Statement of Management Guidance for LREC Restoration Activities
6/14/2004

Introduction

Site Description

The Litzsinger Road Ecology Center is located on 34 acres of land in the St. Louis suburb of Ladue. Within its bounds the LREC contains three major ecosystems: tallgrass prairie, creek/bottomland forest and urban creek. The Center's urban setting significantly influences each of these ecosystems. Along with these influences, the LREC has been the site of active tallgrass prairie restoration since 1989. The primary function of the LREC grounds is to serve students in the greater St. Louis metropolitan area as a premier ecological education center. Specifically, the site provides field experience opportunities in a variety of ecosystems within an accessible distance for tens of thousands of students.

Challenges

The urban location of the setting and its corresponding disturbance history has created a challenging set of management hurdles including: exotic species dominance, loss of native flora, extreme erosion, and alterations in natural hydrology. These problems have been compounded by a historic lack of cohesion in management efforts (excepting prairie areas) and high rate of staff turnover. Thus, the LREC presents a number of challenges for present and future managers/restorationists.

Motivation

The potential for the LREC to be an exemplary site showcasing both the restoration capacity of degraded urban ecosystems and functioning urban ecology is boundless. Thus, this document is designed to provide the cohesion in future management efforts required for the LREC to become a premier education center.

Statement of Goals

The broad-scale goal of the LREC restoration efforts is to increase the quality of the ecosystems in terms of flora, fauna, ecological function, and educational value. Implicit within this statement are a number of specific goals:

Flora

1. Increase the biodiversity (FQI) of all restored areas.
2. Eliminate exotic plant species.
3. Control aggressive native species.
4. Increase the overall aesthetic value of the restorations.
5. Increase the native forb percentage.
6. Create a more contiguous and intense bloom throughout the growing season.
7. Increase the abundance of spring flowering species.
8. Restore extirpated species.

Fauna

1. Increase populations and diversity of native-plant dependent fauna.

Ecological function

1. Create an urban refuge and corridor for native-plant community dependent species.
2. Build sustainable energy flow, nutrient cycling, species dispersal, and genetic dispersal within and between the individual ecosystems on-site.
3. Create a robust, diverse, and self-sustaining ecosystem.

Educational Value

1. Increase the scientific integrity of the management efforts at LREC.
2. Create a long-term data collection system including vegetation monitoring.
3. Increase the level of research performed on-site.
4. Synergize management efforts with the K-12 educational efforts of the LREC.

Prairie

Present conditions

The tallgrass prairie restorations cover roughly 12 acres of the LREC and represent the most advanced component of restoration activities at the LREC. The 12 acres are divided between three individual prairies: North prairie, South prairie, and Pasture prairie. Restoration efforts began with the North and South prairies in 1989. See Davit (2000) for early history of restoration efforts. The prairies are largely wet-mesic, with surface water pooling after heavy rains. The mesic areas are limited to a small area on the western slopes of the North prairie. The hydrology of the eastern third of the North prairie was altered by the installation of a drainage system.

Along with a diverse set of prairie species, each of the three prairies contains a monitoring system consisting of 0.25 m^2 quadrat frames distributed at regular intervals along a 15-meter, intersecting grid system (See Ochs 1993). Using this grid system two of the prairies have been monitored for vegetation changes in both 2001 and 2003 (Hiser et al. 2002).

According to the 2001 survey the North prairie contains 167 species of which 145 (86.8%) are native to Missouri. The species composition in 2001 for the North prairie demonstrated a mean Coefficient of Conservatism of 3.8 and a FQI of 45.75 (Hiser et al. 2002). It is important to put these numbers into perspective. Unfortunately, vegetation-monitoring data is not widely available for prairie restorations. Lacking restoration-based data surrogate comparisons can be made with remnant prairies. Compared with vegetation monitoring results from Missouri Prairie Foundation prairie remnants, LREC has fewer native taxa and consequently a lower FQI. However LREC values for mean Coefficient of Conservatism are in the same range as the Missouri Prairie Foundation remnants (Ladd and Churchwell 1999).

The results of the vegetation-monitoring program suggest that while LREC is becoming an excellent urban prairie restoration, copious amounts of work remain. The prairies are dominated by a few species namely, *Solidago altissima*, *Rudbeckia subtomentosa*, *Apios americana*, and *Andropogon gerardii*. Along with these dominant natives there are both woody invaders (*Rubus* spp., *Salix nigra* and *Morus rubra*) and exotic species (*Humulus japonica, Festuca* spp., *Melilotus alba*, *Euonymus fortunii, Lonicera japonica, Rosa multiflora, Vicia villosa*. and *Rumex* spp.) present in the prairies. Along with the influence of the exotics the LREC prairies demonstrate a patchwork of species with large tracts of near monocultures rather than the well-blended matrix present in remnant prairies. Overall, the prairies at LREC are in fair to good condition considering their age.

Management history

The original planting and its legacy

The prairies at the LREC have seen various management methodologies since their inception. The original planting history can be read in Davit (2000). However, between the date of the original planting and 2002, management records are scarce. Based upon available records, personal communications, and present conditions the LREC staff assembled a basic management history.

The first prairie planting in 1989 included the North and South prairies. The planting plan divided the prairies into 6 sections. Seed mixes were prepared to match the abiotic characteristics of each section. The legacy of this planting plan can be seen today. The western most section of the planting plan included only short grass species (*Sporobalus heterelopsis* and *Schizachyrium scoparium*). The grasses failed to become established, leaving an area dominated by *Solidago altissima*. The middle planting strip included *Rudbeckia subtomentosa*. This species became established, forming a band of near monoculture in the center of the North prairie. *Tripsacum dactyloides* was included in small amounts in plantings along the eastern edge of both prairies. The species was well adapted to the wet-mesic conditions at LREC and continues to dominate and spread along that area.

The Pasture Prairie was sown a few years after the North and South prairie. Notable in this sowing was the inclusion of *Andropogon gerardii* from Calvary Cemetery in St. Louis County. This grass seems to be less aggressive than the ecotype used in the North and South prairies.

Subsequent plantings

After the original plantings, each prairie planting was augmented with both seed sowing and transplant plantings. These plantings have occurred yearly since the original planting. Records exist of each planting, however before 2003 the data lacks accurate location information. See the files: 2003 sowings, 2003 transplants, 2004 sowings, and 2004 transplants for maps and species lists from 2003 and 2004. These plantings also form part of a growing LREC-based GIS database.

Species sown repeatedly with little success

Comparing the existing planting records with the present plant community illuminates some trends in plants sown and transplanted repeatedly with few species persisting. This information is useful in order to avoid repeating past mistakes (Appendix 1).

Shade influence

Along with the original planting plan, shade influence is a significant factor in the formation of present prairie systems at LREC. Most of the prairie edges are influenced by significant shade. The eastern edges of the North and South prairie, the southern edges of the South and Pasture prairie, and the western edge of the Pasture prairie demonstrate the most extreme level of shade influence. The clearest influence of shade can be seen in the eastern third of the South prairie. From 1989 to 1999, a large cottonwood grew in this section of the prairie. The shade influence precluded the establishment of the sun dependent seeds. Consequently, the area is presently dominated by shade tolerant, early successional species (*Ambrosia spp., Verbesina alternifolia* and *Muhlumbergia spp.*) and various exotics. Due to administrative

decisions, management efforts are not able to address the cause of the shade influence. Little in terms of prairie species panting has been done to address the issues of shade influence. **Managers should approach administrators with proposals for limited tree removal in order to limit the shade effect.**

Fire prescription

The fire regime for the LREC prairies has included an annual or biennial rotation period. Early on in the restoration, burns occurred mostly in March and April. However, some burns were conducted in November and December. All prairie areas were generally burned in a single day, destroying any potential refuge areas.

Weed control

Early weed control methods included both physical and chemical means. The efforts focused on exotic and woody species (*Humulus japonica*, *Rumex spp., Morus spp.,* and *Rubus spp.*) Recent efforts included the use of herbicides to control both native and exotic plants of concern. Efforts since 2000 were expanded to include dominant, native plants (*Solidago altissima, Rudbeckia subtomentosa, Apios americana*, and *Ambrosia spp.*). In 2001 a large area in the South prairie was sprayed with 3% glyphosate in order to kill dominant *S. altissima*. Along with limited large-scale spraying, targeted cut and paint application has been used to control *S. altissima*.

Prioritized management directives

The attainment of the LREC restoration goals will require efficient management efforts. Below is a prioritized description of specific management directives to be implemented in the LREC prairies. See appendix 2 for a description of specific management techniques.

1. **Implementation of a replicated vegetation-monitoring program:** The implementation of the replicated vegetation-monitoring program is a primary management priority. Without a replicated monitoring program, LREC management will have no method for assessing techniques and efforts. The program should calculate the mean C of C, percent native taxa, and Floristic Quality Index (See Hiser et. al. 2002). After 2004, baseline data will be available for each of the three prairies. **Subsequent efforts should focus on one prairie per year, thus creating a three-year monitoring rotation per prairie**.
2. **Eradication of non-native species:** Although complete eradication may not be possible since outside influences cannot be controlled, the control of exotic weeds is integral in the creation of premier urban restorations. Presently, LREC prairies are home to a variety of exotics including: *Rumex spp., Lonicera japonica, Humulus japonica, Melilotus spp.,* and various Poaceae species). Along with controlling the existing cohort of exotic species, managers must guard against the establishment of new exotics.
3. **Establishment of diverse prairie communities in areas dominated by early successional species:** Disturbance, poor seed establishment, and shade influence have created many areas dominated by early successional prairie species (*Verbesina alternifolia, Erigeron annuus*, and *Ambrosia trifida*). These areas offer an opportunity for the establishment of a robust prairie system through over-seeding, mowing, and transplant planting. However, they are also ideal sites for exotic establishment. Efforts

to establish native plants in these areas must consider site-specific abiotic factors. Specifically, shade influenced areas should be over-seeded with shade tolerant species.

4. **Control aggressive native species:** The LREC prairies are home to a variety of species that are extremely adapted to the rich, wet-mesic conditions. Consequently, these species (*Apios americana, Solidago altissima, Rudbeckia subtomentosa, Tripsacum dactyloides, Andropogon gerardii,* and various woody species) dominate many areas of the prairie and form near monocultures. Of these various species, *S. altissima* and *A. americana* represent the largest threat to LREC biodiversity. Attempts to control these species must consider the long-term consequences of individual management techniques. Specifically, large scale spraying should be used as a last resort. Since large scale spraying resets the entire community, it offers little guarantee that the previously dominant plants will not return. Less disruptive, focused methods such as cutting and herbicide painting, over-seeding, and mowing are preferable. These methods offer more promise of long-term control.
5. **Implement an ecologically responsible fire regime:** The implementation of a fire regime is a complex endeavor. There are many justifications for the use of fire in prairie management. Thus, it is difficult to mandate a one-size fits all plan. However, **a responsible fire regime must leave unburned refuges in order to ensure source populations for future faunal reestablishment. Thus, LREE management should implement an annual to biannual fire rotation, leaving one prairie unburned per year.** A regime with a longer rotation would not be sufficient to control woody plant growth in the wet-mesic conditions at LREC. See Appendix 2 for a discussion of fire ecology and LREC specific considerations.
6. **Increase aesthetic appeal:** The benefits of an aesthetically attractive prairie are partly anthrocentric. However, they should not be ignored. An attractive prairie will help attract attention from students, neighbors, and volunteers thus promoting native plants. An aesthetic prairie will also have increased bloom throughout the seasons thus supporting a more diverse pollinator cohort. These efforts should focus particularly on spring flowering plants. The present spring flowering component is extremely limited. However, specific efforts to increase the aesthetic appeal must consider site limitations. Appendix 1 lists species repeatedly sown or planted at the LREC with little to no success. Efforts must use site appropriate plants including (*Castilleja coccinea, Pedicularis canadensis, Zizia aurea,* and *Phlox pilosa*). Management efforts to increase the aesthetic appeal should include, over-seeding, targeted transplanting, late season mowing, and seeding in shade influenced areas.

Woodland/Savanna areas

Present conditions

Separated from the prairies by a firebreak, the woodland areas at LREC consist of 10+ acres of creek bottomland forest. Over half of the total woodland acreage lies across Deer Creek. The woodland on the west bank of Deer Creek has seen limited restoration efforts while the tract on the east bank has seen none. Due to the lack of restoration efforts, the woodlands at LREC are best described as extremely degraded.

The disturbance history of the woodland area at LREC is unclear. The LREC was likely the site of limited logging and land clearing. The history of disturbance on the site has created

an understory component that represents the greatest challenge for restorationists. *Lonicera maackii* was actively removed in some areas but continues to dominate a majority of the woodland. Removal of this species from LREC does not represent as significant a challenge as the ubiquitous *Euonymus fortunei*. ***Euonymus fortunei*** **dominates roughly 75% of the ground cover, often to depths up to 20 cm. This species represents the largest challenge to restoration efforts at LREC.** Along with these two exotics, LREC is also home to a growing population of exotic *Alliaria petiolata* and *Lonicera japonica*. Scattered among these exotics are populations of spring flowering plants. Most of the species present in the LREC woodland are not rare and could be easily reestablished.

The tree community of the woodlands is not as degraded as the understory. However, despite bordering a near-annually burned prairie, the woodland has few fire tolerant species. The dominant trees of the LREC woodland are *Acer negundo* and *Acer saccharinum*. These shade and flood tolerant species are complimented by a number of early successional bottomland species, *Populus deltoides* and *Platanus occidentalis*. Additional tree species include, *Ulmus rubra, Fraxinus pennsylvanica*, *Celtis occidentalis, Juglans nigra, Asimina triloba, and Sassafras albidum.* Although present, remnant oak and hickory species (*Quercus bicolor, Quercus macrocarpa*, *Quercus imbricaria*, *Quercus palustris* and *Carya laciniosa*) are represented by few individuals.

Management history

Prior to 2003 management efforts in the LREC woodland have focused mainly on clearing and planting small patches of ground. In 2003 management efforts began to focus on large-scale restoration. On the western side of Deer Creek 95% of the *Lonicera maackii* was removed. *L. maackii* bushes were left along the upper banks of Deer Creek in order to limit erosion. Along with the removal of L. *maackii*, LREC staff actively removed *Lonicera japonica, Rosa multiflora,* and *Alliaria petiolata*. The LREC staff also experimented with methods of killing *Euonymus fortunei.* Based upon these results, roughly 1 acre of the *Euonumus fortunei* was sprayed with glyphosate in April 2004.

Fire prescription and planting

After the removal of *L. maackii* LREC staff burned roughly 1 acre of the woodland. This area, called the North Trail area, is located on the west bank of Deer Creek, east of the North Prairie. The fire prescription was designed to: clear exotic species from the woodland, prepare the ground for seed establishment, and soften the artificial transition between the woodland and prairie. After the area was burned it was sown with three seed mixes each designed to match the varying light levels of the area (see 2004 woodland plantings). School groups also planted 500 woodland plants within the wooded area.

Prioritized management directives

1. **Implementation of a replicated vegetation-monitoring program:** As in the prairie areas, the implementation of a replicated vegetation-monitoring program is a primary management priority in the woodland. The relatively unrestored condition of the woodlands offers an ideal opportunity to monitor changes as restoration activities increase. The monitoring program should be repeated biannually or triannually and should focus on the herbaceous species present. The herbaceous survey should catalogue all species present and calculate the percentage of native taxa, mean C of C, and FQI. A

separate survey should catalogue and assess (conditions, position in canopy, and DBH) the tree species within the woodland.

2. **Eradicate *Euonymus fortunei* from the woodland:** The dominance of *Euonymus fortunei* poses the single largest challenge to restoration activities at LREC. This plant's ability to form a thick monoculture in the forest understory limits herbaceous diversity. Thus, **eradication this plant from the woodland even at the expense of other species should be a top priority**. See appendix 2 for a discussion of methods of control.
3. **Control exotic species:** Aside from *E. fortunei* the LREC woodland is home to many aggressive exotic species. *Lonicera maackii, Lonicera japonica, Alliaria petiolata,* and *Rosa multiflora* are all present in the woodland. The growing population of *Alliaria petiolata* is of particular concern. As the woodland is cleared of *E. fortunei* and *L. maackii*, and *A. petiolata* will continue to increase in abundance until the seed bank is diminished. According to Solodar (pers. comm) *A. petiolata* seed is viable for 22 months. Although this is relatively short, Deer Creek will continue to deposit seed during flooding events. Thus, controlling *A. petiolata* will be a long-term challenge. However, with efficient planning and vigilance it can be controlled.
4. **Increase diversity in the herbaceous understory:** The eradication of *E. fortunei* will provide an opportunity to restore many herbaceous plants to the LREC woodland. This restoration should include a diverse mix of forbs and graminoids adapted to bottomland environments (See appendix 2 for seeding methods.)
5. **Return the influence of fire to the woodland:** The woodlands are separated from the prairies by an artificial firebreak. Given the prairie fire regime, it is undoubtable that fire should be an influence on the structure and composition of the woodland. Specifically, the woodland should have an open character where it borders the prairie with the herbaceous component composed of open woodland and savanna species. The tree community along the edges should consist of fire tolerant tree species, specifically *Quercus bicolor* and *Carya laciniosa*. Away from the prairie woodland border returning fire to the woodland will create a mosaic canopy with gaps in areas with high fuel loads and fire intolerant tree species. Thus, the entire woodland will have a varied canopy structure. Some mechanical methods should be employed in order to maintain existing openings along the north trail area. These areas should be actively restored to resemble an open, flood influenced, savanna/woodland.
6. **Restore a fire tolerant tree community:** The increase in fire frequency will necessitate the active restoration of fire tolerant tree species in certain areas. See Dey et. al. (2001) and Dollar et. al (1992) for a discussion of bottomland forest composition (note that the areas discussed are large river not creek bottomland forests). The bottomland forests at LREC should be fire and flood tolerant. Thus, in areas near the prairie where fire is frequent and intense they should be dominated by oak and hickory species. Areas with frequent flooding should be dominated by maple, cottonwood, and sycamore.

Edge component

Due to the extensive firebreak surrounding the prairies, there is a significant edge component at the LREC. These areas include 10 to 20 meter wide strips of semi-wooded land separating the prairie areas. Similar to the LREC woodland, these areas have been artificially excluded from the fire regime. Consequently, they are highly degraded areas dominated by *Euonymus fortunei,* Eurasian graminoids, and *Lonicera japonica.* The wooded nature of these

areas shades the restored prairies and contributes to challenges in prairie establishment. They also complicate fire prescription.

Management history

These areas have been the sites of various levels of management, with little cohesive planning. A few of these areas include diverse, showy plantings. While the rest remain as screenings. The screen areas are almost without exception dominated by *L. maackii*. In 2004 LREC management began to actively remove exotic species from some of the edge areas. Large *L. maackii* bushes were replaced with smaller, native bushes.

Prioritized management directives

1. **Eradication of exotic species:** The domination of these areas by exotic species provides a continuous seed source for exotic species to invade other restored areas.
2. **Inclusion of these areas in the fire regime:** Similar to the woodland areas these edges would benefit greatly from a limited fire regime. Once exotic species are eradicated, fire will be the most efficient method of keeping them in check.
3. **Creation of areas designed for wildlife benefit:** The edge areas provide an opportunity to create attractive native garden areas designed to attract wildlife and demonstrate the potential for native landscaping. Specific areas should include: a native pollinator garden and a stonewall designed to attract reptiles.
4. **Demonstrate the use of native plant material as screening:** Similar to the creation of attractive garden areas, edge areas should be used to demonstrate native alternatives to exotic plant screenings.

Deer Creek

Deer Creek is typical of urban creeks. What was once a perennial stream now flows intermittently with a significant recurrence of flooding events. The creek has eroded its bed down to the limestone bedrock and undercut the banks. The banks continue to be undercut after significant rainfall, causing the loss of large trees, other plant material, and soil. Efforts to vegetatively stabilize the banks in the most eroded areas have failed.

Along with the challenges of bank stabilization, the creek complicates restoration efforts in both the woodland and prairies. Flooding in both of these areas deposits exotic seeds and removed native seed from sowed areas.

Management history

Management techniques along the creek have included many attempts to stabilize areas using living plant material. Many of these efforts have failed due to high rates of erosion. In 2004, LREC staff and students planted roughly 600 willow cuttings in moderately eroded bank areas. The cuttings survived extreme flooding for the first month post planting. The success or failure of the plantings will be measured in the next few years. Various agencies and individuals have consulted with LREC staff regarding bank stabilization. See Jennifer Brown for details.

Prioritized management directives

1. **Document erosion and habitat loss:** The extremely limited level of control the LREC dictates over upstream flow rates severely limits efforts to stabilize the stream bank.

However, the LREC staff has an excellent opportunity to document erosion and habitat loss.

2. **Incorporate erosion and habitat loss into education:** Data regarding erosion and habitat loss should be used to educate LREC students, volunteers, neighbors, the River Des Peres Coalition, and policy makers.
3. **Investigate engineering solutions to stream bank loss:** Roads and structures bordering the creek may require engineering and construction for preservation. It is in the long-term interest of the LREC to investigate these possibilities in advance of an emergency.

Fauna

Most of the animals observed at the LREC are adapted to an urban environment. However, the relatively large green space provided by LREC offers a refuge and potential corridor for wildlife. The insect community and bird community are relatively well studied (Ochs 1993, Clinebell, and Solodar 2002). Other than causal observations and extrapolation little is known about mammalian, amphibian, or reptilian populations.

Management history

Aside from large-scale vegetative restoration, successful habitat improvements are limited to the construction of bird boxes. A variety of bird boxes including: blue bird, wood duck, and kestrel were installed at various locations around the LREC. Some efforts were made to construct vernal pond areas for amphibian reproduction.

Prioritized management directives

1. **Ensure source populations for future recolonization:** In order to ensure continuing faunal populations, particularly for insects, it is necessary to allow for refuges while conducting prescribed burns. Thus, a two year fire rotation per prairie with one prairie left unburned per year is desirable.
2. **Assess populations of existing animal populations:** Since a high quality restoration includes fauna as well as flora it is necessary to assess faunal populations in order to measure success and guide management.
3. **Address habitat gaps:** Assessment of faunal populations will highlight gaps and strengths in habitat. This information can be used to guide management activities and supplement plant material or physical structures as required.

Caveat

The statements above represent the culmination of two years of work, observations, conversations, and interpretations. They are designed to create long-term continuity in restoration and management efforts at LREC. They are suggestions to be altered over time as monitoring and management efforts dictate. However, management decisions and changes should be made only after considering long-term implications and temporal continuity.

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