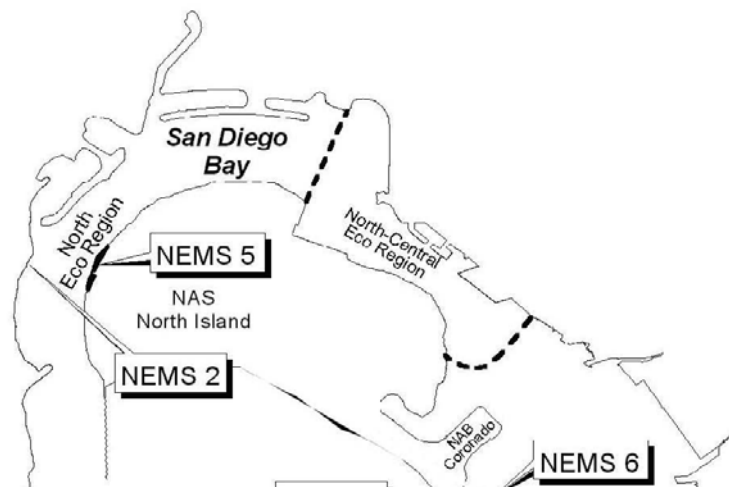


Locator Map  
Navy Eelgrass Mitigation Sites 1, 2, 4, 5, 6

Figure  
1

In July 2008, the Commander, Navy Region Southwest, the Los Angeles District of the U.S. Army Corps of Engineers (USACE), and the National Oceanic Atmospheric Administration (NOAA) Fisheries Service established a Banking Instrument (BI) which sets forth the agreement of the parties regarding the establishment, use, operation, and maintenance of the Navy Region Southwest San Diego Bay Eelgrass Mitigation Bank. With this instrument in place, the Navy may use any mitigation transplant success that, after five years, exceeds the mitigation requirements specified in the original mitigation agreement for a specific NEMS, to be considered as bank mitigation credits. The future use of these credits must be with the approval of the resource agencies and be consistent with the provisions stated in the agreement establishing the mitigation bank. Furthermore, monitoring of each approved mitigation bank must be conducted on an annual basis until all credits are exhausted.

The service area of the bank includes all of San Diego Bay, which is divided into four ecoregions. Impacts to eelgrass occurring in the north or north-central part of San Diego Bay may be mitigated through the application of credits available in those ecoregions (i.e. existing credits available in NEMS 2 and 5 may be used to mitigate future impacts within those ecoregions). Likewise, NEMS 1, 4, and 6 may be applied to mitigate for impacts to eelgrass resources occurring in the south-central and south ecoregions.



## Results

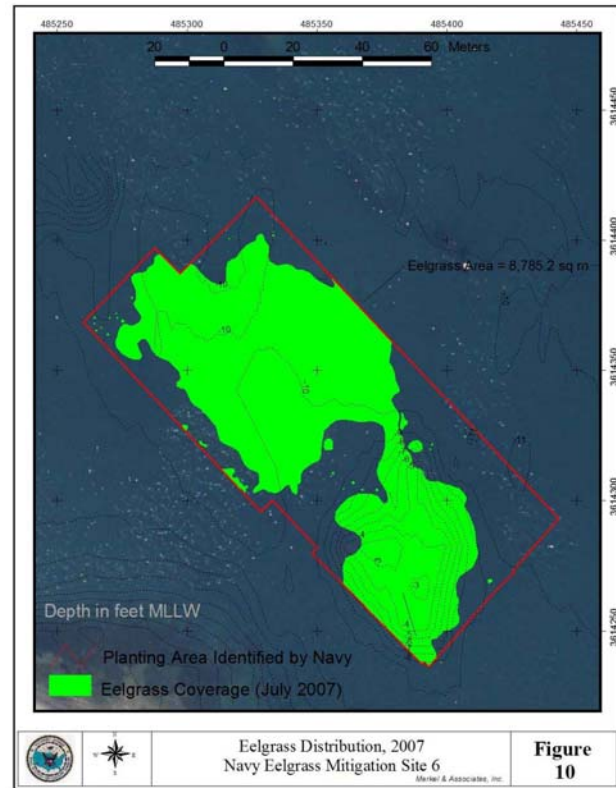
Upon establishment in 2008, the total number of credits in the bank was 4.38 hectares (ha.). This amount was derived by first calculating the mean of eelgrass coverage mapped during the four most recent monitoring surveys (2003-2007). This 4-point mean provides a more realistic representation of the long-term viability of an eelgrass site than a single monitoring survey.

The four-point mean for each of the five NEMS with available credits was as follows:

- (a) NEMS 1 – 4.02 ha
- (b) NEMS 2 – 0.14 ha
- (c) NEMS 4 - 0.43 ha
- (d) NEMS 5 – 4.40 ha
- (e) NEMS 6 - 0.81 ha

Next, the Navy's mitigation requirements were subtracted from the 4-point mean, resulting in the following credits at each NEMS:

- (a) NEMS 1 – 2.15 ha
- (b) NEMS 2 – 0.03 ha
- (c) NEMS 4 - 0.04 ha
- (d) NEMS 5 – 1.41 ha
- (e) NEMS 6 - 0.75 ha



Prior to the bank establishment date, the USACE allowed 0.17 credits to be transferred from NEMS 1 in advance of executing the BI. From this point forward, each additional credit release must be approved in writing by the USACE. The actual number of credits released shall be determined by the USACE, in consultation with the other cooperating agencies. No additional credit transfer shall occur until the applicable credit release has occurred.

At present, the Navy is applying for a credit transfer in the south-central ecoregion as a component of the Silver Strand Training Complex Operations and Training Plan and subsequent National Environment Policy Act documentation. The banked habitat (area to be determined through consultation with NOAA) will offset eelgrass loss as a result of amphibious landings and Seabee elevated causeway training at Bravo Beach in the San Diego Bay. Upon transfer of the credits, the Navy will have a permanent training area that can be accessed 365 days of the year.

## Conclusion

Mitigation banking to compensate for environmental impacts due to military construction or training activities is a potentially useful and cost effective tool for natural resources management on military installations. The Navy's initiative to establish an eelgrass mitigation bank, using as assets previously established mitigation sites in the San Diego Bay, offers an excellent means to economically manage natural resources while executing its environmental responsibilities under the Sikes Act. This example may suggest ways in which the establishment of a mitigation bank could contribute to effective natural resources management on other military lands.



**A Unique Habitat Management Program to Support Military Training Opportunities at  
Nellis Air Force Base, Creech Air Force Base, and the Nevada Test & Training Range,  
Nevada**

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**Background**

The Nellis AFB (NABF) natural resources program is responsible for the NAFB, Creech AFB (CAFB), and the Nellis Test and Training Range (NTTR) which occupy collectively over three million acres in portions of Clark, Lincoln, and Nye counties, Nevada. This military complex, hereafter referred to collectively as “Nellis,” is the largest in the U.S. Air Force and one of the largest in the world. It is currently estimated that less than five percent of the land area of Nellis is being impacted by mission activities, meaning that 2.7 million acres remain relatively undisturbed by human activity. Human disturbance on Nellis is minimal due to the fact that most of Nellis is under a high level of security with little or no public access allowed. Thus, many of the plant and animal communities that have become established at Nellis are attaining ecological succession levels far beyond those occurring outside of the boundaries of the range area. Continued proper management of natural resources at Nellis will ensure that these unique plant and animal communities will be conserved. In addition to the unique plant communities and topographic features of Nellis, large game species including mule deer, antelope, and desert bighorn are found on Nellis. Of these species, only desert bighorn are hunted on a regular basis through a cooperative agreement with Nevada Department of Wildlife and the U.S. Fish and Wildlife Service. Plant and animal species present on Nellis are often protected from disturbance or habitat loss because they are designated species with formal legal protection or because they are listed as sensitive species. One plant species and five animal species considered sensitive by resource agencies are known to occur on Nellis.





## **Military Mission**

The Nellis mission is to train military professionals for combat, operational testing, and tactics development. This incorporates ordnance drops by fighter pilots on land targets that resemble the location of potential military interaction. The military mission of Nellis requires large expanses of remote, undeveloped land. Nellis is the only location in the United States where both individual and large multi-force training can be conducted in highly sophisticated training exercises that simulate full-scale battlefield scenarios.



## **Identifying Habitat Diversity**

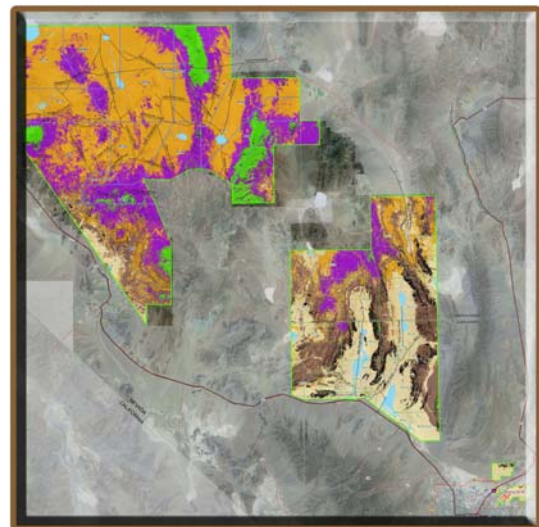
Nellis natural resources planners must have accurate information regarding the ecosystems present so that mission activities do not have unintended consequences on unique habitats or individual sensitive species. To address this concern the Nellis natural resources team developed a Unique Habitat Management Program (UHMP) that began with an evaluation of Nevada's Wildlife Action Plan (NWAP) in relation to Nellis' three million acres. The NWAP organizes the various ecological systems of the entire state into 27 key habitats types. The NWAP lists only 14 unique habitats occurring within NTTR, whereas the Nellis natural resources team estimates that there are actually 20 of the 27 key habitats occurring within the Nellis complex.

## Refining Habitat Delineations

NWAP habitat maps were developed by incorporating landcover data from the Southwest Regional Gap Analysis Project, an update of the Gap Analysis Program's mapping and assessment of biodiversity for the five-state region encompassing Arizona, Colorado, Nevada, New Mexico, and Utah. However, through field data collection and extensive field surveys, inaccuracies are being identified and addressed. These habitat delineations will be continually reviewed and adjusted as data gaps on Nellis are addressed. Researching and compiling information on these habitats will assist Nellis planners with information and insight on current natural resources conservation objectives. These efforts will sustain military air training operations readiness and reduce potential training delays.

## Satellite Imagery

The Nellis natural resources team uses a combination of on-the-ground field surveys, studies, and satellite imagery to manage natural resources on Nellis. The goal is to sustain military operations readiness and reduce potential training delays. High-resolution imagery is providing a tool for more accurately identifying habitats, and evaluating interrelationships among natural resources and the effects of human actions upon these resources. Because of the vastness of Nellis, this is one of the most efficient means of examining the landscape to reach more effective and prompt mission decisions.



## Conclusion

The UHMP developed by the Nellis natural resources team provides important decision making tools to sustain natural resources and the landscape of the Nellis military complex. It plays a valuable role in maintaining realistic training areas while conserving fragile desert ecosystems. This program could be adapted for other large military training ranges.



## Air Force Academy Cone Collection Program

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### **Background**

The 18,455-acre United States Air Force Academy (Academy) is situated along the Rocky Mountain Front Range in Colorado, about six miles north of downtown Colorado Springs and approximately 60 miles south of Denver. Approximately 13,000 acres of the Academy are forested, predominantly with Ponderosa Pine (*Pinus ponderosa*). The forests of the Academy and its Farish Recreational Area represent one of the most aesthetically pleasing and environmentally important components of the ecosystem. Their health and stability contribute to the overall environmental well being of the region and play an essential role in the Academy's mission. For those reasons, the management of the Academy's forests is one of the most important and challenging responsibilities of the natural resources program. An ongoing management concern is obtaining genetically adapted seedlings for the many reforestation projects undertaken by the Academy's natural resources office. To address this problem, we instituted a cone collection program to ensure that we will always have well-acclimated seedlings for reforestation needs.

### **Methods**

Cones were collected in several elevational bands to ensure that future plantings can be done with seedlings best acclimated to that elevation. Because successful development of these pines is dependent on the tree's ability to adapt to environmental fluctuations, care is taken to document seed collection locations and assure compatibility in subsequent planting locations. According to guidelines developed by U.S. Forest Service (USFS) geneticists, ponderosa pine should be planted within 400 feet elevation of the seed collection location. In addition, Colorado is subdivided into numerous seed provenance zones, within which seed can be transferred as long as elevation requirements are met. Seed collected outside of a designated seed zone and elevational band will not be genetically adapted to the planting site. For example, trees sown from seed collected at lower elevations may grow well, but will not be as frost-hardy as those collected from



seed at a compatible elevation. Conversely, trees grown from seed collected at a higher elevation may be very frost-hardy, but will not grow as well as locally-adapted seed. Many roadside pines in the Colorado foothills have been grown from seed collected in the Black Hills of South Dakota. While these trees are sturdy, they tend to be very stout with diameters up to 14 inches and heights of only 20-30 feet. This unusual growth habit stands out in sharp contrast to the 60 foot tall native pines in the Colorado landscape.

Our cone collection efforts have included a variety of methods. We utilized a cherry picker truck to collect cones from easily accessible trees. We received strong support from various construction project managers, accommodating our need to have selected trees felled upon cone maturity in areas scheduled for clearing. While collecting from downed trees is the most efficient collection method, this also provided an opportunity to utilize this forest resource before these trees were cleared for parking lots and buildings. A Cub Scout troop assisted in collecting cones from one such area. A local logger also supported our efforts. While working on a thinning task, he agreed to leave numerous trees slated for removal until cone maturity, at which time he felled those and assisted in collecting cones. His flexibility in project timing compromised the efficiency of his operation, but demonstrated his commitment to long-term sustainability of our forest resources.



We partnered with the adjacent Pike-San Isabel National Forest (PSINF) to monitor cone maturity and transport cones to the USFS Bessey Nursery in Nebraska. The PSINF was able to purchase our excess seedlings (due to high germination rates) in 2008, since the seed provenance was compatible with their planned planting location. Our excellent working relationship with the PSINF has been very beneficial in this program.



We developed an Interagency Agreement with the Bessey Nursery to extract seeds, perform germination tests, protect seed in long-term cold storage, and grow seedlings when requested. The Academy purchases seedlings as needed. We have ordered 400-1,000 seedlings annually since 2006. We have used these hardy seedlings to restore disturbed areas such as trail closures, and to reforest recently



burned areas and several pockets that were cleared due to heavy dwarf mistletoe infection.

In addition, we were able to engage a Colorado State land management agency in collecting cones from Academy trees. We provided guidance in this project, including identification of seed trees and advice on collection techniques. Seeds from these cones were grown into

seedlings and sold to landowners across Colorado's Front Range in 2007. This was the first time in many years that the agency had gathered seed from a local source rather than from out-of-state, representing a major stride in providing genetically well-acclimated seedlings for planting across the Front Range. This is an accomplishment that transcends the Academy's boundaries.

The west boundary of the Academy transitions into a mixed Douglas-fir –ponderosa pine forest, as the elevation rises along this east-facing slope. A Douglas-fir cone collection to supplement the pine seedbank was carried out in 2009. This will provide seed for reforestation on higher elevations or more mesic north slopes, and will enhance future forest biodiversity.

## **Results**

Focusing on well-formed healthy trees with good cone yields, we have collected enough seed to grow approximately 1,000,000 seedlings. In addition to addressing incidental reforestation needs, this seedbank will be critical in the event of a devastating wildfire. Seed can remain viable for over two decades, providing an insurance policy against this potential scenario.


Another local military installation recently suffered several large wildfires but did not have seed for reforestation. These fires were at a considerably lower elevation than the Academy, negating the possibility of utilizing Academy seeds for planting in these burn areas. However, a 2009 partnering project with the Academy made a good start towards establishing a seedbank for this installation. We are firmly committed to assisting other military installations in establishing local seedbanks for which to address immediate and future reforestation needs.

## **Conclusion**

Our cone collection program has provided an opportunity to partner with several agencies to provide well-adapted, genetically-acclimated seedlings for future reforestation needs. This important investment in the future exemplifies a sound long-term approach to forest management, biodiversity conservation, and a commitment to preserving the Academy's beautiful landscape for the future.

**U.S Air Force Academy**

**Cone Collection to Collect Seed for  
Current and Future Reforestation Needs**



An Investment in our Future

We have collected 130 pounds of seed from high quality pines at varying elevations across the Academy. This is enough to grow 1,000,000 genetically adapted seedlings, which may be necessary for reforestation in the event of a wildfire. Seed will remain viable in cold storage for over 20 years. We are planning another collection in 2009, due to a bumper pine cone crop. We will also collect Douglas fir cones to enhance biodiversity.

