

# THE JENNINGS ENVIRONMENTAL EDUCATION CENTER MANAGEMENT PLAN - PROTECTION AND MANAGEMENT OF A RELICT PRAIRIE ECOSYSTEM

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## INTRODUCTION

This 20 acre relict prairie ecosystem is a relatively unusual natural community of significant botanical interest in view of its autecology and geo-botanical history. It first rose to scientific concern in the early 1900s, but was not formally protected until 1951. Comprising only six percent of the park's total acreage, it houses nearly all of the park's endangered plant and animal species. It is located on the Western side of PA Routes 8 and 173 and on the north side of PA Route 528. It is bordered on the south by the prairie area day use management unit and on the north, east and west by a firebreak. The relict prairie ecosystem was designated a state park special management area in February of 1996. Due to its unique stature, the relict prairie ecosystem requires a further degree of explanation. In order to understand the prairie ecosystem one must consider the geologic, climatic, and botanical history of the area.

The Jennings prairie site was discovered in the early 1900's by Dr. Otto Emery Jennings. Dr. Jennings was associated with the Carnegie Museum of Pittsburgh and was also the chief naturalist of the Western Pennsylvania Conservancy. When originally discovered, the Jennings prairie was probably a tiny island of prairie species surrounded by woody shrubs and trees. It was through the publications and research of Dr. Jennings that the significance of this relict prairie site became known. The management of the Jennings prairie has changed significantly over its history. The prairie was originally under the auspices of the Western Pennsylvania Conservancy, a private land-holding conservation group. The western Pennsylvania Conservancy's preliminary management techniques focused primarily on increasing the number of blazing star flowers (*liatris spicata*) blooming each year. In 1981, Jennings became a state park Environmental Education Center. The park's present management approach is more holistic in nature, incorporating techniques to benefit all prairie species as well as create a stable habitat for the en-

dangered massasauga rattlesnake and other associated fauna. It is now widely accepted that fire plays a vital role in maintaining the balance in a prairie community. A prescribed burn is conducted annually to reduce encroachment of the larger woody vegetation, retard undesirable species and stimulate the response of the true prairie species. The use of this small controlled fire enhances conditions that support the prairie plants and massasauga rattlesnake. Holistic prairie management techniques in conjunction with concurrent and on-going prairie research are intended to help maintain this relict prairie ecosystem in its natural state. There are three trails wholly or partially within the relict prairie. A detailed vegetative analysis record is available in the park files.

The prairie ecosystem wetland consists of minor open water stand and associated wetland located near the center junction of the four relict prairie ecosystem quads. The wetland is approximately 0.11 acre in size with no major over-story. Some woody growth encroach-

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ment is present with more typical wetland vegetation such as cattails, skunk cabbage, marsh marigold, grasses, sedges, and rushes. This wetland is an important structure in that it provides the fundamental hibernacula for the massasauga rattlesnake. It is paramount that this wetland be protected and managed carefully.

## MANAGEMENT UNIT OBJECTIVES

The encompassing overall goal of prairie ecosystem management is to protect, maintain and enhance a unique disjunct ecosystem in a holistic manner while maintaining acceptable levels of rare and endangered status holding species in a shared community. Toward this larger goal are a variety of secondary goals supporting specific areas. Conflict arises when a singular secondary goal conflicts with another secondary goal or detracts from the primary goal. In this ecosystem, these conflicts are common and must be resolved with a common denominator approach.

Directly opposing or irreversible conflicts must be prioritized and even then often require considerable compromise. One important secondary goal is the maintenance of a safe and durable visitor integration system that will not jeopardize the resource through impact. Some specific secondary goals are; to protect the ecosystem from unnatural vegetative infiltration, maintain species composition, enhance status holding species populations, maintain concurrent research on management prescription effects, control soil water saturation and water based hibernaculum area and to prevent woody growth invasion.

### *Relict Prairie Wetland Area Objectives*

- To maintain the biotic integrity of the wetland as a massasauga rattlesnake hibernaculum
- To maintain natural water table parameters as determined by historical averages.
- To control the open water area to approximate normal size as determined by historical averages.
- To control and manage the extent and size class of woody encroachment to provide immediate post-hibernation emergence cover for the massasauga.
- To provide stable habitat factors for small amphibians which provide a percentage of the massasauga rattlesnake's diet.
- To manage habitat stability for several vegetative species not found elsewhere in the park.
- To monitor hibernacula area abiotic water quality for possible presence of pollutants toxic to massasauga rattlesnakes or important food chain species.

## RELICT PRAIRIE MANAGEMENT

### *Prescribed Burning*

Controlled burning is a nationally recognized and well-accepted treatment for maintaining and enhancing natural prairie ecosystems. Unlike woodland fire effects, fire is considered to be a natural catalyst for biotic stability within the realm of modern prairie and savannah management. While fire effects on any natural ecosystem are extremely complex, difficult to correlate, and often indicate false correlation, controlled burning in this area is intended to prevent generalized prairie ecosystem decadence by furthering five major objectives; retardation of weedy growth encroachment, profloric response to valued species and vegetation structure, macro-floric response of certain species, retardation of alien species, and aesthetic open space vista and savannah maintenance.

Immediate and longer-term effects of fire on complex vegetative assemblages depends on fire severity, extent and timing as well as on the characteristics of the area. Although forb assemblage fires differ from predominately grass prairies and differ greater yet from woodland fires, this burn is basically a stand maintenance fire regime modified to fit the eastern prairie situation. This regime is characterized by moderate to extremely high intensity surface fire with erratic and sometimes impressive rates.

Dominates (by fuel class) are variably killed back. The degree of mortality is often more important in this class (1.5 caliber and below) than consumption. Dominates are effected physiochemically through rapid desiccation of unhardened woody stems with general mortality achieved of around 25% moisture content reduction. Heat kill in this case is usually limited to instantaneous heating to 55-60 degrees centigrade although severe set back has been observed in fleshier plant parts at 40 degrees centigrade. Most successful quad burns produce around 60-80% mortality from direct injury based on blistered cambium and sap exudation.

Since the fire regime at Jennings must consider other factors as well as just the vegetative management, the burn plan becomes rather complex. Detailed information and past records are contained in the park files. General factors for successful burns are; spring burns only - pre emergence of massasauga rattlesnakes (usually March-May 10), alternate quads on alternate years, RH factors of 30 and below wind continuity most important, wind speeds over 20 mph is extremely severe, wind shifts are 90% correlated to counterclockwise (right to left from original wind direction) if in a warm high. Air temperature does not appear to be a severe factor although fuel burn continuity is difficult if under 32 degree Fahrenheit and spot fire hazards are severe if over

70 degree Fahrenheit (incendiary distance nearly doubles). Generally, air temperatures of 60 degrees f and above are associated with good burns. To protect pre-emergent and emerging massasauga rattlesnakes, soil temperatures must be measured at a depth of 6" in both dry and saturated soils. Soil temperatures must not exceed 20 degree centigrade (64 degree Fahrenheit).

More detailed burn regime information is available in the park files. Fire crews must be properly trained and depending upon burn conditions and crew experience, routine fire training (woodland) is often not sufficient for prairie burns. Direct injury to dominant class from below ground parts is believed to be negligible due to the fire speed resulting in shallow heat penetration. No successful empirical tests however, have been conducted to corroborate soil temperatures.

Subordinate (1 cm and less) vegetation mortality is usually due to consumption. Depending upon fire intensity, aspect, and other factors, even living tissue up to 1 cm. diameter is generally consumed. Mortality of subordinate vegetation is usually 100% of contacted fuel although some mosaic area may result in less than 100% of the total quad's subordinate vegetation being killed.

Indirect and delayed injury through mechanical damage, sensitization, and growth loss is assumed but not monitored directly.

Many normal (for woodlands) stand maintenance factors do not apply to prairie ecosystem fire dynamics. Changes to post fire relative abundance of species does occur and must be carefully considered in burn rotations.

General fire regime with specific regard to past fire observations and vegetative analysis is extremely important and present strong implications for long term distortions. Fire baseline data, therefore, is important to concurrent research and future long-term analysis.

### ***Relict Prairie Vegetative Management***

A large component of the relict prairie ecosystem's vegetative management prescription is accomplished directly or indirectly through prescribed burning. Controlled burning is summarized in a separate prescription, and extensive information is contained in the park files.

The retardation of woody growth encroachment is important to relict prairie ecosystems particularly at their eastern extensions. Modern prairie theory embraces a polyphysic prairie concept where even large midwestern prairies were in a constant state of change with woody growth encroachment being a natural component of that change. Due to the diminutive size of

the Jennings' prairie however, a natural polyphysic effect cannot be managed without approaching a 50% loss of floristic display. On an area under 50 acres, this would not be sound management. Woody growth encroachment, therefore must be regularly interrupted and subdued. Enough woody growth should be left to present a natural appearance and teaching model.

While controlled burning is the primary technique, it has limitations and needs to be enhanced with other methods. Prescribed burning is an inexpensive, fast and efficient method to slow, but not completely stop, woody growth takeover in open quads. Depending upon the vegetative control success of the fire, another method or a variety of methods must be applied.

Mechanical mowing with a brush hog can be applied to certain areas at certain times of the year, but must be integrated into other management techniques. A sickle bar mower would result in cleaner mowing, more equalized biomass, and provide better fuel thatch, but requires a biennial mow. Presently mowing is limited to fire lanes, some mosaic savannah treatment in quad A-4, and an experimental mow section in the southern section of quad A-1. Trail edge mowing is important to provide an angle of vegetative set back to avoid tunnel effect after heavy rains. This is accomplished through a specially modified sickle bar cutter mounted on a tractor. This cutter is capable of making standing angular cuts up to 35 degrees. Trail edge maintenance must be conducted at intervals from mid-May to early July. Edge cuts should be stopped in mid-July through late August to allow refoliation of trimmed plants. In most seasons, one more edge mowing in late August-early September is sufficient.

Trail surface mowing of grass trail areas is conducted at regular intervals. Trail turf should not exceed 3 1/2 inches and care should be taken to avoid wet conditions. Prairie Loop Trail should be left at a height of 3 1/2-4 inches in April to about the first week of May. It should then be trimmed to 3 inches until the second week of July then reduced to 2.5 - 3.0 inches until the end of the third week of August. The remainder of the year the height can increase to 3 1/2 inches, with a winter average not to exceed 4 inches of grass height.

Trails with vegetative borders should be maintained at 60" minimum width. Clippings should be directed into the center of the trail cut. This prevents the accumulation of organic thatch along side of the trails that becomes attractive to the massasauga rattlesnake by August creating potential conflict with park visitation and trail use. No limestone should be used in trail surfacing, repairs, etc. due to pH level influences and their subsequent effect on vegetation.

In areas where fire and mowing are not practical, mechanical brush removal by hand is appropriate. This

can be accomplished with long handled pruners or by power scythe. Hand clearing is best done when soils are frozen. If mechanical reduction is necessary in the period from April to November, volunteer crews should not be used. Park forces should wear snake chap leg protection and exercise caution in operation. Woody response to fire is a problem with some species. For example, a single Aspen (*Populus tremuloides michx*) of 3" caliper may be killed back in a burn. Stress factors cause suckering and root-clone development resulting in the presence of 8 aspens of .5" caliper in the same area by the next scheduled burn. These areas can quickly expand and should be monitored. There may be some limited practicality in herbicide application under these conditions. It is conceivable that the injection or slash/spotting of a systemic herbicide would be very effective in controlling clones and fire responsive species.

Quads should be closely monitored for the presence of difficult to control alien woody growth such as multiflora rose (*Rosa multiflora*), etc. These should be eradicated as soon as possible and basal stump topically treated with a herbicide. Picloram based herbicide (Tordon) is vegetatively best, but has longer soil retention (2 years). Past experience indicates that any systemic applied at 2%+ concentrations (i.e. Roundup) will work.

Vegetative species of special concern should be monitored closely for ill effects from management techniques and baseline data on their autecology collected. Population distribution is as important as population numbers, particularly in small population management.

### ***Managing water levels***

Soil water levels are very important to some species and should not be unreasonable tampered with. Baseline tensiometer studies have been conducted on a 10 meter square grid throughout the prairie. Pre and past tensiometer studies should be conducted when any physical changes are made to the prairie's hydrology.

The deliberate or accidental introduction of alien species should be minimized. The profloric effect of the prescribed burning retards alien forbs to a degree. Cool season and Asiatic grasses should be avoided in the prairie and surrounding areas. No non-naturally occurring vegetation (native or alien) should be introduced. No non-native seed or plant introduction of exotic species should be permitted to ensure genetic continuity. No cultivated varieties should be introduced. The integrity of the relict prairie ecosystem's botany is of primary importance and should not be compromised.

In an area whose floristic display attracts thousands of people from the national level, aesthetics is a viable factor. Assuming that none of the above safeguards to

the prairie vegetative community are compromised, some overtime management for aesthetic purposes is necessary. Foremost in its attractive quality is the Blazing Star (*liatris spicata*) bloom that peaks in late July - early August. Tens of thousands of plants in inflorescence are impressive to visitors and have become a visual yardstick of how well they perceived the prairie to be managed. Although this assumption is dangerously incorrect, good blooms of liatris are important to visitor perception and should not be neglected. Ideally, liatris should be well distributed with mosaic clusters. Groups of primarily yellow composites should be maintained in dense clusters at several sites within alternate burn rotation quads. Other species and bloom color mixes enhance the visual quality of areas but are not as visually important. A sense of openness is important in context to prairie imagery and corridors and view-scapes should be considered. Some open canopy savannah stands are complimentary to prairie image and should be maintained as savannah in quad A-4, (See Resource Management Map). Single shingle oak (*Quercus imbricaria michx*) are acceptable within quad A-4 but should be maintained as independent standings or limited to small loose clusters.

## **RELICT PRAIRIE ECOSYSTEM MANAGEMENT OBJECTIVES:**

- To manage the relict prairie ecosystem in a holistic approach coordinating vegetative management with all other management considerations.
- To manage the vegetative aspects of the relict prairie ecosystem subordinate to factors relating to the massasauga rattlesnake.
- To encourage vegetative factors supportive of the naturally occurring prairie species.
- To discourage vegetative factors supportive of alien species and naturally occurring woody encroachment.
- To coordinate concurrent research focusing upon the short and long term effects of management prescriptions.
- To conduct prescribed burning of prairie quads on a scheduled basis.
- To maintain the integrity of the Relict Prairie Ecosystem by prohibiting the introduction of any species not occurring naturally.
- To maintain a vegetative pattern maximizing visitor aesthetics where feasible.
- To protect and manage the massasauga rattlesnake as a primary component

## MASSASAUGA RATTLESNAKE MANAGEMENT

The endangered massasauga rattlesnake (*Sistrurus catenatus catenatus*) is a species of exceptional concern at the Jennings Environmental Education Center. Primarily a resident of the relict prairie ecosystem, the massasauga is a very well known and important feature of the park. Once occupying a range extending from New York through Iowa, man-induced environmental changes have eclipsed the population to severe levels. The massasauga rattlesnake reached "Endangered" protective status through the Pennsylvania Fish Commission's Adoption of the Endangered Species List in 1978. This amendment to the state's endangered species Act of 1973 instigated several investigations into massasauga habitat and range reduction. Historically the massasauga rattlesnake occurred in six Western Pennsylvania Counties. Extant populations are now recognized in three counties. During 1977, nineteen locations of historical occurrence were surveyed for the presence of massasauga and/or suitable habitat. Extant populations were verified at six localities, and suitable habitat remained at four additional sites. The remaining nine localities either lacked suitable habitat, or had such severely degraded habitat that the presence of the massasauga was considered doubtful. Seven of the localities with extant populations or potentially suitable habitat also exhibited signs of habitat deterioration. Damming, highway construction, urban expansion, forest succession, surface mining, and agriculture are the six major factors responsible for altering massasauga habitat. This loss of habitat has substantially decreased the geographic distribution of this species in Pennsylvania and may result in the fragmentation and isolation of populations. This presents a severe problem for endangered species populations.

The Jennings Relict Prairie Ecosystem is considered to be one of the best confirmed sites and the only site under state protection with a Massasauga Rattlesnake Management effort. Overt management prescriptions of the relict prairie ecosystem fall into several main areas of concern. These prescriptions often involve other prescriptions and become a complex factor in prescription and technique integration. Prescribed burning must be carefully conducted on spring burns to coordinate the controlled burn prior to the massasauga rattlesnake's emergence from hibernation. This integration of prescriptions is essential to avoid possible large scale mortality and subsequently the severe jeopardy of an isolated population. The controlled burn should not occur with wet and dry soil temperature over 20 degree centigrade. This factor is extremely accurate and very critical. Other snake species are not good indicators of massasauga hibernation emergence, and are therefore not reliable. Since the burn condition fac-

tors of relative humidity, air temperature and wind stability often correlate at the 1-2 p.m. time period, soil temperatures will often "kick over" between the first and second quad burn. Soil temperatures therefore must be rechecked and monitored throughout the burn day and a sensitive decision made if temperatures are too close to converting, by the second quad burn.

Mowing as a management technique must be seriously considered in relationship to massasauga habitat damage. Although a viable vegetative management option, mowing crushes the loose organic thatch and impacts the shallow A horizon to close off crayfish chimneys and tunnels. Mowing should only be conducted when soils are deeply frozen and never in any known or suspected hibernaculum areas.

One of the keys to massasauga population stability is habitat stability. Vegetative management techniques and prescriptions must consider the vegetative cover needs of the massasauga. Hibernacula areas should be maintained in 1" to 4" caliber cover of at least 36" height to provide adequate emergence cover. Gravid females as well as young breeding age males must have access to low cover, rather open basking area for embryo incubation and sperm production. The massasauga's poikilothermic nature requires access to variety in vegetative cover in order to maintain suitable body temperatures, as well as predator protection during body temperature maintenance. Hibernacula area protection and management is essential. Upwards of 80% of the population concentrates in a 1/4 acre area for six months. These areas must be carefully managed for at least a month prior to and during expected hibernation spans. The only acceptable management technique in these areas is careful hand clearing and hydrological stabilization. Since humans are often a more direct threat to a rattlesnake's wellbeing than just through their habitat degradation, visitor pressure and patterns must be seriously considered. Visitors-snake confrontations must be minimized to protect both visitor and snake. Trail locations, lay out, width, surface and curve radius must be considered.

Law enforcement must carefully consider the direct and implied protection of the massasauga. Violations against the massasauga are violations of State Park and Pennsylvania Fish and Boat Commission Regulations. Pennsylvania Fish Commission fines are severe for endangered status species. Violations against massasaugas fall into three main categories. Other than habitat destruction and degradation, the greatest percent of danger comes from visitors who deliberately kill snakes they come in contact with. Motivation is usually fear and a distorted sense of self-protection. The second largest cause of direct human-related massasauga reduction is the live capture of snakes by amateur and paraprofessional individuals for mainte-

nance in captivity or replacement into a "colony". Colony establishment technique is not widely accepted for massasauga populations among professionals and is not supported here. None the less there are professional and paraprofessionals that disagree and try to use the Jennings population as a colony source. For the most part they are aware of our position and operate covertly. The third human-related direct threat to the massasauga population is professional collectors with financial motivation. In some herpetological circles massasauga specimens are very salable. This last category operates extremely clandestinely and is exceptionally difficult to counter.

As a result of the advisory panel put together at the 1985 International Massasauga Symposium held at Jennings, it was agreed that genetic integrity was an important factor in the Jennings population. This discussion, however, was not unanimous and may change, as more complete genetic inter-relationships are understood. For the time being however, it is our position that we will not permit the translocation of individuals or pairs for colonization or the introduction of individuals for augmentation, of our population.

Environmental education is a key component to massasauga management in terms of modifying visitor attitudes and behavior. An educated visitor clientele is much more likely to act (and react) in a more positive manner toward snake-visitor confrontations and will better support management objectives and practices. Enlightened visitors often provide information, visitor sighting records, photographs, behavioral descriptions and other usable data. A concurrent study of visitor/snake confrontation behavior is ongoing.

The Jennings massasauga population is undoubtedly the best understood and most researched in Pennsylvania. A complete status and morphological examination was completed by Dr. Reinert in 1977. On-going research has continued by several universities and park staff. Information is on file in the park records.

Reliable experts and authorities on the massasauga rattlesnake are still scarce, but there is a growing competency and base of data to compare. Knowledgeable

and experienced resource people should be sought out. The park site should remain open to bonafied research efforts and should be receptive to comments, suggestions and changes to its management policies based upon new findings and understandings.

#### ***Massasauga Rattlesnake Objectives:***

- To maintain the habitat factors primarily associated with the massasauga rattlesnake.
- To monitor and centralize all botanical management around the massasauga rattlesnake.
- To control and manage public access and impact to critical massasauga rattlesnake areas.
- To monitor massasauga rattlesnake population numbers and demographics.
- To monitor massasauga rattlesnake population quality factors.
- To continue to conduct concurrent research paralleling management prescription techniques.
- To manage and protect primary food chains as they relate to the massasauga rattlesnake.
- To protect and manage key massasauga rattlesnake hibernacula.
- To control all outside research on the massasauga rattlesnake.
- To maintain and manage primary basking sites utilized by the post-hibernating male and gravid female massasauga rattlesnakes.
- To monitor morphological confirmation of massasauga rattlesnakes as an index to genetic continuity.
- To monitor reproduction rates of massasauga rattlesnakes, percentages of gravid females, male to female ratios, etc.
- To monitor all external factors that could impact massasauga rattlesnakes. Particular attention should be directed toward the watershed.
- To protect individual snakes from destruction, removal and unnecessary stress.
- To monitor and manipulate situations to protect visitors in massasauga habitat areas in a manner not impacting the snake.
- To monitor and where possible, maintain out of boundary corridors to reduce population isolation