Department of Defense
Legacy Resource Management Program

Natural Selections

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Legacy Program Update

The Legacy Program to meet with DoD decision makers: The Legacy Program will present the results of the FY 2010 proposals review meeting to senior DoD decision makers the week of November 16. We expect to begin making selection announcements by the end of December.

Legacy Project Highlight of the Month

Legacy Project 07-364: Intensive Plant Conservation Training Workshop

The six-day workshops focused on 17 different topics, including rare and imperiled plants, plant protection and legislation, how to measure success, and how to inventory and monitor imperiled plants. Nearly 40 experienced botanists from academia, agencies and non-governmental organizations helped to develop the workshop. These botanists also worked collaboratively to put together take-home resource materials for attendees.

Workshop participants complete an exercise in monitoring. Photo: Center for Plant Conservation

The workshop instructors are among the top plant conservation practitioners in the country. They provided

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In The News

Endangered *Cyanea superba* Responds Positively to the Strategic Management Efforts of the Army Garrison Hawaii's Natural Resources Program

By Kim Welch[1] and Michelle Mansker[2]

1 Environmental Outreach Specialist, Research Corporation of the University of Hawaii
2 Natural Resources Section Chief, U.S. Army Garrison Hawaii, Directorate of Public Works, Environmental Division Oahu Army Natural Resources Program

The rough crunching sounds of spiked hiking shoes mixed with morning bird calls, as a crew of field technicians from the Army Garrison Hawaii's Natural Resources Program (NRP) made their way into the native forest at the back of Makua Valley, Oahu. The crew walked at a brisk pace, anxious to get in position to receive a delivery of precious air cargo that had taken years to prepare. Today, 29 endangered *Cyanea superba* plants would be re-introduced to the forest of their origin.

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Inside This Issue

Naturally Speaking

From the Desk of L. Peter Boice,
DoD Deputy Director, Natural Resources and Director, Legacy Program

The Military Value of Plants

Plants on military training sites have it tough: if they're not being run over by wheeled vehicles, they're being trampled by foot soldiers or inadvertently set ablaze by wayward ordnance. They're also susceptible to more traditional disturbances, such as extreme weather conditions and infestations by invasives.

Yet, maintaining a healthy vegetative cover is a key component of a fully operational military training area. It is essential to realistic training, enhances safety, and is more cost-effective than treating and restoring degraded areas.

Grassland areas are perhaps DoD's most intensively used systems. When possible, the ecological and economic preference is to maintain native grasses through a combination of rest, rehabilitation and restoration. But both native and nonnative grasses have a role. To protect more fragile areas, DoD has worked with researchers from institutions such as the Agricultural Research Service to develop training-resilient plants from a variety of source materials. This work has focused on developing improved lines of native grasses such as wheatgrass, as well as on complementary efforts to develop genetically diverse new grasses derived from nonnative (but non-invasive) grasses.

Studies sponsored by the DoD Strategic Environmental Research and Development Program (Project SI-1103) have shown that naturalized, introduced species are more tolerant and recover more rapidly from repeated tank tracking than native plants. Two native species, the western and Snake River wheatgrass, show promise as stabilization species because of their ability to colonize damaged areas. Other studies confirm that seed mixes of selected native and introduced species establish more rapidly than all-native mixes, allowing earlier land use for training and ultimately leading to healthy and resistant stands of native plants.

Like grasslands, forest ecosystems also are important. For example, they provide essential outdoor classrooms for today's military. A longleaf pine forest, such as those found on major Army training bases in the southeastern United States, affords both suitable cover and room to maneuver; further, it provides good bivouacking opportunities. In addition, healthy forests are less susceptible to damaging wildfires.

Healthy coastal vegetation also supports military readiness. Dune grasses protect amphibious training areas; likewise, wetlands vegetation reduces erosion and prevents other pollutants from damaging streams and other waterways. Controlling erosion takes on increased importance as we begin to see the very real consequences associated with rising sea levels. These changes will only accelerate over the coming decades, further emphasizing the urgency to protect coastal vegetation.

In addition to these and other means in which they directly support the military mission, plants add to the quality of life in military cantonment and recreational areas – be it through native plantings in arid areas, shaded picnic and camping sites, prime habitat for game species such as wild turkey, or the occasional walnut or blueberry.

Not all plants are of equal value. The February 2010 issue of Natural Selections will focus on the dark side of plants: when they become invasive. So, stay tuned for the next exciting issue of Natural Selections… and the one after that, and the one after that.

Did You Know?

Trees help nourish the environment in many ways: they help remove carbon dioxide, a greenhouse gas, and reduce urban runoff and erosion. Trees also help improve water quality by filtering rain water.

Trees provide huge energy efficiencies by providing shade and shelter, reducing heating and cooling costs by about $2.1 billion per year. Planting trees in strategically placed areas around buildings may reduce air-conditioning costs by up to 50%.

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attendees with invaluable practical advice based on years of experience. Instructors at the Hawaii 2008 workshop were employed by partners such as the Chicago Botanic Garden and the Smithsonian Institution; these skilled scientists addressed common issues facing DoD installations across the country. Because the workshop instructors are on the front lines of plant conservation, they presented the latest in plant-conservation science.

Of the more than 30 participants in the Hawaii workshop, many of whom were DoD personnel, 100% stated that they would recommend the workshop to others and felt that the knowledge gained from the instructors would help them in their careers. Through the workshop, attendees gained confidence in securing and managing plant biodiversity resources on DoD lands and made connections with scientists, both within and outside of DoD, who can provide resources and information for plant-conservation efforts going forward. The Center for Plant Conservation (CPC), with support from the DoD Legacy Program, will present another workshop in December 2009 in Berkeley, California. Registration information is on the CPC website: www.centerforplantconservation.org.

Legacy Project 07-368: Listed Plant Species Evaluation

In order to preserve our nation's threatened and endangered flora, seed and other materials from imperiled plants need to be collected and securely stored ex-situ (or off site) to support critical research and restoration needs. With these collections at many institutions scattered across the country, it is difficult to determine what materials still need to be preserved in order to ensure the health of plant communities.

The CPC's Legacy-funded plant species evaluation project assessed the status of ex-situ collections of 185 at-risk plants found on DoD lands. By strategically engaging CPC's network of botanical institutions to survey records and botanical experts, and maintaining a database about these collections, CPC determined for DoD which species had existing collections and those locations of the collected seed.

Some of the imperiled plants DoD is concerned about, such as Harperella (*Ptilimnium nodosum*), are already part of CPC's National Collection of Endangered Plants, wherein CPC institutions are assigned to secure genetic samples ex-situ in case a species becomes extinct or no longer reproduces in the wild.

Harperella, known from only ten populations, is in the same plant family as carrots and dill, as well as several other plants that have medicinal value.
Photo: Johnny Randall

Seed freezer storage at Berry Botanic Garden.
Photo: Ed Guerrant

The final assessment of 185 species on DoD lands showed that 61 DoD species of concern -- almost one-third of the species surveyed -- have no material secured in storage. In addition, 69 species collections are not from DoD lands specifically, which may limit the department's ability to conduct restoration of these species with the most desirable material. CPC's report provided DoD with detailed information about all existing collections, enabling DoD personnel to prioritize planning for new and additional collections of plant material.

Projects like these further plant conservation and ultimately help to preserve our nation's biodiversity for generations to come. For additional information on the Center for Plant Conservation, visit the CPC website at www.centerforplantconservation.org.

CPC Provides Resources for DoD Conservation

By Anna W. Strong
Conservation Projects Coordinator
Center for Plant Conservation

The Center for Plant Conservation (CPC), celebrating its 25th anniversary in 2009, is the only national non-profit organization dedicated solely to saving America's most at-risk plants. CPC's national office in St. Louis, Missouri, coordinates plant conservation work through its 36 selected botanical institutions across the country. By developing standards and protocols, conducting conservation programs in horticulture, research and restoration, and raising awareness, CPC is striving to save America's most vulnerable plants from being lost forever.

CPC is pleased to have the opportunity to partner with the Department of Defense on two significant plant conservation projects: the intensive plant conservation training workshops and the listed plant species evaluation. By providing training to natural resource managers and botanists and by analyzing existing seed banked collections for federally listed and candidate plant species on DoD lands, these projects have provided the resources for DoD to increase the knowledge and expertise of personnel working with imperiled plants. The projects also promoted partnerships with other federal agencies and non-governmental agencies and facilitated the increasingly important work of plant conservation around the country.

Did You Know?

Some plants are able to make their own heat. The skunk cabbage blooms earlier than most other North American flowers and, as the flower bud grows, it can produce enough heat to melt the surrounding snow and ice.

The tallest tree in the world is a California Redwood located in the Redwood National Park, California; it soars over 375feet. The oldest recorded tree is the Great Basin Bristlecone Pine, located in the Ancient Bristlecone Pine Forest of the White Mountains near Bishop, California. Nicknamed "Methuselah," it is believed to be more than 4,600 years old.

Wheat is the world's most cultivated plant. It is grown on every continent except Antarctica.

Photo by Dorothy Jackim

Bamboo is not a tree. It is actually the world's tallest grass, growing to heights of over 130 feet. Bamboo is the primary food source for the endangered panda. It is also the fastest growing woody plant in the world. In North America, where it lacks natural controls, bamboo has become highly invasive, often displacing native plants and forming dense monotypic stands.

Strategic management, continued from page 1

Since 1998, when less than 10 wild *Cyanea superba* remained on the planet, NRP staff has taken proactive measures to improve the plant's chances for survival. The remaining wild plants were closely monitored, year after year. Although they would produce flowers and fruit, the lack of new seedlings on the forest floor did not bode well for the future of wild *Cyanea superba* in Hawaii. Recognizing this sure path to extinction, NRP intervened.

Fences were built to keep pigs and goats from damaging the Cyanea's fragile roots and seedlings. Invasive weeds were kept in check. Slug deterrents were put in place to keep these non-native plant predators from nibbling up precious Cyanea seedlings. Rat-traps and rat bait stations were put in place to keep rodents from decimating the Cyanea fruit. And if the NRP staff could get to the plants before the rats, they would collect fruit and bring the seeds back to the seed lab.

Cyanea superba seedlings discovered growing in the wild beneath plants that had been re-introduced into Kahanahaiki by NRP staff.

Helicopter delivers a plant box filled with endangered plants to a remote native forest where NRP staff re-introduce them to the wild.

The precious seeds were placed in petri dishes and grown in incubators. Form there, seedlings were moved into the nurseries where they were nurtured and monitored until they reached a full meter in height, a process that normally takes up to three years. Unfortunately, during these ten years of intensive management, the last remaining *Cyanea superba* went extinct in the wild. But NRP anticipated this sad day and the Cyanea seedlings that were growing in NRP nurseries would soon fill the void in the native forest of Makua. To date, over 250 *Cyanea superba* plants have been grown and returned to Makua by NRP staff and this week's delivery would raise the number by an additional 29 plants.

This week the endangered Cyanea were loaded into a plant box designed for transport by helicopter to the remote out-planting site. Matt Keir, NRP Rare Plant Manager, guided the incoming helicopter to the nearby landing zone on the rim of Makua. The plant box was hooked up to a cable and within minutes it was airborne beneath the helicopter and carried into the Makua forest. The awaiting field crew in the forest unloaded each plant and packed them on their backs into shady gulches for planting.

Did You Know?

With a whopping 317 threatened and endangered species, Hawaii is often referred to as the endangered species capitol of the world. There are more listed endangered species per square mile on these islands than any other place on the planet! Thirty percent of these endangered plants and animals can be found on Army lands.

Cyanea superba looking skyward.

Just this month, a researcher in the forests of Makua noticed seedlings beneath a handful of re-introduced Cyanea. In 10 years of working on this project, Keir said that had never happened. When asked why this particular re-introduction of *Cyanea superba* was unique, Keir could barely contain his enthusiasm. “We found seedlings for the first time, really ever. That’s huge,” said Keir. “That’s exactly what we’re trying to do. We’re trying to out-plant little seed-making machines, basically. We grow them up so they’ll survive well, put them out there, and we hope that they just dump seeds on the ground for the next 25 years.”

NRP staff is hopeful that this week’s re-introduction of *Cyanea superba* will be a significant boost to the seed making potential. “And if we can protect the forest around them,” says Keir, “then hopefully we can just step back and let it happen.”

Cyanea flower. The *Cyanea superba* is one of 73 federally-listed endangered species that the Army manages on Oahu.

NRP field technician, Kala Lindsey-Asing (right) and Hawaii Youth Conservation Corps volunteer, Koa Matsuoka (left), take measurements of an endangered *Cyanea superba* in Kahanahaiki.

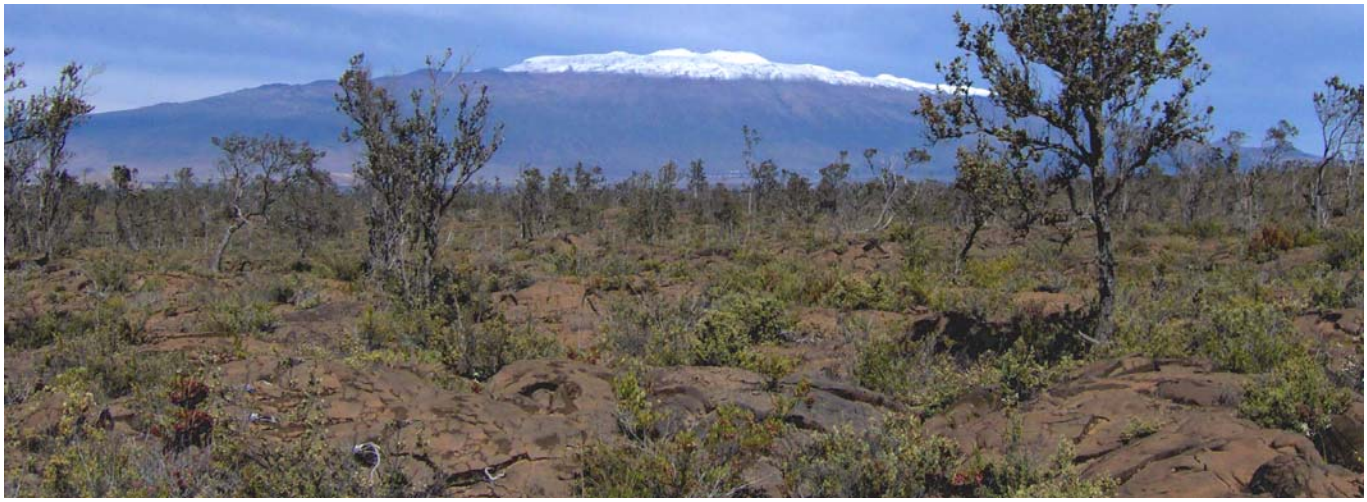
Understanding the Pollination Ecology and Breeding Systems of the Endangered Plant, *Kadua coriacea*

By Christian Torres-Santana and Clifford W. Morden
University of Hawai`i at Mānoa, Department of Botany

The endangered *Kadua coriacea* (formerly *Hedyotis coriacea*), or kio`ele, is a small, multi-branched shrub with leathery leaves and blooms white, perfect flowers. This endemic member of the coffee family (Rubiaceae) is now known only from the U.S. Army Pōhakuloa Training Area (PTA) on the island of Hawai`i, but is historically also known from the islands of Maui and O`ahu. There are only 175 wild plants left that are scattered in five subpopulations of this subtropical, montane to subalpine dry forest, a very rare ecosystem worldwide. The risk of extinction for this species is exacerbated from direct browsing by introduced feral goat and sheep. Since this species was rediscovered in PTA, only a single seedling is known to have germinated and grown naturally despite the fact that the plants are flowering and fruiting annually and that browsing ungulates have been excluded. Consequently, the PTA Natural Resource Staff are working to increase wild grown plants by reintroducing several hundred individuals in PTA, Pu`u Wa`awa`a Forest Reserve, Koai`a Tree Sanctuary, and Pu`u Huluhulu.

A coalitions is conducting field studies to better understand the reproductive mechanisms and the pollination ecology of *K. coriacea* since the beginning of January 2009. This work involves many collaborators, including U.S. Army

environmental personnel, the Colorado State University Center for the Environmental Management of Military Lands, Pōhakuloa Training Area Natural Resources Staff (PTA NRS), the manager of the Pu`u Wa`awa`a Forest Reserve, and the University of Hawai`i (UH) Pacific Cooperative Studies Unit. Researchers from other organizations, including Dr. Jeff Zimpfer of the U.S. Fish and Wildlife Service, Dr. Karl Magnacca from the UH-Hilo, and Dr. Caroline Gross from the University of New England (Australia), assist in the field with data collection. In addition, various students from UH-Hilo and UH-Mānoa along with community members of the island of Hawai`i are involved.



Subalpine dry forest with Mauna Kea in the background. Photo: Carlos A. Torres

The components of the study include mostly manipulated pollination experiments, flower phenology monitoring, insect visitation observations, and other aspects of plant reproductive biology (e.g. nectar content, pollen viability). The remoteness of the field site and logistical reasons made it necessary to use circuit surveillance cameras to monitor insect visitation on flowers of *K. coriacea*. This surveillance system can record continuously for 24-hours and records the data on video for later viewing. Even though in-person observations are more reliable, the surveillance camera facilitates more hours of direct observation that may be essential to detect rare pollination events of these plants.

A summary on the findings of the study suggests that in 2009, *K. coriacea's* flowering peak in PTA occurred from April to July, following the rainy season. However, some plants were found to be flowering earlier and/or later than the peak dates. The majority of the plants in the population are adult, indicating that most plants are capable of reproducing. The flowers of *K. coriacea* are heterostyly (having different flower morphologies, usually to promote cross pollination) and occasionally varying in flower size and color. All of the five manipulated pollination experiments resulted in a fruit set at different proportions. Therefore, the preliminary results suggest that plants may self-pollinate. Self-pollination may lead to inbreeding and possibly inbreeding depression, although the genetic fitness of the seeds and seedlings are yet to be investigated.

A) *Kadua coriacea* flowers showing heterostyly.
B) Adult plant of *Kadua coriacea*.

Observations recorded at different time intervals, suggest that a total of 10 species of insects, one spider, and one mite visited the flowers of K. coriacea at different times of the day. The insect groups include house flies, syrphid flies, moths, honey bees, yellow faced bees, ants, beetles, and aphids. The most common visitors, however, were the introduced honey bees and syrphid flies. Native yellow faced bees (Hylaeus spp.) were also observed visiting plants on hot sunny days, mostly in the morning and midday hours. Interestingly, the native Hylaeus bee was observed robbing all the pollen from an untouched, open flower that subsequently did not yield any fruits.

Christian Torres (left) installing an insect exclusion bag (right) used in manipulated pollination experiments.

Since 2006, PTA NRS has been successfully reintroducing K. coriacea to Pu`u Wa`awa`a Forest Reserve. Some plants were established and set seeds, but no regeneration was observed in subsequent years. A recent discovery of 26 seedlings by PTA Horticulturist Kathy Kawakami gave us hope that the species will someday recover and finally reproduce to become bountiful.

The funding for this study was provided by the U.S. Army Garrison. Ongoing studies also include examination of the population genetics of the species to determine what genetic issues may be impacting plants in these populations. We anticipate that these efforts will assist the PTA NRS in their conservation management decision of this endangered plant species.

Where Have All the Chestnuts Gone? The Army National Guard and Legacy Doing their Bit to Help Bring Them Back (Legacy # 08-401)

By: Janie Becker, Conservation Biologist
TNARNG Environmental Branch (Contractor)

Before the turn of the 20th century, the American chestnut (*Castanea dentata*) was one of the dominant tree species in the eastern forests of the United States. They were majestic trees in extensive stands, with mature individuals averaging five feet in diameter and over one hundred feet tall. In addition to providing an unparalleled food source for wildlife and dominating the forest ecosystem, the nuts and lumber from this species played a major role in many rural Appalachian economies. Its wood was fast growing, rot resistant, and it was the primary hardwood timber species harvested in the 19th and early 20th centuries.

All of this changed after the arrival of the Asian chestnut blight (*Cryphonectria parasitica*) in the United States in the late 1890s. The first documented occurrence of the blight in the United States was in 1904 at the New York Zoological Garden. Its microscopic spores are released into the air and infect chestnut tissue when they land on wounds or trunk fissures, which are created when a tree matures. This fungus decimated American chestnut stands and, by 1950, most of the chestnut trees throughout its native range, east of the Mississippi, were dead or dying. In just a few decades, the American chestnut went from being the keystone species on an estimated 9 million acres to a relic, hanging on in the sprouts arising from the root stock of the fallen trees and a few surviving mature trees scattered across the species' range. The sprouts, too, are almost always killed by the blight before they reach reproductive age, so natural reproduction is almost unknown.

Protective tree tubes are placed on top of seeds and seedlings as they are planted to protect the trees from small mammal herbivores.

The Backcross Method

Today, several different approaches are being taken in the effort to restore the American chestnut. One of these, the backcross method, seeks to instill blight resistance into American chestnuts by hybridizing 100% American chestnuts with the 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 traits that are more outwardly American chestnut are used to produce seed for the following generation. The term “backcross” is used to indicate that a 50/50 hybrid (an offspring with parents of two different species, in this case, American chestnut and Chinese chestnut) is crossed back to a plant of the same pedigree as one of its parents. Backcrossing is used with American chestnuts to get trees that hold onto only one small portion of the genetic code from their Chinese ancestors — blight resistance, but that still look like American chestnut trees.

A two-year old hybrid chestnut seedling planted in April 2009 at the American chestnut backcross orchard at VTS-Catoosa.

One of the most essential resources needed for the backcross 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 the American Chestnut Foundation to establish American chestnut seed orchards at two of its facilities: VTS-Milan (Lavinia, TN) and VTS-Catoosa (Catoosa County, GA).

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 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.

Orchard preparations were conducted in the winter of 2009 and included clearing trees, controlled burning of grasslands, and, most importantly, surrounding each orchard with an eight-foot tall, deer-resistant fence. In April 2009, 760 chestnut seeds and seedlings were planted at the two TNARNG facilities. For the first few years, trees must be watered, as necessary, and fertilized biweekly during the growing season. These young trees are just completing their first season of growth and are currently being monitored for survival, vigor, and general health.

Each backcross orchard was surveyed on four occasions during the first growing season. Monitoring included recording germination rates of seeds, root collar diameter and height of seedlings, and mortality of seedlings. Year end surveys were recently conducted at each TNARNG orchard, at which time, TNARNG personnel checked every planting location and, in between taking measurements, made efforts to determine causes of seed/seedling failure so that some of these issues may be avoided or remedied in the future.

On April 18, 2009, 20 volunteers participated in the American chestnut orchard planting at VTS-Milan in Carroll County, Tennessee.

The TNARNG American chestnut orchards are expected to be in place for at least 10 years, barring the need to use the land for military training; they will be maintained and surveyed annually for the duration of this project. More trees will likely be added to the orchards wherever a seed fails to germinate and/or wherever gaps are created by dead or culled trees. In addition, the orchard at VTS-Milan has well over an acre of fenced land on which seeds may be planted. There are some pedigrees that perform better than others at each of the orchards and once the first year’s data has been thoroughly analyzed, the backcross varieties that are more suited to growing conditions at the orchards will be used in follow-up plantings in the coming years.

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. BC2 trees exhibiting blight resistance will be crossed with 100% American chestnuts, while surviving BC3 trees will be crossed with other BC3s from other orchards to produce the first intercross generation.

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 species and enrich the training environment for military generations to come.

Project Point of Contact:
Janie J. Becker
Conservation Biologist
TNARNG Environmental Branch (Contractor)
Business World Management, Inc.

Janie.Becker@tn.gov

The South Puget Sound Prairies: Grassland Jewels in an Old-Growth Forested Landscape and the Native Species Nursery Project to Help Restore These Jewels to Fort Lewis, WA (Legacy Project # 306)

By Rod Gilbert
VERSAR, Inc
Fort Lewis Fish and Wildlife Program, Environmental and Natural Resources Division
Fort Lewis, Washington

Fort Lewis' prairies and associated oak woodlands are one of the rarest and most threatened ecosystems in the U.S. It's estimated that only 8% of the historic habitat remains, much of which is highly degraded. It is home to four federal candidate species, five federal species of concern, and several state-listed threatened or endangered species.

The Prairies Today

Approximately two-thirds of the remaining prairie habitat now occurs on Fort Lewis, while a handful of smaller parcels are located on state and county property. Many prairie species are now very rare: two are federally-listed as threatened, four are federal candidate species, and there are five federal species of concern. In addition, several more species are listed as endangered, threatened or sensitive by the State of Washington. Many more that have no ranking because they occur elsewhere in their range are so rare locally, that they are only known from just a handful of plants. Over three dozen species are known to already be extirpated from the prairies and many more are on the verge of being extirpated.


High quality prairie on Fort Lewis.

The historic diversity of the prairies was considerably greater than that of the surrounding old growth forests. Recent floral surveys recorded as many as 28 native species growing in one square meter, roughly as many species as one might find on acres of adjacent forest land. Species diversity increases significantly in habitats that share 'edges' with one another; the prairie landscape was divided into several different habitats whose boundaries continually weaved in and out with each other. Even today, it's still possible to cross four distinct habitats within a few hundred meters. Much of the very gravelly prairie is classified as upland prairie. Based on soil layers, it is estimated that upland prairie once covered about 80% of the historic prairie footprint of approximately 150,000 acres. It also has a distinct flora from other prairie habitats. Only the most drought- and fire-tolerant plants can persist here. Roemer's fescue is the keystone prairie species, but between the clumps of bunchgrass were open areas of soil where forbs were abundant. Many floral species have bulbs, thick corms or rhizomes to protect themselves from fire and it was primarily these species that were harvested as food by Native Americans. Several members of the lily family, all bulbous, important food for their starch content,

were baked in fire pits and mashed into patties. Bracken fern rhizomes were ground into flour and baked as a type of bread. Three different biscuit-roots (*Lomatium spp*.) were commonly collected for their thick edible roots and seeds. Other species were collected for their fruits, such as wild blackberries and strawberries. Many of these species' common names still reflect their historic indigenous use as food: rice lily, Indian carrot, biscuit-root, fool's onion (only a fool would dig so deep to get the bulbs!), and harvest brodiaea, to name a few. However, introduced rhizomatous and other pasture grasses filled in the gaps over time, resulting in a dramatic decline in herbaceous forbs and annual species.

Puget balsamroot, Indian paintbrush and western buttercup bloom in high quality prairie in the artillery impact area. This prairie is home to all four federal candidates that occur on Fort Lewis and contains the highest quality prairie remaining because of the annual artillery-initiated fires.

Interspersed in these prairies were numerous kettle wetlands. These were formed when large chunks of ice that were carried in the glacial floods and became buried by subsequent debris flows. As the ice slowly melted, they left behind a series of depressions that ranged in size from less than an acre to over a hundred acres.

A kettle wetland surrounded by Garry oak in high quality prairie in the artillery impact area on Fort Lewis. This is one of only a few wetlands that still resemble what they historically looked like and all are located in the Artillery Impact Area (AIA). The AIA prairie is maintained by artillery-initiated fires since the Fort was established in 1917. All other prairie wetlands have now been encroached by conifers around their margins.

These ephemeral kettle wetlands fill with winter precipitation and slowly recede through the summer months until they are completely dry. They provide important water resources for wildlife, but also provide a suite of different flora. One of these, water howellia (*Howellia aquatilis*), is federally-listed as threatened and can only be found in two areas on earth: SPS prairies and similar ephemeral wetlands along the glacial margin near Spokane, WA. This annual, aquatic species requires wetlands that dry each year so that seeds can germinate on the exposed soil. Twenty-two of the 28 known wetlands in western Washington occur on Fort Lewis.

Wet prairie is often associated with undulating swale habitat, wetland edges and areas between pimple mounds, where soils were sometimes loamier and often held water into the early growing season. Many of the xeric upland prairie plants are unable to survive here, allowing for a suite of different plants to occur. Hall's aster (*Symphyotrichum (Aster) hallii*), one of only a handful of true prairie endemics, is found in these wet habitats.

There are only four known occurrences of Hall's aster, two of which occur on the Fort in patches less than two square meters; the Washington Natural Heritage Program lists it as State Threatened. Another rare species found in this habitat is Texas toadflax (*Nuttalanthus texanus*). This species is known only from three locations in Washington, one of which is on the Fort. Several other rare prairie species also occur in this habitat type. There is only one known population of rose checker mallow (*Sidalcea malviflora ssp.virgata*) in Washington, which is listed as State Endangered.

Texas Toadflax

Rose Checker Mallow

Did You Know?


Golden Paintbrush

Golden paintbrush (Castilleja levisecta) is a brilliant butter-colored spike about 12" high and occurs in upland prairie habitats and coastal bluffs. It is arguably the most attractive of all the paintbrush family and is now so rare that it is federally-listed as threatened. There are only eleven extant sites remaining, some of which are now very small. White-topped aster (Sericocarpus (Aster) rigidus) is a prairie endemic and listed as a federal species of concern. Fort Lewis contains some of the largest and last remaining colonies for this rhizomatous plant.


White-topped Aster

Garry oak (*Quercus garryana*) is the only native oak to occur in Washington and was a prominent and important component in the prairie landscape. Conifer savannah was historically very rare in the prairie landscape as most conifers are not fire tolerant until they are of sufficient size to withstand the heat. However, ponderosa pine (*Pinus ponderosa*) is fire-tolerant and the only natural population in western Washington occurs on Fort Lewis. Though it is not known how long this population has been established, as the oldest cored tree is around 400 years old.

The Native Seed Project: Action Taken to Conserve and Restore

These alarming declines of both flora and fauna prompted prairie land managers to form a collaborative consortium to pool together current knowledge, address critical areas that require research and perfect restoration techniques that can be conducted on a landscape level. One of the limiting factors for conducting restoration on such a large scale is the lack of available local-source prairie seed. The most important identified management action was to focus on ramping up seed production for large scale restoration efforts. The DoD Legacy program supported establishment of a native prairie nursery for use by all the prairie land managers. The primary focus is to produce seed or plugs for species that are rare or that are used by the federal candidates, primarily larval and nectar host plants for two federally-listed candidate species: the Taylor's checkerspot (*Euphydryas editha taylori*) and the Mardon skipper (*Polites mardon mardon*).

The Offsite Nursery

Work on the Fort Lewis Legacy Seed project started in 2007 and will be completed in 2010. The project is divided into four concentrations: project infrastructure, seed production, plug production, and trials and protocols.

Forty large seed production boxes (32'x 4') were installed, filled with growing medium, and sown with seeds collected during the 2005 and 2006 collection seasons. An additional 12 smaller boxes were built or retrofitted, filled, and sown with target species. Three different types of irrigation systems were installed in the boxes. The entire system is controlled automatically on five different zones that can be programmed according to changing irrigation needs throughout the year. The system of mainlines and lateral lines was designed for flexibility over the course of the project: as seed crops germinate, grow, mature, and produce seed, their irrigation requirements will change.


Preparing seed trays at The Nature Conservancy's Shotwell's Landing Nursery.

Over half of the large seed production boxes are fitted with frames designed to hold row cover cloth, germination misters, shadecloth, or poly cover. These multipurpose frames are used to provide early frost protection for annuals and to hold overhead misters. A weed barrier was installed surrounding all seed production boxes.


TNC's Shotwell's Landing Nursery.

The infrastructure goal for plug production was to build a plug propagation area that is easily serviceable and that provides all the components necessary for the production of high quality plugs deliverable on a precise schedule. The plugs grown for this project are to be transplanted into seed production areas outside of the nursery. Plugs produced for this project need to be grown in an ambient temperature nursery, also known as an "outdoor" nursery. The existing plug production area at the nursery was improved and expanded to provide the growing capacity necessary for the production demand under this project. Engineered non-code metal cold frame buildings were purchased and transported. Three 96' x 20' buildings covering close to 6,000 square feet of production space were installed. They provide a rough capacity for 140,000 forbs at a time. Each coldframe houses 33 growing tables; each table has space for 1,400 1.5" diameter ray leach containers.

On Base Seed Plots

Two seed-source plots are being developed on Fort Lewis for restoration. One is a 17 acre site to grow Roemer's fescue (*Festuca idahoensis ssp. roemeri*), which will be drill-seeded this year, and the other is a sixteen acre site for herbaceous forbs. A cooperative agreement between Washington Department of Corrections, The Nature Conservancy (TNC), The Evergreen State College, and Fort Lewis developed a plug production program at Stafford Creek Correctional facility. Inmates will grow up to 200,000 plugs each year that will be used to fill the herbaceous beds. In addition, the prairie nursery that is operated by TNC will be able to produce another 150,000 plugs a year. It will take many years to fill the beds with over 50 native species but they should start producing some seed for restoration within a year.

The Benefits of this Project

The open prairie landscape on Fort Lewis is used extensively for most military training, including artillery practice, large arms fire, Stryker vehicle training, firebase construction, parachute drop zones and foot training. Habitat restoration and enhancement efforts allow military trainers greater flexibility to use existing DoD lands and support Fort Lewis' commitment to recover federal candidate species.


The federal candidate species that will benefit from the prairie restoration: (Left to Right: Mardon Skipper, Streaked Horned Lark, Taylor's Checkerspot, and Mazama Pocket Gopher).

Successful prairie restoration will allow for the reintroduction or translocation of candidate species that will benefit regional recovery efforts and could significantly reduce the potential for listing any of the candidate species. Successful translocation and reintroduction efforts on Fort Lewis would allow for further translocations to other SPS prairies further reducing the risk of listing. All four candidate species currently occur in the Artillery Impact Area and on other prairies on the Fort. If one of the candidate species were federally-listed, it could cause serious disruption to training by impacting the type, location, duration and/or timing of the training involved.

But this project will benefit not only Fort Lewis, but as a successful demonstration project, this concept and process will also serve as an example to other installations that have similar management concerns and feel the constraints on their restorations efforts due to the lack of appropriate native seed and plant stock. One important product from this project will be a transition plan that will serve as a guide to those who want to follow the Fort Lewis example and set up their own native seed nursery and outgrowing program.

Rod Gilbert is a field biologist with Versar Inc. and has worked on the Fort Lewis prairies for over 14 years.

All photos by Rod Gilbert. Other photos of prairie plants and prairies can be found at: http://www.pbase.com/rodg

Did You Know?

The world's biggest seed is the Coco de Mer nut, which is French for coconut of the sea, its scientific name is *Lodoicea maldivica*, or *Lodoicea callipyge*. This plant is formerly known as the Maldive Coconut, which can weigh up to 45 pounds.

The Coco de Mer palm grows to a height of 25-34 meters. The species name *callipyge* is from Greek, meaning "beautiful rump," because sailors who first saw the double coconut floating in the sea imagined that it resembled a woman's buttocks.

This rare and protected species is a palm endemic to the islands of Praslin and Curieuse in the Seychelle Islands, in the western Indian Ocean.

Photo courtesy of the Smithsonian Institution

Did You know? The rare Sandhills lily (*Lilium pyrophilum*) grows in fire-maintained habitats on Fort Bragg, North Carolina.

Training, Announcements & Events of Interest

Workshops, Interagency Training Announcements and Future Events of Interest to the Conservation Community

SPONSORED! **Applied Plant Conservation Training:** December 7-12, 2009 in Berkeley, CA. This six-day workshop will cover the following topics: legislative protection and regulatory obligations for plant recovery, population evaluation, demography, population viability analysis, plant conservation genetics, restoration and management (ex-situ and in-situ) inventory and monitoring techniques, tools and partnerships, and more. Participants will receive pragmatic tips, information resources, contact lists, and a unique opportunity to have questions answered by experts in the field. **Space is limited to 35 attendees and registration is filling fast, so register now**! For registration and more information, contact Anna Strong, Center for Plant Conservation at: Anna.Strong@mobot.org.

SPONSORED! **Strategic Management of Invasive Species in the Southeastern United States Workshop:** December 7-11, 2009 in Chapel Hill, NC. This five-day invasive species course for installation personnel and their strategic partners in the southeastern United States (NC, SC, GA, FL, KY, TN, AL, and MS) is sponsored by the Legacy Program. The workshop will provide participants with the knowledge and resources that will enable them to improve land stewardship by building partnerships and effectively addressing invasive species problems. Invasive terrestrial plants of the southeast will be emphasized. Science and management experts will address pressing ecological issues and explain key components of an invasive species management strategy. Participants will also learn about local, state, and federal invasive species initiatives and regional partnership opportunities. Registration is available online at: http://invasiveplantcontrol.com/registration.cfm. Please contact Steven Manning at steve@ipc-inc.org to be placed on a list to receive notices about this workshop.

Call for NEPA Examples: Have you ever used NEPA for your bird-related projects? Or have you had any problems or questions about NEPA and your bird projects? If so, we would like to use your examples to create a step-by-step guidance document about how to properly execute NEPA when dealing with migratory birds. Please send your examples to Chris Eberly (ceberly@dodpif.org) no later than December 15, 2009.

SERDP HIGHLIGHT! **Learn More About Funding Available Through SERDP – Two Opportunities, Two Different Times:** Participate in a webinar hosted by the U.S. Environmental Protection Agency Technology Innovation Program. SERDP's Executive Director Dr. Jeffrey Marqusee will conduct an online seminar, "SERDP Funding Opportunities," on November 13, 2009 at 1:00 pm EST. This "how to play" briefing will offer valuable information for those who are interested in new funding opportunities available through SERDP in FY 2011. During the online seminar, participants may ask general questions about the funding process, proposal submission, and the current solicitation. To learn more about this online seminar and to register, visit www.clu-in.org/conf/tio/serdpfunding.

Partners in Environmental Technology Technical Symposium & Workshop: Join us in person for the December 1-3, 2009 Symposium in Washington, DC, where SERDP's Executive Director Dr. Jeffrey Marqusee will present a Funding Opportunities session on Thursday, December 3, 2009 at 12:15 pm. This presentation will offer valuable information for those who are interested in new funding opportunities available in FY 2011, as well as answer questions about the funding process, proposal submission, and both the current FY 2011 SERDP solicitation and upcoming FY 2011 ESTCP solicitation. To learn more about the Symposium or to register, visit www.serdp-estcp.org/symposium.

SERDP/ESTCP Annual Technical Symposium & Workshop: The Partners in Environmental Technology Technical Symposium & Workshop will take place December 1-3, 2009 in Washington, DC. This event is sponsored by the Strategic Environmental Research and Development Program (SERDP), DoD's environmental science and technology program, and the Environmental Security Technology Certification Program (ESTCP), DoD's environmental technology demonstration and validation program. This comprehensive technical symposium and workshop will feature 11 technical sessions and 5 short courses. Technical sessions will highlight research and innovative technologies that assist DoD in addressing increasingly complex environmental and mission sustainability challenges. Short courses on select technologies in the environmental restoration and munitions management areas will offer unique training opportunities on recent advancements in science and technology. For the most up-to-date

information about the Symposium, visit www.serdp-estcp.org/symposium. If you have any questions, please e-mail partners@hgl.com or call the Symposium contact line at 703-736-4548.

GIS Design for Natural Resources Lands Management (TEC7114): December 7-11, 2009 at the National Conservation Training Center, Shepherdstown, WV. Bring your GIS project/data to class and you will have over 20 hours of open lab time to complete the project while being consulted by a cadre of highly skilled instructors. The remaining classroom time will be dedicated to learning new material through hands-on computer exercises. Topics include GIS planning, data acquisition, metadata development, geodatabase design, relationship classes, editing with topology, model builder and more! This class is limited to 16 students and is offered only once a year, so register early to get a seat. Class Registration: https://doilearn.doi.gov/ and search the catalog for "TEC7114". Registration Deadline is November 6, 2009. For More Information Contact: Eric Kelchlin, eric_kelchlin@fws.gov or (304) 876-7453.

Native Aquatic Species Restoration Webinar: December 9-10, 2009, 1:00 pm-4:00 pm EST each day, sponsored by the National Conservation Training Center in Shepherdstown, WV. This seminar focuses on current native fish and mollusk restoration endeavors on-going in the U.S. It will describe a historical perspective of many of the causes for our native aquatic species declines but will also highlight the outstanding efforts of many conservation organizations, federal and state agencies, and academia to slow and reverse these trends. It will cover restoration efforts from bull trout in Crater Lake NP to brook trout in the Carolinas to roundtail chub in Arizona to mollusks in the Southeast. Many of these efforts are now being supported by the National Fish Habitat Action Plan and coordinated through several regional initiatives and joint ventures. Class Registration: https://doilearn.doi.gov/ and search the catalog for "native aquatic". For more information, go to: http://training.fws.gov/CSP/Course_descriptions/csp3901.htm.

Applied Supervision (LED 6102): January 11-15 and February 8-12, 2010 at the National Conservation Training Center, Shepherdstown, WV. This course covers those critical skills new supervisors need to successfully and effectively supervise employees in mission accomplishment while building and maintaining a productive work environment. Course topics include transitioning into a supervisory position, roles and responsibilities, developing and motivating staff, handling difficult situations, coaching and counseling, leadership practices, change management, and a day with Human Capital representatives on classification, hiring & recruitment, performance and conduct, diversity and EEO. Class Registration: https://doilearn.doi.gov/ and search the catalog for "LED6102". Course content questions: Carol Adams at (304) 876-7491 or carol_adams@fws.gov; logistical questions: Tannor Kopp at (304) 876-7477 or Tannor_Kopp@fws.gov.

10th National Conference on Science, Policy, and the Environment: The New Green Economy: January 20-22, 2010 in the Ronald Reagan Building and International Trade Center in Washington, DC. The National Council for Science and the Environment's National Conference engages leading thinkers and doers from a diversity of disciplines, sectors, and perspectives in a structured conversation about the meaning of the green economy and how investments in green education, research and jobs can help to solve both the economic and environmental crises. For more details and registration visit: http://ncseonline.org/conference/GreenEconomy/.

Natural Resources Compliance: January 26-29, 2010, in Honolulu, HI and May 11-14, 2010 in Jacksonville, FL. This Natural Resources Compliance course offers instruction in specific natural resource laws, regulations, policies, Executive Orders, DoD Instructions, and other guidance, noting Service-specific requirements. The course addresses stewardship, preservation, and process; fish, game, and wildlife management laws; protection of wetlands, waterways, and other protected ecological areas; forest and land use management laws; Sikes Act and INRMP; and inter-service cooperation. The course includes a practical exercise, half day tour of a DoD or Coast Guard natural resource site and guest speakers. This course is approved by the Inter-Service Environmental Education Review Board (ISEERB). There are no tuition costs for this course. It is a 4-day course, from 0730 - 1600 everyday. For more information or to register, please visit: https://www.netc.navy.mil/centers/csfe/cecos/

Designing and Delivering A Training Session (LED5109): February 1-5, 2010 at the National Conservation Training Center, Shepherdstown, WV. This train-the-trainer course teaches curriculum developers and/or instructors

how to design an effective training session and includes the opportunity to practice effective presentation and classroom management skills. It covers the fundamentals of instructional design, adult learning principles, writing objectives and lesson plans, and interactive strategies to engage participants in learning. It also includes an overview of the instructional design cycle including needs analysis, development, content design, delivery and the five levels of evaluation. Class Registration: https://doilearn.doi.gov/ and search the catalog for "LED6102". Course content questions: Jack Owens at (304) 876-7903 or Jack_Owens@fws.gov; course registration questions: Tannor Kopp at (304) 876-7477 or Tannor_Kopp@fws.gov.

2010 DoD Pest Management Workshop: Operational Pest Management, New Confrontations with Old Foes: February 8-12, 2010, Naval Air Station, Jacksonville, Florida. This workshop will include several symposia, vendor displays, social events and a Plenary Session. Registration for the workshop is electronic: please visit http://www.afpmb.org/workshopregistration and complete the online form. A general information page, including workshop agenda and lodging information for the Tri-Service Workshop is now available on the Armed Forces Pest Management Board's web site: http://www.afpmb.org/meetings/TriService2010/info.htm.

Migratory Bird Conservation: A Trust Responsibility (ECS2102): February 22 - 26, 2010, National Conservation Training Center, Shepherdstown, WV. This course is designed to give participants a working knowledge of the legal and conservation implications of the Migratory Bird Treaty Act. Partnerships, resources and initiatives that address migratory bird conservation are explored in detail, providing participants an excellent overview of how they can further implement migratory bird conservation. The course includes a field trip with bird walk and mist-netting demonstration. To register visit the online registration site (http://training.fws.gov/learn/courses.htm) and type the course code (ECS2102) in the search box to proceed with registration. Contacts: For registration: Brenda Hooper, NCTC Phone: 304/876-7449 (brenda_hooper@fws.gov). For content: Karene Motivans, Course Leader, NCTC Phone: 304/876-7458 (karene_motivans@fws.gov).

Funding Available for Environmental Research and Development: The Department of Defense's (DoD) Strategic Environmental Research and Development Program (SERDP) is seeking to fund environmental research and development in the Sustainable Infrastructure focus area. The development and application of innovative environmental science and technology supports the long-term sustainability of DoD's installations and ranges, as well as significantly reduces current and future environmental liabilities. The Sustainable Infrastructure focus area concentrates on natural resources, cultural resources, and the sustainable management of DoD facilities. SERDP intends to fund multiple projects that respond to the following four focused Statements of Need (SON) in Sustainable Infrastructure:

1. Impacts of Climate Change on Alaskan Ecological Systems
2. Behavioral Ecology of Cetaceans
3. Ecological Forestry and Carbon Management
4. Ecology and Management of Source-Sink Populations

Proposals responding to the Fiscal Year (FY) 2011 SONs will be selected through a competitive process. Pre-proposals from the non-federal sector are due by Thursday, January 7, 2010. Proposals from the federal sector are due by Thursday, March 11, 2010. The SONs and detailed instructions for federal and private sector proposers are available on the SERDP web site at www.serdp.org/funding.

Sustainable Military Lands Management Certificate: This Colorado State University three-course online certificate will train you in the breadth and complexity of military land management and provide you with knowledge of the rapidly evolving practices, technologies, and analytical tools necessary to support this national defense mission. For more information on this certificate or about registration, please contact Jenny Hannifin at 970-491-2665 or jhannifin@learn.colostate.edu.

Recent Natural Resources Documents Online

Reports, Fact Sheets, Photos, Videos

This section highlights recently uploaded reports and factsheets on the Legacy Tracker or on the DENIX website. For Legacy related products, please visit https://www.dodlegacy.org/Legacy/intro/ProductsList_NU.aspx. All Legacy products and many more are available at https://www.denix.osd.mil/portal/page/portal/denix/environment/NR. In addition to these two websites, bird-related products are also posted on http://www.DoDPIF.org.

Invasive Species Guidebook for Department of Defense Installations in the Delaware River Basin: (Legacy 08-328) This report provides a guide for invasive plant species identification, management techniques, how to guide on preventing recurring invasive species and restoring historical plant communities, forming cooperative partnerships to achieve management goals, and case studies.

COMING SOON! Grassland Restoration and Management Plan for the Repatriation of the Regal Fritillary Butterfly (*Speyeria idalia*): (Legacy 08-392) In 2007-2008, the Pennsylvania Department of Military and Veterans Affairs Wildlife Office entered into an agreement with multiple landholding agency partners to restore native grasslands within an effort to repatriate the regal fritillary butterfly (*Speyeria idalia*). In an attempt to conserve this rare butterfly species, an effort to repatriate (return a native species to an area from which it has been extirpated) regal fritillaries to landholdings having a historic occurrence or probable occurrence was proposed. The objectives of the project are to establish native warm-season grassland habitat to benefit a multitude of species including, but not limited to, the regal fritillary, and to establish a long-term sustainable breeding populations of regal fritillaries outside of Department of Defense managed lands.

Pollinators Fact Sheets: What Can You Do To Help and The Facts About Pollinator: Both of these factsheets can now be found at https://www.denix.osd.mil/portal/page/portal/NaturalResources/OtherConservationTopics(A-H)/EcosystemServicesandEcosystemManagement and at http://dodpollinatorworkshop.com.

Fact Sheet: Migratory Bird Monitoring Using Automated Acoustic and Internet Technologies: (Legacy 06-245) Acoustical methods play a prominent role in avian monitoring efforts because many birds can be heard more reliably and at much greater ranges than they can be seen; however several limiting factors may reduce the effectiveness of acoustic techniques. We address the limiting factors of observers monitoring birds acoustically and of monitoring birds protocols that may be missed by traditional observation methods and provide solutions and sample data that enhance DoD's capacity to monitor avian resources on and around DoD lands and analysis and summary of these data. (https://www.denix.osd.mil/portal/page/portal/NaturalResources/FishandWildlife/Birds)

Removal of Invasive Fire Prone Grasses to Increase Training Lands in the Pacific: (Legacy 07-362) The goal of this project was to determine the effectiveness of three different methods in reducing the surface fuel loads in a guinea grass (Panicum maximum) dominated community, thereby reducing susceptibly to sustained fires. Three control treatments were tested including mechanical removal, herbicide application and grazing using cattle to reduce the fuel loads at Marine Corps Training Area Bellows, on the island of Oʻahu, Hawaiʻi. Information on the cost of the various control treatments and their long-term effectiveness in maintaining reduced fuel loads would also benefit land and resource managers in the Pacific Islands where guinea grass and frequent fires are problematic. (https://www.denix.osd.mil/portal/page/portal/NaturalResources/OtherConservationTopics(I-Z)/InvasiveSpeciesInvasiveSpeciesManagement)

Photo of the Month

Capturing the beauty of our natural resources

November 2009 Photo of the Month Winner!

Two State of Wisconsin endangered Phlox Moths, *Schinia Indiana*, perched on downy phlox, (*Phlox pilosa*), which is the host plant for the moth. Photo taken on Fort McCoy.
Submitted by *Natural Selections* reader: Tim Wilder
Fort McCoy, Wisconsin.

Did You Know?

Little Did You Know Conservation Could Be So Much Fun!

Did you know…some plants lust for blood! In low-nutrient environments some plants have developed amazing adaptations for getting necessary nutrients by trapping and digesting small critters. Although sometimes called "insectivorous plants" because insects are their most common prey, these carnivores obtain vital nutrients by trapping and digesting a variety of invertebrates, and occasionally even small frogs and mammals. Once trapped, the nitrogen from the hapless victim is slowly absorbed through modified leaves. The most common habitats for carnivorous plants are fens and bogs, where sunshine and water may be seasonally abundant but where nutrient concentrations are low.

Help I've fallen in a plant and I can't get up!

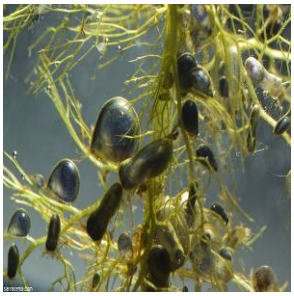
The mechanisms vary widely but most can be grouped into these five categories:

Flypaper traps

Flypaper Traps (like the sundews and butterworts) exude sticky mucilage from long tentacles on their leaves; their stalks are tipped with glands which are often brightly colored. The glands exude attractive nectar, adhesive compounds, and digestive enzymes. Insects that land on the leaves, stick fast and are engulfed in the leaves and digested.

Pitfall traps

Pitfall traps (like the bog lilies and pitcher plants) have specialized leaves that are folded into deep, slippery tubes with pools filled with digestive enzymes on the bottom. The leaves not only resemble pitchers, they are also good mimics of flowers, and it is the latter trait that fools its victims. Once lured in, the prey confronts a waxy surface leading to a pool of water. Although a fly can often escape the surface of water, the pitcher plant reduces its chances by supplying a wetting agent that wets the fly's wings and prevents it from flying and the steep sides of the leaf and, being unable to fly straight up like a helicopter, is forced to crash into the walls of the leaf.



Suction traps

Suction traps (such as bladderworts), are highly modified leaves in the shape of a bladder with a hinged door lined with trigger hairs. Tiny hair-like projections at the opening of the bladder are sensitive to the motion of a passing snack, like a water flea. When the hairs are stimulated, these hairs cause the flattened bladder to suddenly inflate, sucking in both water and the passing snack and closing a trap door after it.

Lobster-pot

Lobster-pot (like in corkscrew plants) traps insects in a pair of thin tubes joined in an inverted 'V' shape, with spiral grooves down their lengths that allow the entrance of the invertebrates du jour. The grooves are lined with inward-pointing hairs that prevent the prey from escaping and which force the prey items to move towards the center of the tube. From there, prey is ferried toward the apex of the 'V', where they are digested.

Snap traps

Snap traps (like in Venus fly traps and waterwheels) have hinged leaves that snap shut when trigger hairs are touched. In the Venus fly trap, a series of tiny hairs near the crease where the leaf jaws join up are the trigger. When a tasty morsel walks across these hairs, touching two or more of them in succession, the leaf will close quickly enough to prevent its escape. Unable to escape between the hair-like teeth at the edge of the leaf, our victim sits and is slowly digested and absorbed by the leaf. Glands on the leaf surface secrete several digestive enzymes that help to decompose the insect. Once the insect has been digested sufficiently, the leaf re-opens for another victim.

Although carnivory is documented in at least 9 plant families and 600 species, most are still relatively rare and should not be collected in the wild. So the next time you go a-wandering, waxing poetic about how nice all those roses smell, don't forget about the carnivores and watch where your step!

Information and images of this month's Did You Know? are from the Botanical Society of America (www.botany.org) and the International Carnivorous Plant Society (www.sarracenia.com).

Links of Interest on the Web

Useful URLs

Bat Conservation International: http://www.batcon.org BCI, based in Austin, Texas, is devoted to conservation, education and research to protect bats and their ecosystems around the world.

DoD Legacy Resource Management Program: https://www.dodlegacy.org DoD program that provides funding to natural and cultural resource projects that have regional, national, and/or multi-Service benefit. The Legacy Tracker lets you download fact sheets and reports for completed Legacy funded projects.

DoD TER-S Document Repository: http://www.nbii.gov/portal/community/Communities/Ecological_Topics/Threatened_&_Endangered_Species/DoD_TES_Document_Repository/ A compilation of DoD Threatened and Endangered Species documents and data made available online through National Biological Information Infrastructure. The information contained within these documents is considered "gray" literature (i.e., not peer reviewed).

Biodiversity Handbook: http://www.dodbiodiversity.org On this website you will find a thorough introduction to biodiversity and how it applies to the military mission; the scientific, legal, policy, and natural resources management contexts for biodiversity conservation on DoD lands; and practical advice from DoD natural resource managers through 17 case studies. A Commander's Guide to conserving biodiversity on military lands is also available.

DoD Partners in Flight: http://www.dodpif.org The DoD PIF Program supports and enhances the military mission while it works to develop cooperative projects to ensure a focused and coordinated approach for the conservation of resident and migratory birds and their habitats.

DoD Pollinator Workshop: http://www.DoDpollinators.org Provides an overview of the 2009 NMFWA workshop on pollinators. Many useful resources available including factsheets and technical reports, pocket guides to identifying pollinators, and links to other websites on pollinators.

DoD Invasive Species Outreach Toolkit: http://www.DoDinvasives.org In order to help installation natural resource managers protect the natural resources on our nation's military lands, the Legacy Program developed the Invasive Species Outreach Toolkit. The Toolkit is an education and outreach tool to help DoD land managers communicate about invasive species. It contains modifiable outreach materials such as posters, brochures, reference cards, and a PowerPoint presentation. A list of resources to help identify information and funding sources is also included.

DENIX: https://www.denix.osd.mil DENIX is an electronic environmental bulletin board that provides access to environmental information, such as Executive Orders, policies, guidance, INRMPs, fact sheets, and reports. This website is under reconstruction. We will advise you when it is fully operational. In the mean time, we suggest you visit these other Natural Resources Links.

DoD Partners in Flight: http://www.dodpif.org The DoD PIF Program supports and enhances the military mission while it works to develop cooperative projects to ensure a focused and coordinated approach for the conservation of resident and migratory birds and their habitats.

Cooperative Ecosystem Studies Unit Network (CESU): http://www.cesu.psu.edu/ This network of 17 cooperative units provides research, technical assistance, and training to federal resource and environmental managers. DoD is a member of 12 units of the CESUs National Network.

DISDI Portal: https://rsgis.crrel.usace.army.mil/disdicac (DoD only, CAC required) The DISDI Portal offers high-level geospatial data on DoD's installations, providing strategic maps of installations and information on how to access more detailed data. IVT data forms the foundation for the DISDI Portal, which is accessible to DoD staff with a common access card.

PARC - Partners in Amphibian and Reptile Conservation: http://www.parcplace.org/ Partners in Amphibian and Reptile Conservation (PARC) is an inclusive partnership of individuals and entities dedicated to the conservation of amphibians and reptiles (i.e., herpetofauna) and their habitats as integral parts of our ecosystem and culture through proactive and coordinated public/private partnerships.

Strategic Environmental Research and Development Program (SERDP): http://www.serdp.org/ SERDP identifies, develops, and transitions environmental technologies that relate directly to defense mission accomplishment.

Environmental Security Technology Certification Program (ESTCP): http://www.estcp.org/ A DoD program that promotes innovative, cost-effective environmental technologies through demonstration and validation at DoD sites.

Contact Us

Who we are and where to find us!

For further information about the Legacy Resource Management Program, please contact:

L. Peter Boice
Deputy Director, Natural Resources

Jane Mallory
HydroGeoLogic, Inc.
Natural Resource Management Specialist
703-604-1774

Pedro Morales
HydroGeoLogic, Inc.
Natural Resource Management Specialist
703-604-1933

Cecilia Brothers
HydroGeoLogic, Inc.
Cultural Resource Management Specialist
703-604-1724

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For additional information about DoD's Natural Resources, please contact the Deputy Director, Natural Resources or the DoD Natural Resources Conservation Staff.