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A post workshop review: Discussion, process, and highlights for developing a leafy spurge strategic management plan within Theodore Roosevelt National Park

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Abstract:

Theodore Roosevelt National Park is managed to represent a primitive vignette of the area as it appeared before extensive settlement of the region. This includes representation of native flora and fauna, as well as other natural and cultural resources values. Leafy spurge is one of 59 species of exotic plants that are known to occur in the park. National Park Service (NPS) policy requires the containment, control and management of exotic species to the greatest degree possible, particularly those with serious ecological effects. Intensive management is required to reduce and contain these infestations while comprehensive and integrated approaches are needed to restore this habitat.

Current research shows that leafy spurge is a serious invader into the park's native vegetation communities, resulting in significant ecological disruption of these communities, and in some instances replacement of all native species in a given locality. Habitat loss also has the potential to adversely affect native ungulate species.

Theodore Roosevelt National Park and Forest Service convened a workshop and special advisory panel of interdisciplinary experts to develop a strategy for control of leafy spurge within the park and adjacent lands. Previous research in the park and management actions were evaluated.

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Interagency coordination with USDA-Agricultural Research Service (ARS)-Remote Sensing Research Unit (RSRU) lead to the use of an integration of high resolution aerial color photography and airborne video with Global Positioning System (GPS) technologies for detecting and mapping leafy spurge. Preliminary analysis of the data indicated that 1,358 acres were infested in the park's 46,000 acre South Unit. Ground-truthing of the data resulted in a revision of the leafy spurge acreage estimate to 1,735 acres. The ARS base map serves as a reference point from which to develop specific recommendations geared to future management implementation and control actions. Advisory panel members used the data in recommending a strategy to implement a variety of integrated pest management (IPM) techniques.

The mapping project helped foster interagency/private cooperation in the management of leafy spurge locally. The NPS, Forest Service, ARS, two county weed boards, a grazing association and twenty-eight private individuals are partners in a North Dakota Department of Agriculture Weed Innovation Network (WIN) grant. This noxious weed knows no jurisdictional boundaries. Through joint cooperative efforts a strategy will be developed for managing different levels of infestation within identified watershed basins.

Introduction

Exotic plants are non-indigenous species introduced into ecosystems where they have not existed before. Exotics may become pest if they successfully establish themselves in environments that do not contain their natural enemies, allowing them to spread unchecked. Thus, exotic plants such as leafy spurge present a formidable challenge for land managers across the country. Leafy spurge infestations within North Dakota also have a serious economic impact, estimated in 1991 at a $87 million loss to the state's wildlife, tourism and agricultural economy.

The North Dakota Game and Fish Department recently declared leafy spurge as the greatest threat to wildlife in North Dakota. The National Park Service (NPS) considers invasion of exotics as the most serious threat facing the National Park System. Through a combination of factors national park areas are no longer isolated preserves or islands. Exotic species do not respect political or geographical boundaries. It does no good to manage noxious weeds on your own land and not coordinate efforts with all neighboring landowners-private, state and federal.

Theodore Roosevelt National Park is located in southwestern North Dakota, encompassing approximately 70,000 acres of the rugged Little Missouri Badlands. The park is divided into three separated units, including nearly 30,000 acres of the Theodore Roosevelt Wilderness. Over a million acres of the Little Missouri National Grasslands, Custer

National Forest surround the park. Forest Service lands are intermingled with private ownership.

The park was established in 1947 to preserve the scenic, scientific, historical and recreational value of the Little Missouri Badlands. The park is managed to represent a primitive vignette of the area as it appeared before extensive settlement of the region, including representation of native flora and fauna, as well as other natural and cultural resources values. The park's natural resources are also significant because of their role in shaping the life of Theodore Roosevelt, who ranched in this area in the 1880's, and his subsequent conservation philosophy demonstrated during his years as President. He commented in several of his literary works about the decline of the bison, elk and bighorn, all of which were extirpated from this area near the turn of the century. These species have been reestablished. However, gone are the predators such as the Plains grizzly and wolf. Native ungulates are again being threaten, this time by leafy spurge.

Results and discussion

Leafy spurge was brought into North Dakota by Eastern Europeans during the Homesteading Period. Locally, leafy spurge originated west of the park in Golden Valley County along Knutson Creek during the 1930's. Leafy spurge was first reported in the park in the late 1960's.

Superintendent Arthur L. Sullivan addressed the spurge issue in a memorandum to the Regional Director on November 12, 1968:

> "...With the cooperation of the USFS and local ranchers it may be possible to eliminate the weed (leafy spurge) from this area (Knutson Creek & Burning Coal Vein)...The objective of the project will be to eradicate spurge where ever it occurs..."

In 1970, park managers estimated that were 32 acres of spurge infested, divided into 103 separate patches ranging from a few square meters to 3 acres. In the 1971, tordon was placed on the restricted use list and the National Park Service did not authorize its use. The park addressed their concerns in the following memorandum to the Regional Director from Superintendent James B. Thompson, dated November 25, 1971:

> "The cancellation of the above program (pesticide program) has caused considerable dismay here in the park. The suggested alternative leaves much to be desired (2,4-D)...We again request authorization to proceed with the use of Tordon 212 on the control of a maximum of 35 acres per year... The infestation can be expected to spread each year... As a result of the fiscal cutbacks we have had to eliminate leafy spurge control from the 1971 program... This curtailment alone will cause a setback in the hopefully future control of this exotic."

Superintendent John O. Lancaster addressed the spurge issue in a memorandum to the Regional Director on July 23, 1975:

> "...we believe with adequate funding the weed could be controlled. It will never be eradicated, but if once knocked down to a few scattered patches, a small number of people-days per year should be adequate to prevent any major outbreaks... A rough estimate of the cost of an accelerated program for 1976 would be in the neighborhood of $32,000.00."

The infestation estimate was 400 acres between 1975 - 1983. In 1986, 700 acres was considered a conservative estimate of leafy spurge in the park.

Superintendent Pete Hart addressed the spurge issue in a memorandum to the Regional Director in 1991:

> "...The North Unit, has thus far had only spotty infestations, but we are eradicating it there on a regular basis and the infestations gain yearly. In the South Unit, spurge is totally out of control. In our judgement this is the most serious resource problem currently facing the park. At present base funding levels, we are able to treat 10% of our 1990 estimated 800 acres..."

Over the past two decades, the detrimental consequences of leafy spurge have become very apparent in the park. The rapid invasion and expansion of leafy spurge, due to the absence of natural enemies, has disrupted the complex and delicate badlands ecosystem. This aggressive invasion has displaced many native plant species, including some North Dakota rare species. In addition to destroying the rich species diversity unique to the badlands, the habitat loss to the park's ungulate species is a major concern.

Habitat has already been adversely affected by leafy spurge in the Little Missouri River bottoms and west of the river in the Knutson and Wannagan drainages. Heaviest concentrations are found along streambeds, drainages and wooded draws. The University of South Dakota recently completed a three-year study on the ecological effects of exotic plants. Leafy spurge is unpalatable to most native species and thus lowers the availability of forage for wildlife.

The vegetation found in the park is dominated by cool season mixed grass prairie types typical of the Northern Plains. This complex of topography and vegetation supports a variety of wildlife. Important herbivores include the white-tailed deer which is commonly associated with tree-covered drainages; mule deer found in brush covered draws and open uplands; bison and wild horses which utilize a variety of open habitats; and elk which feed in open grasslands and utilize woodlands for cover.

Leafy spurge is one of 59 species of exotic plants that are known to occur in Theodore Roosevelt National Park. The park has been engaged in a limited herbicide application program since 1975 aimed at containing leafy spurge. The program has had very limited success because of magnitude of the infestations, limited mapping of infested areas, funding short-fall for personnel and supplies, and difficult access in backcountry areas. Exotic plant management is the highest priority in the park's resources management program. Unfortunately, exotic plant species have not gained the fiscal respect that is required to manage them. Park managers are seriously handicapped by budgets that have not kept pace with inflation and lack of base funding year after year. The future outlook of the Federal budget and personnel cuts makes matters worse.

Studies conducted in North Dakota show that unless local landowners and managers can treat at least 70% of the expanding acres of leafy spurge, more and more acres of prairie will be infested and the cost of control and the amount of ecological damage will only increase. Research indicates that these areas will require retreatment for 3-5 years with periodic spot treatment. Park funding levels over the last several years have permitted treatment of only 3%-15% of the infestation. NPS policy requires the containment, control and management of exotic species to the greatest degree possible, particularly those with serious ecological effects.

Frustrated by a seemingly random approach to control of leafy spurge, both inside the park and on adjacent lands, park managers saw the need for an overall management strategy. In order to develop control strategies, the park coordinated with USDA-Agricultural Research Service (ARS) in 1993 during the peak bloom the use of an integration of high resolution aerial color photography and airborne video with Global Positioning System (GPS) technologies for detecting and mapping leafy spurge. ARS flew the South Unit and portions of the adjoining Little Missouri National Grasslands.

A Geographic Information Systems (GIS) map was prepared from these aerial photographs. Preliminary analysis of the data indicated that 3% of the landscape, or 1,358 acres were infested in the park's 46,000 acre South Unit. The minimum level of resolution mapped was $25m^2$. Photographs for portions of the National Grasslands and private lands are currently being digitized by the Forest Service. No base map of infestations existed prior to this project for the park. Previous control action maps were the park's sole reference, but this was grossly inadequate.

In 1994, the NPS has begun reviewing the aerial photographs and ground-truthing the GIS map for any revisions. Photographic limitations did not permit the ability to penetrate through woody draws and forest canopies. A revised map was prepared that now identifies 1,735 acres, or 3.7% of the South Unit being infested. Completion of this task has now provided important information in evaluating the technology used to map leafy spurge.

The park is developing a nominal data base utilizing GIS for vegetation and soils. Vegetation and habitat maps were completed by Montana State University and are currently in digital format. The park has under contract with the Soil Conservation Service the preparation of a soil survey. Utilizing the ARS GIS base map and other thematic layers, managers will be able to review environmental considerations and evaluate which IPM techniques should be implemented. Existing vegetation conditions and soil types are necessary for determining management alternatives such as biological controls or chemical treatment.

In response to the need to develop a cohesive strategy, the Rocky Mountain Elk Foundation teamed up with the National Park Service, the National Grassland's Medora Ranger District and DowElanco to sponsor this Leafy Spurge Strategic Planning Workshop and Scientific Advisory Panel in Dickinson, North Dakota. The special advisory panel of interdisciplinary experts included scientists from the fields of animal and range sciences, crop and weed sciences, ecology, fire ecology, plant physiology and entomology. The panel members included:

Dr. Russell J. Lorenz, Co-Chairperson
USDA-ARS (retired)

Dr. Edward F. Redente, Co-Chairperson
Rangeland Ecosystem Science Department, Colorado State University

Dr. Paul C. Quimby, Jr.
USDA-ARS, Rangeland Weed Lab, Montana State University

Dr. Robert B. Carlson
Department of Entomology, North Dakota State University

Dr. Rodney G. Lym
Crop and Weed Science Department, North Dakota State University

Dr. Calvin Messersmith
Crop and Weed Science Department, North Dakota State University

Kevin Sedivec
Department of Animal and Range Sciences, North Dakota State University

Dr. Linda Wallace
Department of Botany and Microbiology, University of Oklahoma

Dr. Carolyn Hull Sieg
USDA-Forest Service, Rocky Mountain Forest and Range Experiment Station

The workshop brought together 90 state and federal natural resource managers, scientists, ranchers, farmers and other interested persons. The two-day intensive workshop was directed toward providing management strategies and alternatives involving the integration of biological controls (insects and pathogens), cultural controls (grazing and mowing), herbicide treatments and prescribed fire. It provided the participants an opportunity to hear specialists discuss the latest in control technologies and remote sensing detection capabilities. Previous research in the park and management actions were evaluated.

The panel was asked to evaluate management alternatives and to provide recommendations for implementing a long-term management program to control leafy spurge that were consistent with National Park Service and Forest Service management policies, guidelines and legal mandates. Alternatives were evaluated based on environmental sensitivity, safety, and effective integrated pest management (IPM) techniques. The park will incorporate the panel's final recommendations into the preparation of a Leafy Spurge IPM Plan and Environmental Assessment specifically for the park. This workshop set the ground work for long-term cooperative management at the local level. In May 1994, the panel reconvened at the park for an on-the-ground survey of the problem. The panel members discussed the preliminary recommendations for implementing a long-term management program to control leafy spurge within the park and the Little Missouri Badlands ecosystem. In October 1994, the findings of the Advisory Panel were published in the Recommendations for the Management of Leafy Spurge in Theodore Roosevelt National Park. Recommendations that are made for the park have applications for adjacent public and private lands. How successful the plan will be depends on funding, staffing and local cooperation. Although there is a Federal Noxious Weed Act, it has no base funding for federal agencies. A conservative cost estimate for management of leafy

spurge in the park alone is $600,000 over four years. However, a more reasonable time period is over the next ten years.

Findings of the advisory panel for leafy spurge management in Theodore Roosevelt National Park were:

1. Because of the serious infestation of leafy spurge on lands adjacent to the park, it is imperative that the park work with adjacent land landowners-private, state and federal to develop a regional management plan.
2. Develop a working GIS capability for mapping infestations and monitoring management actions within the park.
3. Ground-truthing needs to be conducted to verify remote sensing data. Utilizing GIS maps, develop a confine, contain and control strategy for areas of infestation similar to wildfire suppression strategies. A high priority for treatment is to keep clean land clean and contain spread in areas of greatest threat, such as critical habitat for wildlife, rare plants, woody draws, and riparian. Every effort should be made to maintain biological diversity while treating leafy spurge.
4. Establish weed management units throughout the park and develop priorities for management. Investigate combinations of IPM treatments based on units.
5. Base herbicide treatment on containing large areas of infestation and control of small or patchy areas infested. Different methods and intensities of treatment need to be established.
6. The park is well suited for a variety of biological control agents and would serve as an excellent research site. Establish multiple insectaries of various species for re-release back into the park. Release agents in optimal locations of continuous heavy infestations and environmentally sensitive areas where other management actions are inappropriate. The augmentation of native plant pathogens should be studied from samples collected in the park.
7. Develop a specific plan to communicate with the public and the hierarchy within the NPS for public education, political action, and agency support and awareness. Develop interpretive brochures, displays and exhibits on the exotic plant situation and its impacts on the resources.
8. Monitoring should address the number of control and sample plots needed per unit sprayed or biologically controlled. The program needs to include monitoring frequency, control effectiveness (density and mortality), site recovery and potential resource impacts such as water quality and non-target species kill. All plot locations should be established with GPS and photographed. Vegetation monitoring techniques should be standardized techniques.
9. There are potential problems with the introduction of using domestic livestock (goat and sheep) in the park for grazing control of leafy spurge. The risk of spreading diseases to native ungulates is real and the potential threat serious. This alternative is being further evaluated.
10. Take preventative action with horses brought into the park to manage importation of hay into the park as a source of undesirable species.

Some of the same landowners who attended the workshop are part of a $56,000 North Dakota Department of Agriculture's Weed Innovation Network (WIN) Grant/cost share program in which 28 Billings and Golden Valley Counties landowners, Billings and Golden Valley County Weed Boards, the Medora Grazing Association, USDA-ARS, National Park Service and Forest Service are participating. Extended partners include the international community of Agriculture Canada and European researchers. Based out of park headquarters, interagency field personnel assist with the IPM program through training of participants, pre-planning site releases and monitoring biological control agents, and monitoring other controls. Maintaining consistency in monitoring and developing an overview of the cooperating participant's site status is critical for the success of the program.

Management actions are necessary to mitigate loss of habitat as a result of exotic infestations. The park is working in cooperation with USDA-Agricultural Research Service (ARS) and North Dakota Department of Agriculture through signed agreements to establish insectaries and expand research efforts in experimental biological control programs for leafy spurge. North Dakota State University is also very instrumental in research and providing biological control agents. The species approved for biological control release in the park include *Aphthona abdominalis, Aphthona cyparissiae, Aphthona czwalinae, Aphthona flava, Aphthona lacertosa, Aphthona nigriscutis, Chamaesphecia hungarica, Spurgia esulae,* and *Oberea erythrocephala*. All but *Aphthona abdominalis* have been released. These biological control agents will not eliminate the spurge, but the goal of the program is to reach an acceptable ecological balance between it and the native plant communities. Initial releases involving limited numbers of agents (50-250 per site) were made in 1987, 1988 and 1990. In 1992, larger agent release numbers (500-1,000 per site) are beginning to show promise in the results of their control actions. Releases have been made on 137 sites through 1994. The ability to utilize biological control on a large scale in the park is probably still five years away.

Control actions in the past have included herbicide application by hand crews utilizing pack animals. However, in FY93 funding for the 4-person exotic plant crew was eliminated. Herbicide spraying by helicopters equipped with micro-foil booms have been tested and used in many places. This application method in North Dakota has met with a great deal of success including no complaints of drift or misapplication. A 200 acre study plot within the wilderness area was aerially sprayed in 1993 and 1994. One additional year is planned for this plot. The helicopter was more accurate and precise in application rate than boom or hand spraying. This technique is very cost effective with cost estimates in the park at $45/acre versus the more expensive hand crews at $90/acre. Due to the rough nature of the badlands, some areas can not be treated by helicopter. These areas should be treated by hand crews or by other techniques. An expanded and funded herbicide program is needed to contain large infestations and eliminate smaller patches where possible. The herbicide program must be run in close coordination with all biological control programs, in order to reduce or eliminate infestations outside of containment areas, while allowing the biocontrol agents to work inside such areas.

Fire is a natural component of the ecosystem in the Northern Plains grasslands which must be permitted to influence park ecosystems if natural systems are to be perpetuated. Fire has been described as a primary means for prairie vegetation management and ulti-

mately, habitat maintenance for native wildlife. In the future the park plans to develop a prescribed fire program in efforts to restore the role of fire to native prairie. The emphasis with fire would be to maintain non-infested lands in native prairie where it still exists. In addition fire would be integrated along with herbicide or biological controls within infested lands. By returning to a more natural burning scheme, floral diversity through natural plant succession and perpetuation of habitat for native wildlife would result, achieving the NPS goal to conserve native flora and fauna.

Park managers see the advantage of IPM programs that utilize a variety of techniques-such as biological control, herbicides, and use of prescribed fire to manage exotic plant problems. The ARS mapping project has helped foster interagency/private cooperation in the management of leafy spurge locally. Through joint cooperative efforts a strategy will be developed for managing different levels of infestation within identified watershed basins. Implementation will require a serious commitment of financial resources over an extended period of time.

Our partners in this battle are our neighbors. With their assistance we might stand a chance of slowing down the spread of leafy spurge. This noxious weed knows no jurisdictional boundaries. The park hopes that with the united efforts of its partners inside and outside the boundary fence there is a chance that leafy spurges' free rein over the prairie is close to an end. However, it will be many years before the plant is controlled and it may be that it will never be totally eradicated. No action today leads only to a larger problem for tomorrow.