

Arnold Air Force Base

Natural Resources Conservation — Large Installation / Civil Works Facility

Arnold Air Force Base (AAFB) offers a unique opportunity to conserve species and natural communities of national and global importance while accomplishing a highly complex military mission. This dual challenge is achieved in an outstanding manner through the use of efficient business processes, sound scientific methods, and effective communication.



AAFB IS A BIOLOGICALLY SIGNIFICANT SITE, with many rare species — 21 animal and 63 plant species state or federally endangered listed — being dependent on Barrens habitats.

Natural resources plans and projects were successfully coordinated with the military mission, civil works projects, and other environmental compliance and restoration initiatives through formal committees, informal meetings, and contract administration.

External coordination with partners in conservation management was highly successful. Major partners include the U.S. Fish and Wildlife Service (USFWS), Tennessee Army National Guard (TNARNG) a major military tenant on AAFB, and the Tennessee Wildlife Resources Agency (TWRA).



AAFB GRASSLAND — Grasslands on AAFB contain 25 rare plants, three plant communities, and the faunal communities they support. Important faunal groups include grassland birds, small mammals, and reptiles.

Arnold Air Force Base is restoring Barrens habitats by reintroducing fire as an ecosystem process. Of the 33 plant associations found on the installation, 17 are imperiled vegetative communities (Natural Heritage Classification).

Outstanding implementation of current Integrated Natural Resources Management Plan (INRMP) goals and objectives was accomplished while planning for and writing a completely revised INRMP.

The premier accomplishments include:

- Successfully supporting all military missions with no delays in mission timetables and no added cost.
- Delisting of formerly federally Threatened Eggert's sunflower in September 2005.
- Completion of a major 5 year revision to the AAFB INRMP.
- Continued management of 3,324 acres of Barrens habitat with 823 acres managed with prescribed fire in the FY05-06 period.
- Control of 20 invasive species on 3,300 acres.
- Significant contributions in conservation education and community involvement.
- \$50,000 savings by obtaining a new five-year wetland jurisdictional approval from the Nashville US Army Corps of Engineers by interpreting data from GIS without additional remote sensing or field work.
- Implemented Executive Order 13352 *Facilitation of Cooperative Conservation* through involvement in 11 state, regional, and/or national cooperative conservation efforts.

BACKGROUND

Located just west of the Cumberland Plateau in Middle Tennessee (TN), Arnold Air Force Base (AAFB) is home to the Arnold Engineering Development Center (AEDC). AEDC has contributed to the development of nearly every top national aerospace program since the 1950s. Customers include the Air Force, Army, Navy, National Aeronautic and Space Administration (NASA), the Federal Aviation Administration (FAA), private industry, allied foreign governments, and educational institutions.

AEDC is the most advanced and largest complex of flight simulation test facilities in the world with 58 aerodynamic and propulsion wind tunnels, rocket and turbine engine test cells, space environmental chambers, arc heaters, ballistic ranges, and other specialized units. The AEDC facilities can simulate flight conditions from sea level to altitudes of more than 300 miles, and from sub-sonic velocities to those well over Mach 20. Twenty-seven of the center's test units have capabilities unmatched in the United States.

As the only active-duty Air Force base in Tennessee, AAFB employs approximately 2,500 Air Force, Navy, Army, civilian, and contractor personnel. AAFB also supports the TNARNG on the 7,657 acre Volunteer Training Site near Tullahoma, TN where an annual average of 35,000 man-days of troop, tank, and artillery training take place. Additionally, the Tennessee Air National Guard has two active drop zones on AAFB.

AAFB occupies 39,081 acres including:

- 3,632-acre Woods Reservoir
- 1,894 acres of karst wetlands
- 171 miles of streams
- Cultivated pine forests total 5,494 acres
- Hardwood forests comprise 23,053 acres
- Grasslands and early-successional habitats in utility rights-of-way occupy 2,219 acres
- The remaining 4,683 acres of the installation are occupied by wildlife food plots, buildings/structures, mowed/bush hog areas, and other open areas.

About 90% of the installation is available for hunting, fishing, and other outdoor recreation activities and more than 75,000 recreation-use days occurred annually during the award period.

AAFB lies in the heart of the Barrens region of the Eastern Highland Rim. The Barrens region is a fire dependent ecosystem. This term most often refers to grasslands similar to the Midwestern tallgrass prairie, but may also be used to describe a mosaic of woodland, savanna, and shrubland.

There are three designated natural areas on AAFB:

- **Goose Pond (158 acres)**
- **Sinking Pond (394 acres)**
- **AEDC Power Line Barrens (244 acres)**

AAFB's INRMP was approved on 15 November 2001. Much of the FY05–06 period was spent in an intensive planning and writing effort, resulting in a completely revised INRMP for FY07–11 that was approved in December 2006. Responsibility for management of the natural resources program at AAFB falls under the 704th Mission Support Group, 704th Civil Engineering Squadron, 704th Environmental Flight, specifically the Natural Resources Manager (NRM) within the Environmental Flight.

The in-house contractor at AAFB is Aerospace Testing Alliance (ATA). The ATA Conservation Division provides assistance in planning and implementation of specific projects and activities outlined in the INRMP. A staff of 11 biologists, foresters, technicians, and administrative personnel make up the highly successful team that provides exceptional stewardship of natural resources on Base.

Program coordination and integration are accomplished through the Environmental Safety & Occupational Health Council (ESOHC) and annual work plans. Quality assurance is accomplished through the use of performance metrics and is evaluated at Quality Management Reviews and ESOHC meetings.

SIGNIFICANT ACCOMPLISHMENTS

OVERALL CONSERVATION MANAGEMENT

AAFB completely revised its INRMP for FY07-11 during the FY05–06 period by first incorporating information from previous component plans. This eliminated the time and expense of annually updating multiple component plans. AAFB then led a series of Site Conservation Planning (SCP) meetings using The Nature Conservancy's Five-S (Systems, Stresses, Sources, Strategies, and Success) Framework for Site Conservation. SCP was used as a tool for transferring the science-based, adaptive framework of ecosystem management into a clear set of goals and objectives for the Base's INRMP.

This two-year effort involved the Conservation staff and stakeholders; including USFWS Ecological Services Field Office, Cookeville, TN; TNARNG Environmental Office, Nashville, TN; TN Wildlife Resources Agency (TWRA) Region II Director and staff; and TN Department of Environment and Conservation's Division of Natural Heritage.

The new INRMP drastically improved conservation targets by expanding from four to eight targets. Threats, sources of threats, and conservation strategies were developed for all targets which were used to develop 17 new INRMP goals. AAFB's award winning GIS team was an integral part of the planning effort. Of the over 400 spatial and non-spatial databases available from in-house and subcontractor run projects, GIS coverages used in the planning effort included, landscape geomorphology



PRAIRIE GENTIAN — Barrens restoration benefits numerous rare plants — from the diminutive Dwarf Sundew to the attractive flowers of the Prairie Gentian (state listed "endangered") shown here. AAFB is currently one of three known locations for Prairie Gentian in Tennessee.

and historic vegetation modeling; historic Barrens forest structure and fire assessment; endangered, threatened, or species of concern; vegetation classification; soils; satellite imagery; jurisdictional wetlands; and archaeological sites.

The focal conservation targets identified for the 5-year period, FY07-11, are:

- **Amphibians**
- **Gray Bat**
- **Karst wetlands**
- **Streams, springs, riparian zones, and mesic slopes**
- **Closed canopy hardwood forest**
- **Woodland, savanna, and shrubland**
- **Grassland**
- **Rare, threatened, or endangered flora (those species/communities not managed under system targets).**

Planning efforts identified 3,015 acres of fragmented forest in the northern section of the Base and used GIS to determine how this could be consolidated, over time, into a 6,150-acre block of interior forest by discontinuing food plot maintenance, road day-lighting, and pine planting.

Additionally, several large blocks totaling 8,348 acres were identified for future barrens restoration and prioritized based on spatial factors such as proximity to existing restoration units to improve habitat connectivity.

Conservation and/or restoration of these targets will now benefit all the rare species and communities on the installation. It will also benefit 11 USFWS Birds of Management Concern species that require habitats ranging from grassland to forest interior.

A significant reduction in future INRMP update requirements was attained by combining the forestry, conservation, and Invasive Pest Plant Management two-year plans, which were previously prepared separately. Four additional separate component plans were also incorporated into the INRMP.

LAND USE MANAGEMENT

All ground-disturbing activities are evaluated during the Environmental Impact Analysis Process (EIAP) and erosion control recommendations are made. Best Management Practices (BMPs) have been developed and are used during all maintenance and construction projects. All revegetation activities for erosion control are integrated with the Invasive Pest Plant (IPP) management program to prevent introduction of noxious weeds.

AAFB enjoys a significant cost savings, approximately \$150,000 annually, by taking an innovative approach to its game and fish management program. A Memorandum of Agreement (MOA) allows the TWRA to operate a State of TN Wildlife Management Area on AAFB property, except for the AEDC Security Area. The TWRA coordinates all fish and wildlife activities on AAFB with the NRM and ATA Conservation on a continual basis. Lands managed for enhancement of



WHITE-TAIL DEER — In FY05-06, an innovative census technique was implemented that utilized infrared triggered digital cameras, the source of this photo, to determine deer density, buck/doe ratios, and fawn recruitment rates.

hunting opportunities include 927 acres of agricultural outleases and 933 acres managed directly by TWRA.

Hunting within the AEDC Security Area is managed directly by AAFB. Scientifically based harvest goals are now being implemented and continuing censuses are used to adaptively manage the herd.

ECOSYSTEM MANAGEMENT

Barrens restoration benefits numerous rare plants — from the diminutive dwarf sundew to the attractive flowers of the prairie gentian. Plant communities along with rare animal species — ranging from the secretive Northern Pine Snake and Eastern Slender Glass Lizard to the better known Henslow’s Sparrow and Northern Bobwhite also benefit from the restoration of these habitats.

Foremost among the rare plant species is Eggert’s Sunflower, a species formerly listed as Threatened by the USFWS.

Recovery of a federally listed species, the Eggert’s sunflower, was a FIRST for the Air Force.

EGGERT’S SUNFLOWER — Eggert’s Sunflower was removed from the USFWS list of Threatened species on 19 September 2005. The success of Eggert’s Sunflower is a highlight for AAFB and the Air Force. It is a clear illustration that careful, well-planned stewardship of natural resources is integral to mission flexibility and effectiveness.

The FY07–11 INRMP demonstrates AAFB’s continued commitment to the conservation of this species. It assures species conservation by adopting the management activities and monitoring protocols outlined in the AAFB Cooperative Management Agreement and the federal Post-Delisting Monitoring Plan, which requires monitoring for the five-year period following delisting. The monitoring protocol, which was adapted directly from the Base’s protocols, is simpler and more efficient than the previous one required for delisting.

This effort produced several advantages for the Air Force in that Section 7 Endangered Species Act (ESA) Consultations are no longer required and land use restrictions are no longer needed outside of Barrens restoration areas. Species management was simplified by reducing the number of habitat units from 358 sites scattered throughout AAFB to only nine large restoration areas, leading to a 40% reduction in management cost.



FOREST MANAGEMENT

Forest management activities provide transitional early successional habitat for many priority Barrens associated species in addition to generating funds. Forestry activities in FY05-06 generated \$586,881 total revenue by harvesting 23,169 tons of pine pulpwood, 9,239 tons of hardwood pulpwood, 1,352,340 board feet of pine sawtimber, and 269,862 board feet of hardwood sawtimber. Management activities also included 1,182 acres of prescribed fire in pine forests and reforestation of 262 acres of pine forest.



ROW THINNING — The processor shown here during a row thinning operation reduces soil compaction by using tracks instead of rubber tires.

FISH AND WILDLIFE

AAFB manages a diversity of habitats ranging from closed canopy forests to open grasslands. This variety of habitats provides for a highly diverse assemblage of fish and wildlife. To date, 412 species of vertebrates have been identified from the Base including 226 species of birds, 61 species of reptiles and amphibians, 42 species of mammals, and 83 species of fish. Additionally, 1,734 species of invertebrates have been catalogued. Two federally listed species are currently known to occur on AAFB — the Bald Eagle (Threatened) and Gray Bat (Endangered).

AAFB provides important foraging habitat for Gray Bats from the Woods Reservoir Dam maternity colony and other Gray Bat colonies around AAFB. A long term Gray Bat banding project was implemented in 2003 to determine the connectivity of bats foraging on Base and known Gray Bat colonies. In FY05-06, 1,675 Gray Bats were captured, banded, and released on Base and at area caves.

This project has provided unexpected early success with 11 recaptures in FY06 that documented previously unknown regional population dynamics. Additionally, night vision cameras were used to film and do out flight counts at project caves. These estimates were provided to the USFWS for incorporation into a review of the species' federal status.



INTERNS TRAP GRAY BATS — Gray Bats banded by AAFB biologists have been recaptured by other agencies as far away as Kentucky — demonstrating the importance of cooperative conservation efforts when dealing with this highly mobile species.

OTHER NATURAL RESOURCES

Extensive use of prescribed fire for Barrens Restoration also benefits the Northern Bobwhite and other game populations. The AAFB Wildlife Management Area (WMA) is ranked number one in the state based on strength of diversity and abundance of game species including turkey, deer, waterfowl, numerous small game species, and a sport fishery on Woods Reservoir.

The remnant grid of roads from Camp Forrest, an old World War II base on AAFB, creates an ideal circumstance for disabled hunters and has been set aside as a wheelchair-bound hunting zone. AAFB also has a boardwalk on Woods Reservoir for wheelchair-bound fisherman and is a designated TN Watchable Wildlife Area offering opportunities to view many game and non-game species.

The Base has numerous gravel roads available for hiking and biking. In FY06 the Base addressed the growing problem of unauthorized off-road mountain bike use. This problem was turned into an opportunity as natural resources personnel worked with these outdoor enthusiasts to design and mark a 13-mile mountain biking course. Similarly, the Base worked with the local saddle club to establish an updated 22-mile horse back riding course. These popular activities now occur in areas where damage to important natural communities is avoided. Other popular outdoor activities include skiing, picnicking, swimming, triathlon, boating, sailing, skeet and rifle range, and a youth fishing derby totaling over 75,000 person days of outdoor recreation annually.

COOPERATIVE CONSERVATION EFFORTS

AAFB took the initiative to organize the formation of the Tennessee Bat Working Group (TNBWG) by contacting the participants, writing the charter, supervising nominations and elections, and chairing the group in 2005-2006. Participants include 15 state and federal agencies, non-governmental organizations (NGOs), and universities. This initiative has led to three annual meetings in November of 2004-2006, an email list server hosted by The Nature Conservancy (TNC), and a web site hosted by TWRA.

Through this affiliation, AAFB biologists have provided technical assistance to TNC, TWRA, USFWS, and Humboldt State University. Projects included trapping and banding Gray Bats at two off-Base caves, a cave clean-up, trapping Gray Bats to contribute to the development of a call library for US bats, and volunteering at a cave gating. AAFB staff has also taken a leadership role in the Tennessee Exotic Pest Plant Council, serving on the Board of Directors and as Recording Secretary.

AAFB biologists assisted TWRA with the development and implementation of a state-wide monitoring program for the Henslow's Sparrow, a high priority grassland species for Partner's in Flight that is on the USFWS Birds of Conservation Concern list. Biologists also involved volunteers from the TN Ornithological Society (TOS) in annual Henslow's Sparrow banding efforts on Base. Additional assistance in the development of bird conservation strategies were provided by serving on the technical committee for the North American Bird Conservation Initiative's Central Hardwoods Bird Conservation Region. AAFB also participates in the

Monitoring Avian Productivity and Survivorship (MAPS) program by operating a constant-effort bird-banding station, the Mid Winter Eagle Count, and the Christmas Bird Count.

The Base actively cooperates with the Barrens Topminnow Recovery Group (chaired by USFWS) on the recovery of this globally imperiled Barrens endemic species. Strides were made over the two-year period to develop strategies to exclude Mosquito Fish, the Topminnow's greatest threat, from Topminnow reintroduction sites.

AAFB's NRM is an active participant in the Range Commanders Council Range Environmental Group (RCCREG). AAFB hosted and provided a tour and field trip for the June 2006 meeting of this group. In all, AAFB personnel are affiliated with over 16 regional and national professional and non-profit organizations.

INVASIVE PEST PLANT MANAGEMENT

The Conservation program systematically prioritizes IPP management activities at restoration sites identified during the SCP process based on the severity of threat posed to biodiversity at the site and across the entire Base. Sites are then evaluated based on the relative contribution to biodiversity conservation gained by managing IPPs in those sites. In FY05-06, 3,200 acres were surveyed for 30 IPP species and occurrences of 29 were documented with Global Positioning System (GPS). Geographic Information System (GIS) was used to evaluate these and other IPP occurrences leading to the treatment of 20 species on 3,300 acres in FY05-06.



HENSLOW'S SPARROW is a high priority grassland species that breeds at AAFB.

CONSERVATION EDUCATION AND COMMUNITY RELATIONS

AAFB is very active in conservation education. Activities and accomplishments include:

- **Four large conservation storyboards** were produced and displayed throughout the base.
- **Two GIS poster presentations were produced.** One was awarded First Place for Best Data Integration at the 2006 TN Geographic Information Council and the other was awarded Best Overall at the 2006 Southeast Regional ESRI Users Conference.
- **Sixteen college students were provided with 9,500 hours of internship opportunities.** Three Masters Theses related to management issues on the Base were produced by these students — a benefit for the students and cost savings for the Base.
- **Other activities and accomplishments include scientific presentations** at the National Military Fish and Wildlife Association (NMFWA), TNBWG, TOS, publishing a peer reviewed paper in the Southeastern Naturalist, and a non-technical article in *The TN Conservationist*.

MISSION ENHANCEMENT

Prescribed fire is used as a tool for Barrens restoration while simultaneously supporting the military mission. Management of the TNARNG's weapons firing fan with prescribed fire (1,181 acres) reduces the chance of reoccurrence of significant wildfires that have previously impacted training.



AAFB IS RESTORING BARRENS HABITATS by reintroducing fire as an ecosystem process.

AAFB identified and implemented land management and outdoor recreation strategies to improve availability of ranges to meet TNARNG training requirements. Prescribed fire is also used, rather than annual mowing, to implement Bird Air Strike Hazard (BASH) strategies on the airfield, resulting in an annual savings of \$25,000. Additionally, AAFB used a three dimensional representation of the slope and airborne Light Detection and Ranging (LIDAR) data in GIS to conduct an analysis of vertical obstructions within a 40:1 slope north and south of the airfield.

BASH is further supported by monitoring the Sinking Pond Great Blue Heron rookery. This rookery is located on the airfield approach and departure routes, so data are important for safe flight operations.

The Woods Reservoir Dam is a mission essential structure that provides cooling water for the AEDC engine test facilities. It also houses a priority two Gray Bat maternity colony in its gate rooms. Access to these gate rooms is prohibited during the maternity season, except in emergency situations. As a 50-year old structure, it was in need of extensive maintenance by 2005. In FY06 AAFB successfully completed an informal consultation with the USFWS to allow additional night time entrances, when accompanied by AAFB biologists, for USACE and contractor pre-bid inspections. Repair contracts were awarded on time and the needed maintenance was completed outside of the maternity season.



ENVIRONMENTAL ENHANCEMENT

AAFB Conservation designed and implemented an extremely challenging, Commander-directed timber sale to widen the right-of-ways on 15 miles of AAFB's major highways. This project enhanced public safety and reduced the potential for long term road closures from severe ice storms. It also alleviated the potential for major mission impacts from future ice storms that previously caused thousands of downed trees. This effort required the establishment of over 50 logging decks with rock to protect drainage systems and expending over 6,000 man-hours in support of this huge one-time timber sale.

NATURAL RESOURCES COMPLIANCE PROGRAM

All installation activities are evaluated for impacts to natural resources through a computer automated Environmental Impact Analysis Process using MATRIX software. Conservation personnel are now able to review 100% of proposed projects and require appropriate mitigations or schedule consultations if needed. In FY05-06, 512 AF Form 813s were reviewed and all were completed on time for fast turn projects.

TIGER SALAMANDER — Twenty-six species of amphibians occur on AAFB. Amphibians were chosen as a conservation focal target because they require wetlands for breeding and maturation of young and forest for the adult stage. This unique life history trait connects upland habitats with aquatic systems and allows for nutrient transport out of wetlands and back into upland habitats, thereby contributing to ecosystem health and function.