LNWR, where other forms of defoliation—especially mowing—can be impractical. Even under ideal management strategies, however, the population status of the Dakota skipper may be tenuous at LNWR, which is considered to be the western edge of the species' range (USFWS 2002). Before the 1900s, frequent fire and bison grazing in this area likely promoted a more arid, short-grass state (Visher 1916)—habitat that may have been marginally suitable for the skipper.

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Pastures for Upland Birds: Landowner Incentive Program Restores Native Species in Bermudagrass Pastures (Texas)

Matt Wagner, Texas Parks and Wildlife Department, 106 Nagle Hall, 2258 TAMU, College Station, TX 77843, 979/845-5798, Fax: 979/845-7103, mwagner@tamu.edu; Dr. Fred Smeins, Dept. of Rangeland Ecology and Management, Texas A&M University, College Station, TX; and Brian Hays, Blackland Research and Extension Center, 720 East Blackland Road, Temple, TX 76502

The conversion of large areas of post oak savanna in eastern Texas to Bermudagrass (*Cynodon* spp.) and other non-native forage grasses has contributed greatly to the decline of wildlife species, including bobwhite quail (*Colinus virginianus*) and eastern wild turkey (*Meleagris gallopavo silvestris*). Because private landowners do not typically have the expertise, materials, or equipment to restore wildlife habitat, the Texas Parks and Wildlife Department (TPWD) and Texas Cooperative Extension (TCE) recently created a restoration incentive program called "Pastures for Upland Birds." As part of the program, we have conducted research to find cost-effective strategies for establishing and managing native grasses and forbs in Bermudagrass pastures.

Beginning in spring 2001, we established 20-ft x 50-ft (6-m x 15-m) test plots in sandy, sandy loam, and clay soil types at three study sites in Falls, Grimes, and Lee Counties. On each site, we established four replicates of six treatments consisting of 1) control/seed mix, 2) 4 quarts herbicide/acre (10 l/ha) plus seed mix, 3) 6 quarts herbicide/acre (15 l/ha) plus seed mix, 4) control/no seed, 5) 4 quarts herbicide/no seed, and 6) 6 quarts herbicide/no seed. For the treated plots, we used either Glyphomax Plus or Roundup Pro (41-percent glyphosate). In May 2001, we sprayed one set of plots at the Falls and Grimes sites, and another in late February 2002 following a period of warm temperatures. The Lee County plots were sprayed in mid-July 2003 (the preferred month for herbicide application if soil moisture is adequate).

At least two weeks after spraying, we used a Truax no-till drill to plant a combination of native seed comprised of the following five grasses and three forbs (including cultivars) and seeding rates of Pure Live Seed: "Haskell" sideoats grama (*Bouteloua curtipendula;* 3.1 lbs/acre or 3.5 kg/ha); "Van Horn" green sprangeltop (*Leptochloa dubia;* 2.5 lbs/acre or 2.8 kg/ha), "Alamo" switchgrass (*Panicum virgatum;* 0.5 lbs/acre or 0.6 kg/ha), little bluestem (*Schizachryium scoparium;* 2.5 lbs/acre), "Cheyenne" Indiangrass (*Sorghastrum nutans;* 2.5 lbs/acre), Illinois bundleflower (*Desmanthus illinoensis;* 1.3 lbs/acre or 1.4 kg/ha), "Eldorado" Engelmann daisy (*Engelmannia pinnatifida;* 1.3 lbs/acre), and "Aztec" Maximilian sunflower (*Helianthus maximiliani;* 0.3 lbs/acre or 0.3 kg/ha).

Three years after applying herbicide, we measured an average 79 percent reduction of Bermudagrass cover in plots with sandy and sandy loam soils treated at 4 quarts of herbicide. Bermudagrass control on clay soil ranged from about 39 percent

Figure 1. Seeded strips two years after planting. Indiangrass (*Sorghastrum nutans*) and Maximilian sunflower (*Helianthus maximiliani*) are the dominant seeded species, while woolly croton (*Croton capitatus*), western ragweed (*Ambrosia psilostachya*), and other early succession species provide a complex mix beneficial to wildlife. *Photo by Fred Smeins*

reduction on plots treated at 6 quarts to no reduction at 4 quarts about six months after spraying. Seeding success was variable, however, ranging from complete failure on plots seeded in spring 2001 to more than 50 percent estimated foliar cover of switchgrass, Indiangrass and sunflower two years after planting in sandy soils. Seeding success was somewhat lower on clay than sandy soils, with an estimated 25 percent cover of sideoats grama, switchgrass, Indiangrass, and sunflower combined on all treated clay-soil plots.

The TPWD currently provides free herbicide and use of a no-till drill to private landowners participating in the program. Landowners must purchase recommended native seed mixes, depending on soil type and rainfall zone. To date, TPWD has provided cost-share assistance to about 25 landowners with sites ranging from 5 to 60 acres (2-24 ha). About 12 other landowners are paying the entire cost of restoration ($7 -$150/acre or $188-$375/ha), with technical assistance from TPWD and TCE.

After four years of research, demonstration, and technical guidance we have developed the following recommendations: 1) treat Bermudagrasss from green-up in early spring through the summer months, depending on temperature and soil moisture; 2) do not treat derelict fields in which many native species are already establishing or treat only selective patches of heavier Bermudagrass cover; 3) use recommended seeding rates, but reduce the seeded species to a few that are relatively inexpensive and likely to establish; 4) contain costs by creating islands of native species planted in strips that are connected to existing patches of habitat, or by seeding blocks within Bermudagrass fields that can expand as the Bermudagrass declines; 5) Because cost and logistics may preclude restoring areas greater than 5,000 acres (2,000 ha) of prime habitat, focus instead on creating corridors to connect patches of existing habitat that eventually will provide enough space for ground-nesting birds and small- to medium-sized animals to obtain food, cover, and nesting habitat; and 6) keeping in mind that it may take four years or longer to see significant results, implement both short- and long-term adaptive-management approaches (selective mowing, burning, grazing, woody plant control) to maintain the restored areas.

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Restoration of Fighting Island is a Detroit River Success Story. 2004. Anon. **National Wetlands Newsletter** 26(5):20.

Restoration of devastated Fighting Island has been so fruitful that it is now included in the Detroit River International Wildlife Refuge. After 58 years of receiving waste from a chemical company, the island near Wyandotte, Michigan, was covered with 35 ft (10.7 m) of dry salt brine and was almost devoid of plants and animals. In 1982, the BASF Corporation acquired and began restoring the property. Techniques included covering the brine with organic material, such as leaves, hay, and yard waste; planting 6 miles (9.7 km) of windbreaks with 180,000 trees; and reconstructing shoreline habitat for fish. Today, Fighting Island is home to mink, deer, and other wildlife, including a few bald eagles, a species that had previously thrived there.

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Why Are We Losing the Burrowing Owl? 2004. Johnson, H., Defense of Place, Resources Renewal Institute, http://HDJ.rri.org; L. Trulio, Dept. of Environmental Studies, San Jose State University, San Jose, CA and J. Evens, Avocet Research Associates, Point Reyes, CA. **California Coast & Ocean** 20(2):28-30.

These authors offer their views on declining burrowing owl (*Athene cunicularia*) populations in California. Johnson recounts his experience of how reflooding former San Francisco Bay wetlands destroyed the hayfields inhabited by burrowing owls, leading to their disappearance from the area. He writes that saving just 10 percent of the reclaimed dry land could have saved the owls and other species that enriched the biodiversity of the area. Trulio and Evens point to rampant development rather than wetland restoration per se as the culprit in their decline. Trulio urges planners to think more broadly about the unintended consequences of restoration. As an example, she describes the South Bay Salt Pond Restoration Project, which maintains protection for species currently using the ponds and uplands, as well as restoring tidal marshes for the benefit of rare species, such as the California clapper rail (*Rallus longirostris obsoletus*).

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Groundwater Discharge: Potential Association with Fecal Indicator Bacteria in the Surf Zone. 2004. Boehm, A.B., Dept. of Civil and Environmental Engineering, Stanford University, Stanford, CA 94305-4020, 650/724-9128, Fax: 650/725-3164, aboehm@stanford.edu; G.G. Shellenbarger and A. Paytan. **Environmental Science & Technology** 38(13):3558-3566.

These researchers used short-lived radium isotopes found in groundwater to investigate the role of groundwater in surf zone pollution at Huntington Beach, California. Analysis of summer 2003 water samples was not conclusive, but suggested a tide-driven link between fecal indicator bacteria (FIB) in the surf zone and the surficial beach aquifer. The authors write that short-lived radium isotopes may be useful for tracing subsurface exchange in other coastal sites as well.