Desert Tortoise Hatchling, Edwards AFB, CA

The desert tortoise (*Gopherus agassizii*) is federally-listed as threatened for the entire Mojave Desert. Installations that manage for this species include National Training Center at Fort Irwin, Edwards Air Force Base, Marine Corps Logistics Base Barstow, Marine Corps Air Ground Combat Center Twentynine Palms, and Naval Air Weapons Station China Lake in CA; Yuma Training Range Complex in AZ and Nellis AFB in NV. Fort Irwin has implemented a series of programs that contribute to desert tortoise conservation, which center on extensive education and public outreach programs, maintenance of off-limits areas, and scientific research. In 2005, using base funds and start up money from Legacy, Edwards Air Force Base began a Desert Tortoise Head Start Program (05-255) a captive breeding program similar to one developed and implemented by Fort Irwin, wherein base natural resource management staff collect reproductive females and hold them in secured enclosures until their hatchlings can be safely released. Each year, Edwards AFB releases dozens of young tortoises back into the wild. This ongoing effort project is designed to help offset the large population decline of desert tortoises. In the most recent Legacy project (09-385) to support desert tortoise management, researchers are developing a landscape-scale predictive model to identify desert tortoise activity centers, map tortoise distribution, and determine phylogenetic grouping to assist managers in evaluating potential military training impacts in the Sonoran Desert, which supports a population of Desert Tortoise that has not yet been listed.

North American Osprey, Langley AFB VA

The osprey or sea hawk (*Pandion haliaetus*) is one of the most widely distributed birds in the Northern Hemisphere and thus poses a risk to military flight operations. The Chesapeake Bay Watershed contains our nation's most abundant and productive breeding areas for ospreys. A multi-year Legacy project in support of the Air Force (08-292) incorporated the application of satellite biotelemetry and geospatial referencing in order to quantify bird-strike risk of migrating and breeding ospreys from the Mid-Atlantic Chesapeake Bay Region. Researchers fitted eleven ospreys with satellite transmitters and tracked them via satellites. This information helped evaluate and identify osprey-strike risk in the vicinity of Langley Air Force Base, VA, and six other installations by determining specific migratory travel routes, timing, and movement characteristics along the Atlantic seaboard, their habitat use patterns and behaviors during the breeding season, and the effectiveness of management activities designed to mitigate osprey-strike hazards. Incorporation of osprey movement information into integrated natural resources management plans (INRMPs) and military flight mission planning systems will allow military flight operations to occur at times and locations that minimize the risk of osprey-aircraft collisions. In addition, the novel approach to bird-strike risk modeling developed by this project will be very useful for assessing strike risks posed by other species (e.g., turkey vulture) that are hazardous to military aviation.

Pitcher Plants, MCB Camp Lejeune, NC

Seepage bogs of the Gulf Coastal Plain are boggy habitats well known for their diversity of plants. They support over 45 carnivorous plants including pitcher plants (*Sarracenia flava*). Seepage bogs also support a remarkably high number of state and federally listed species, candidates, globally imperiled and species at risk. However, over 97% of the bogs throughout Florida, Alabama, Mississippi and Louisiana have disappeared because of human activities (such as fire suppression, drainage, and land conversions).

Some of the best remaining examples of seepage slopes are found on military bases in and adjacent to artillery ranges where fire is a common occurrence and unexploded ordnance provides protection from development. Through the implementation of their INRMPs, military installations throughout the southeast protect this rare habitat. Bases containing this important habitat include Avon Park Air Force Range, Eglin Air Force Base, Tyndall Air Force Base, Naval Air Station, Pensacola, Naval Center, Saufley Naval Air Station, Whiting Field, and Hurlburt Field, in FL; Fort Polk in LA; Fort Benning and Moody Air Force Base in GA; MCB Camp Lejeune in NC; and Camp Shelby in MS. Because of a complicated hydrology, this habitat represents an enormous conservation and ecosystem management challenge. A three-year Legacy study (04-120) quantified the overall regional significance of seepage slope sites on DoD lands and provides information that promotes planning and integration of ecosystem management measures to this rare habitat type.

Golden-cheeked Warbler, Ft. Hood, TX

The golden-cheeked warbler (*Dendroica chrysoparia*) is a small, federally-listed endangered songbird that nests only in central Texas. It occupies mixed ash-juniper and oak woodlands in ravines and canyons, including areas of Fort Hood and Camp Bullis. As part of their INRMPs, both installations monitor this species and work to find ways to protect existing populations and increase species numbers. In 2004, The Nature Conservancy concluded a comprehensive population trend analysis of this species from 1992 to 2002 for Fort Hood. Researchers found that the population on the base had steadily increased over the 10-year period, due largely to habitat protection measures and a Fort Hood program to remove brown-headed cowbirds (a brood parasitic species that causes the loss of golden-cheeked warbler eggs). A Legacy-funded ecological assessment of the species' habitat covering the whole Edwards Plateau (00-114) identified threats and set conservation goals for this and other species in the region. Natural resources managers use the results and recommendations to guide their conservation efforts.

Longleaf Pine Habitat, Ft. Stewart, GA

Some 200 years of logging and land clearing have reduced the range of the longleaf pine (LLP) forest (*Pinus palustris*) by more than 95%, making LLP that occurs on DoD lands an important resource. For example, of Fort Bragg's 161,000 acres, more than half (about 89,000 acres) are covered with LLP, representing one of the last strongholds for this disappearing ecosystem. Well-managed LLP forests provide quality habitat for a variety of plant and animal species including the gopher tortoise (a species at risk in its eastern range) and the federally-listed red-cockaded woodpecker (which uses living trees for nesting cavities), both of which occur on military installations throughout the southeast. Management on Fort Bragg, including prescribed burns and

replanting, as well as training modifications, has resulted in an increase of the red-cockaded woodpecker that exceeds the goals set by the USFWS, while still allowing for in field training. Other installations have similar programs. In 2009, SERDP and other partners hosted a workshop to bring together experts to gain a better understanding of current research taking place on the nexus between longleaf pine and climate change, and to identify issues and opportunities for further research coordination. Expected outcomes could help guide research related to longleaf restoration and climate change.

Burrowing Owl, Kirtland AFB, NM

The burrowing owl (*Athene cunicularia*) is a small, long-legged owl that, unlike most owls, is active during the day and lives in ground burrows. They have declined throughout the Western U.S. and Canada, and have been extirpated from the periphery of their breeding range. In the U.S., the burrowing owl is a federal candidate species, and in several states, they are considered a species of special concern. They are also protected under the Migratory Bird Treaty Act.

Despite declines, this species appears to be increasing in other areas of the country. In order to determine what is truly happening with the burrowing owl (is it becoming less migratory or just rarer?), Legacy funded a five-year project (08-243) in which researchers used stable isotopes of owl feathers, molecular genetics, and radio telemetry, to determine the migratory linkages of this species across 39 installations in the west. The study has quantified the importance of DoD lands to burrowing owl populations in the region, identify migratory linkages among DoD installations and lands managed by 31 partners in the US, Canada and Mexico, and determine whether or not burrowing owls are indeed declining. This information is vital to supporting the military mission because it will:

* help identify the management role of the DoD for conserving burrowing owls,
* improve management on DoD installations throughout the western U.S.,
* help prevent further listing efforts for a species that is found on dozens of DoD installations, and
* facilitate a broad partnership among management agencies in the western U.S. with DoD playing a leading role.

West Indian Manatee, Cape Canaveral AFS, FL

The West Indian manatee (*Trichechus manatus*) is a federally-listed endangered marine mammal that inhabits coastal and inland waters in the southeastern United States and the Caribbean basin. Significant numbers of manatees live in the waterways of DoD coastal installations, including Cape Canaveral AFS, Patrick AFB, Jacksonville FISC, Jacksonville NAS, Key West, NAS, MacDill AFB, and Mayport NAVSTA in FL; Military Ocean Terminal Sunny Point and MCAS Cherry Point in NC; Charleston NWS in SC; Guantanamo Bay NAVSTA in Cuba; and Kings Roosevelt Roads, NAVSTAPR Bay, and Vieques Island AFWTF in Puerto Rico.

Manatees are vulnerable to collisions with watercraft and impacts from these collisions are still the primary cause of severe injury and mortality. Although the US Fish and Wildlife Service (USFWS) mandated reduced speeds for watercraft in manatee habitat, strikes and injuries did not decrease. A marine mammal behaviorist, funded by the US Navy and Legacy (06-232 and 08-414), gathered a comprehensive series of psychoacoustic measurements and behavioral data that revealed in typical ambient conditions, the sounds of many slow moving boats are acoustically masked and manatees cannot detect or locate approaching watercraft. Because the USFWS is retaining its reduced speed requirements, the project

researcher developed a prototype mechanism that alerts manatees of oncoming slow moving vessels. The device is an effective and affordable technology to protect manatees from injury of impact with DoD vessels. Aside from the direct military benefit, these devices benefit the civilian sector and will help protect manatees throughout their ranges.

Nantucket, a Peregrine Falcon
McGuire AFB, NJ

Preventing Bird Air Strike Hazard (BASH) conflicts is a tremendous challenge throughout DoD. Birds can pose a major threat because of the possibility they could get sucked into jet engines and cause crashes. At McGuire Air Force Base, NJ, nuisance species can include Canada geese, English house sparrows, European starlings, common pigeons or rock doves, mute swans, red-winged blackbirds, brown-headed cowbirds, common grackles, and American crows. Installations employ a wide variety of methods to discourage birds and other wildlife from occupying airspace on or near runways. One method that McGuire AFB employs is to fly trained falcons in the area to police the skies around McGuire during the day to frighten and in some cases chase and attack potentially dangerous flocks. Nantucket, a peregrine, is one of 10 falcons used by the McGuire staff. Other bird-prevention techniques include keeping grass short, reducing pools of water and harassment with dogs, pyrotechnics and false distress calls. DoD Partners in Flight representatives provide significant technical assistance to flight safety managers across the country.

San Nicolas Island Fox Kits, OLF
San Nicolas Island, CA

The San Nicolas Island Fox (*Urocyon littoralis dickey*) is a species at risk. Four of the six Channel Islands fox subspecies already are listed under the Endangered Species Act (ESA) due to rapid population declines. While the specific mechanisms for the declines differ, all were associated with a sudden increase in mortality.

Fox densities on San Nicolas Island, CA are unusually high, making this population particularly susceptible to the spread of an unanticipated virulent disease. If the population fell, this species could be listed under the ESA and operations on San Nicolas Island could be severely impacted. A three-year Legacy project (08-308) developed an effective and efficient automated monitoring technique to detect potential threats in time to prevent population declines to critical levels. By use of radio collars and a telemetry system, an efficient and effective way of monitoring a key species on the Channel Islands under the jurisdiction of the U.S. Navy will facilitate fox conservation efforts and minimize costs. Other installations could use these same techniques to monitor their fox populations, both on island and mainland habitat.

Bells Vireo, Fort Huachuca, AZ

Riparian woodlands in the desert southwest are an extremely important resource because they constitute less than 1% of the desert landscape, yet typically support more than 50% of the region's breeding birds. Dozens of species of Neotropical migratory birds, such as the Bells vireo (*Vireo bellii* -a Partners in Flight Watch List Species), use these woodlands during their spring and fall migrations for food, shelter and nesting. Ground water withdrawal (and subsequent loss of surface water) to support urban development in the desert southwest has the potential to degrade or eliminate riparian woodlands, including those along the San Pedro River adjacent to Fort Huachuca, AZ. This could ultimately lead to more species listings and more constraints on military training and operations in the area.

Legacy funded a three-year study (08-290) to quantify the impacts of groundwater withdrawal from the San Pedro River and to determine the extent to which both surface water and the health of riparian vegetation influence the abundance and diversity of riparian birds. Now models allow resource managers on military lands to better predict the effects of future ground water withdrawal and surface water depletion on riparian bird communities such as the Bells vireo.

Loggerhead Sea Turtle, Cape Canaveral AFS, FL

The federally threatened loggerhead sea turtle (*Caretta caretta*) is named for its relatively large head, which supports powerful jaws that enable it to feed on hard-shelled prey. Because loggerheads occupy three different ecosystems during their lives (the terrestrial zone, the oceanic zone, and the nearshore zone), they are vulnerable on the beaches and in the shore waters of DoD installations and elsewhere along the east coast and in the Caribbean.

Installations that manage and protect loggerheads as part of their INRMPs include MacDill AFB, Cape Canaveral AFS, Eglin AFB, Mayport NAVSTA, Patrick AFB, and Tyndall AFB in FL; Military Ocean Terminal-Sunny Point, MCAS Cherry Point, and MCB Camp Lejeune in NC; Dam Neck, Oceana NAS, Wallops Island, and Surface Combat Systems Center in VA; Kings Bay NSB in GA; Vieques Island AFWTF in Puerto Rico; and Guantanamo Bay NAVSTA, Cuba. These installations clean beaches, protect nesting sites from traffic and pedestrians, and monitor populations in various ways (such as with radio transmitters) to gather data crucial for focusing and developing effective management strategies.

Young Red-footed Booby, MCB Hawaii, HI

The red-footed booby (*Sula sula*) is a large sea bird that spends most of its time at sea but breeds and nests on tropical islands. This species is protected under the Migratory Bird Treaty Act and is included as a species of greatest conservation need in the State Wildlife Action Plan for Hawaii.

Marine Corps Base Hawaii on Oahu protects and studies a large breeding colony of nearly 3,000 birds in the installation's Ulupa'u Crater area. Vital combat weapons training and the breeding birds were both at risk from brushfires in invasive grasses within the impact area in the crater. To remedy this, the installation placed gravel-anchored geotextile matting around the perimeter of bird habitat tree clusters, to repress weed growth, hold down the soil, and create a secondary fire break. In addition, the installation installed water cannons for firefighting and artificial perches to offer additional roosting sites. The installation collected baseline breeding success data under the *Red-footed Booby Breeding Success at Ulupa'u*

Crater, Marine Corps Base Hawaii Project, in an effort to understand the threats to breeding success at this colony. From this study, they learned that fire is still the most immediate threat to nesting viability. Study findings will help guide the natural resource managers (not just on Marine Corps Base HI but anywhere this species nests) to the most effective management and protection measures to implement.

Mud Ops at Nu'upia Valley.

Every January since 1982, Marines invade Nu'upia Ponds wetlands at MCB Hawaii with 26-ton amphibious assault vehicles. Their massive tracks kill invasive pickleweed and create a 'moat and island' terrain that the federally endangered Hawaiian Stilt (*Himantopus knudseni*) needs to nest successfully. Stilts nest on mud mounds, where water deters predators; they pierce their sword-like beaks through the mud to devour flies, worms, and crustaceans. The stilt population at MCB Hawaii has more than doubled since mud ops training began.

Timber Rattlesnake, USMA West Point, NY

The Timber rattlesnake (*Crotalus horridus*) is found scattered across most of the eastern United States. However, despite this large range, most are found in increasingly isolated populations. While not yet federally-listed, it is state-listed in many states, including New York. Timber rattlesnakes have been extirpated in many areas, and populations are patchy and fragmented due to unregulated collection and indiscriminate killing. They also reproduce at a low rate, making for slow population growth. At U.S. Military Academy West Point, NY, natural resource managers:

* implemented an eight-year restoration project to boost the population,
* provide education and outreach about the species,
* developed a tagging method used to monitor the species, and
* provided expertise to the State of New York during the development of the species recovery plan.

Mexican Spotted Owl, Ft. Huachuca, AZ.

The Mexican spotted owl (*Strix occidentalis lucida*) is a federally-listed threatened species. Although Mexican spotted owls have the largest geographic distribution of all spotted owl subspecies (and can be found in forested mountains and canyons across the Southwest U.S.), there are only an estimated 2,100 Mexican spotted owls in the U.S today. Recreational development along rivers and streams and timber harvesting in northern Arizona and New Mexico forests contribute to their decline. This species prefers a consistent home range and most owls remain within the same territory year after year, which makes the species particularly vulnerable. Of the 17 territories known to be used by the owl, nine occur on Fort Huachuca AZ. The fort's INRMP contains 18 measures to reduce impacts of military activities on listed species and their habitat. The fort also is implementing a separate Endangered Species Management Plan designed specifically for the owl. Fort Huachuca has supported annual population monitoring, banding, telemetry studies and population genetics research since 1990 to provide a better understanding of Mexican spotted owl population biology. In 2007, the fort confirmed nesting pairs in all nine monitoring sites on the fort, an occurrence that has not happened since base monitoring began. Other installations that monitor and manage for this species include, Camp Navajo, AZ, White Sands Missile Range in NM, and Fort Carson, CO.

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