# Surveys, assessing impacts of management, and conservation plans for Mitchell's satyr (*Neonympha mitchellii*) in southern Michigan: 2006 final report


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**Cover Photos:** Prairie Fen in the early morning, Jackson County Central Site, 2005. Barbara Barton.
**Lower Right inset:** Mitchell's satyr photo, 2005. Daria Hyde.

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## Executive Summary

In 2003, Michigan Natural Features Inventory (MNFI) initiated a multi-year project to facilitate the collection of information important to the conservation of the Mitchell's satyr (*Neonympha mitchellii mitchellii*) in southern Michigan. The fundamental objectives of this project were to; 1) intensively monitor and collect information on the response of the Mitchell's satyr to management activities such as burning, and invasive species control at two occupied sites, 2) develop a site conservation plan at each of the satyr sites in Michigan in which a plan is lacking, and 3) conduct systematic surveys for Mitchell's satyr on lands with suitable habitat that are adjacent to existing satyr populations, reevaluate threats, and monitor existing satyr populations at occupied sites in Michigan.

Mark-release-recapture (MRR) studies were conducted at three sites including the Branch County Site, Jackson County Central and Washtenaw County West in 2005 and 2006. The purpose of these studies was to gain a better understanding of habitat use, movement patterns, and population size as well as document the impacts of management on the populations at these sites. As a result of these studies, we learned that the Branch County Site has the second largest known population. Conservation efforts should be focused on maintaining this site and management should continue to maintain high quality habitat. The MRR study at Jackson County Central confirmed what was learned from the 2003 MRR study; satyrs were most abundant along the edges of the sedge meadow and satyr dispersal appears to be limited. This presents a challenge due to the geographic isolation of the satyr sites. Future work should focus on the effects of different types of barriers on satyr flight behavior to fully understand what restricts their movements and what type of habitat structure, corridors and/or stepping-stones would enhance their dispersal. The population at Washtenaw County West was larger than previously thought (Barton 2004), and it is possible that by concentrating MRR activities in areas of high densities, more individuals were captured than would have been had the entire site been surveyed. The effectiveness of clearing to enhance habitat and increase Mitchell's satyr populations at this site can only be determined with long-term studies that monitor vegetation changes as well as satyr movements and distribution, as the benefits of clearing for the Mitchell's satyr may not be realized for several years. In the coming year, under USFWS Habitat Conservation Plan (HCP) funding, we plan to work on correlating MRR data with timed-meander surveys so that we can arrive at coarse population estimates without the time and expense that MRR studies require.

An enclosure study was conducted in 2005 to document the effects of a prescribed burn at Jackson County Central. The use of enclosures to monitor adult emergence was not effective in this study for several reasons. A second study (HCP funded) on the effects of fire on satyr emergence will begin in 2007 when oviposition will be concentrated within 8 study blocks. In 2008, the treatment blocks will be burned and the control blocks will be excluded from fire. The location of larvae will be known using this technique due to artificially concentrated oviposition, and enclosures will be placed over these areas to detect emergence.

Site conservation plans were completed for three sites including Deep Lake Fen and Turner Creek North Fen in Barry County (Barry County South and Barry County Southwest) and the Mill Creek East Fen in Washtenaw County (Washtenaw County West). We worked closely with partners in writing these plans and implementing management activities at these sites. Three additional occupied sites are still in need of plans. We are working closely with the MDNR Landowner Incentive Program (LIP) to coordinate planning at Jackson County West, where they are actively involved with implementing management activities to improve habitat. Staff from the LIP program have discussed with MNFI the importance of translating these site plans into on-the-ground management. This continued partnership should be effective in implementing these plans. We will complete plans for the other two sites and update existing plans under current HCP funding.

Annual monitoring was conducted each year at the occupied Mitchell's satyr sites. We worked closely with our partners to coordinate this work to insure that all sites (where we had permission to survey) were visited annually. In 2004 and 2005, we were able to confirm the occurrence of the Mitchell's satyr at two new locations, Berrien County East and Cass County Southeast. Both sites were first documented by partner organizations who alerted us to the presence of the satyr at these locations. MNFI is continuing to collaborate with these organizations to conduct satyr surveys at these sites, identify threats and monitor the impacts of management. Each year the BIOTICS database was updated to reflect annual survey information documented at each of the satyr sites, whether monitored by MNFI or by partner organizations.

We also conducted monitoring at several sites where management activities have attempted to reverse the effects of succession and improve habitat for the satyr. We witnessed adult satyrs using areas that had been cleared of shrubs during the previous winter or that had been burned in the spring. While encouraging, it is important to continue monitoring these sites to determine the long-term impacts of these types of management activities.

Surveys were conducted in the vicinity of occupied sites and at historic locations. As a result of these surveys, additional occupied habitat was documented at five satyr sites including Barry County Southwest, Branch County Site, Cass County East, Jackson County East, and Van Buren County Northwest. During the past three years, we were unsuccessful in documenting the occurrence of the Mitchell's satyr butterfly at seven historic locations. The Mitchell's satyr working group will need to explore the potential for reintroducing satyrs at these sites in the future.

MNFI and cooperators documented 15 different rare plant or animal species associated with prairie fens or the adjacent uplands at 29 different sites during surveys for the Mitchell's satyr during the project. This information will be useful in determining the appropriate protocol for conducting management activities at these sites.

Over the past three years, we have greatly enhanced our knowledge concerning the distribution and quality of satyr sites. We have documented threats, which need to be addressed at these sites, and identified management needs that should be implemented to maintain the fens. We have identified microhabitat variables that appear to be important to satyrs and have come to realize the need for conducting long-term monitoring at managed sites to learn how management activities impact the satyr and other fen-associated species. Probably the biggest take home lesson has been understanding how critical it is to develop trust and nurture relationships with the landowners who own the sites where satyrs occur. Their continued cooperation is vital to sustaining satyr populations for future generations.

Further studies are needed to define habitat requirements and complete the life history description of the Mitchell's satyr. Concurrent research should focus on the long term effects of management (prescribed fire, clearing) on the Mitchell's satyr, and long term monitoring should be implemented to document temporal effects with the goal of providing land managers information that can be used to prescribe the best management practices for conservation of the Mitchell's satyr and its habitat.

# Introduction

The Mitchell's satyr butterfly (*Neonympha mitchellii mitchellii*) is a rare butterfly species whose worldwide distribution is restricted to Michigan and Indiana. It is currently only known from 19 sites in southern Lower Michigan and 2 sites in northern Indiana. This species is currently listed as endangered in Michigan and Indiana, and was federally listed as endangered in 1992. The long-term viability of these populations is unknown. From 2004 to 2006, two new sites were documented and satyrs were confirmed at seventeen previously known sites in Michigan. The status of two additional known sites is uncertain. All but two of the known satyr sites occur on private land. The butterfly appears to be restricted to calcareous wetlands that range along a continuum from open fen, wet prairie, prairie fen, and sedge meadow to shrub-carr and tamarack savanna (McAlpine et al. 1960, Shuey 1997, Szymanski 1999). It appears that the Mitchell's satyr occupies areas in these fen communities where woody and herbaceous vegetation occurs as a mosaic (Szymanski and Shuey 2002).

To reclassify to federal threatened status, 16 geographically distinct populations or meta-populations must be established range wide, including 12 in Michigan; to de-list, nine more populations must be established. These populations must remain viable for five consecutive years following reclassification, which will require a valid, repeatable monitoring protocol. At least 15 of the 25 recovered populations also must be protected and managed for the benefit of this species (U.S. Fish and Wildlife Service 1997). Currently, only eight occupied sites in Michigan are considered to have potential to contain viable populations. Satyrs at the remaining sites either occur in much lower numbers or the amount of suitable habitat is limited in size. In addition, some sites are threatened by development, making their long-term viability uncertain.

Field studies continue to be extremely difficult for this species because of its ephemeral nature, the fragility of its habitat, the short survey window, and the difficulties in observing this species. Despite these challenges, our understanding of the satyr's biological and ecological requirements and habitat affinities has increased over the past decade. In addition, site conservation plans have been completed for over half of the occupied sites and at many sites, management is already being implemented.

The Michigan Natural Features Inventory has participated in numerous working group meetings for the Mitchell's satyr butterfly sponsored by the U.S. Fish and Wildlife East Lansing Office since the inception of the working group in 1997. It has been a concern of the group that most of the occupied sites are in dire need of management to control non-native species and to mimic natural disturbance regimes. Working group members have stressed the need to intensively monitor the Mitchell's satyr and its associated habitat at sites undergoing active management to evaluate the response of the satyr to these activities. This information is crucial to developing effective long-term management strategies at occupied sites. Establishing baseline densities and trends is an important part of this process. In addition, long-term monitoring has been identified as essential for determining the overall health of satyr populations.

Expanding searches for the Mitchell's satyr in potential habitat in the vicinity of newly discovered or re-discovered sites as well as at historical sites that have not been re-surveyed is also an important task to determine if there is additional occupied habitat. Many satyr sites were only recently discovered and some historical sites have not been thoroughly surveyed. This report summarizes the work completed during the past three years and highlights relevant findings. Objectives for this project are listed below.

## Project Objectives

1. Conduct landowner contact to provide information and obtain permission to survey.
2. Develop and begin implementation of a long-term monitoring study to assess the response of the Mitchell's satyr to management activities at two sites.
3. Complete site conservation plans for Mitchell's satyr sites where plans are lacking.
4. Conduct surveys around extant and historic satyr sites in southern Michigan.
5. Transcribe and analyze data collected from surveys and monitoring activities.

# Methods

## Landowner Contact

MNFI contacted landowners of occupied satyr sites as well as at sites with potential for satyr habitat during the month prior to the satyr flight. In addition, we worked closely with staff from Southwest Michigan Land Conservancy (SWMLC), The Michigan Department of Natural Resources (MDNR), Landowner Incentive Program (LIP), The Nature Conservancy and the Michigan Nature Association (MNA) to coordinate landowner contact at sites where their volunteers were conducting surveys or coordinating management activities. Landowners were contacted by telephone or in some cases by home visits. Discussions with each landowner emphasized the importance of wetland communities, fens in particular, and the status of the Mitchell's satyr and other associated rare species. Photographs of the Mitchell's satyr butterfly, other butterflies that are often confused with the satyr and prairie fen habitat were laminated and used when talking with landowners and describing the butterfly and its habitat. Landowners that had a prairie fen on their property were provided with information emphasizing the value of this natural community and outlining activities that threaten fens and fen-associated plants and animals. Those individuals that had Mitchell's satyr on their land were informed of the status of the species and the significance of finding the satyr on their property. They were provided with information on how to manage their land in a way that will preserve or enhance the satyr's habitat and informed about activities that pose a threat to the satyr. Finally, they were encouraged to contact us if they had any questions or concerns.

In 2004, MNFI contacted 35 individual landowners to request permission to survey their property for Mitchell's satyr and other fen-associated species. In 2005, 26 landowners were contacted and in 2006, 31 landowners were contacted. The majority of these landowners own property where the satyr occurs and were contacted each year. Only one landowner denied permission in 2006, due to liability concerns. Many other landowners were contacted by SWMLC and MDNR-LIP in areas where they assumed responsibility for conducting satyr surveys.

## Satyr Surveys and Threat Assessments

Teams of two or more scientists conducted walk-through surveys of potential habitat during the satyr flight period. Surveys were conducted during optimal weather conditions, avoiding days that had significant wind or rain. Surveys were generally conducted in the late morning, late afternoon and early evening, avoiding the mid-day period since satyrs tend to be more sedentary during this time. Satyrs typically fly during a two to three-week period ranging from late June through mid-July (Lee 2000). Satyr activities (surveys, monitoring, and oviposition behavior study) in 2004 were conducted from 17 June to 14 July. In 2005, satyr surveys and monitoring took place from 26 June to 15 July and in 2006, these activities were conducted between 15 June and 15 July. In 2006, a volunteer agreed to monitor five known satyr sites beginning on 15 June in order to detect the day of first emergence at sites that occur in different parts of Michigan.

Observers walked in a meandering pattern looking forward, to the sides, and behind to increase the likelihood that all butterflies were seen. Particular attention was paid to areas containing fine-leaved sedges growing in association with low growing shrubs and tamarack (*Larix laricina*), seeps and springs, and small openings along streams and between the shrubs. Adult Mitchell's satyr butterflies are most easily confused with the eyed-brown (*Satyrodes eurydice*), the Appalachian eyed-brown (*S. appalachia*), and the little wood satyr (*Megisto cymela*). Mitchell's satyr was distinguished from these similar species by its characteristic slow, erratic and low flight pattern, its smaller size and darker coloration, and the number and arrangement of eyespots on the wings. Individuals were identified as they flew or rested. Close-focusing binoculars were often used to aid in this identification and it was not necessary to capture butterflies with a net or handle them in any way. If a Mitchell's satyr was found, extreme care was taken to avoid trampling the vegetation in the event that eggs were present. Surveyors used existing game trails

whenever possible to minimize impacts to the habitat. Photographs of sites and the habitat occupied by the satyr were taken and when possible, photographs of adult satyrs were taken as well.

A threat assessment was conducted at all occupied sites visited in 2004, 2005 and 2006 by documenting current disturbances and noting potential threats. Threats may include: altered hydrology; off-road vehicle (ORV) use; livestock grazing; shrub encroachment; development and land use changes; lack of landowner interest in managing for the satyr; point and non-point sources of pollution; or the presence of invasive species such as purple loosestrife (*Lythrum salicaria*), reed canary-grass (*Phalaris arundinacea*), glossy buckthorn (*Rhamnus frangula*), and cattails (*Typha* spp.). Management needs also were identified.

An MNFI Mitchell's Satyr Survey Form was completed at each site where surveys were conducted for the butterfly. Recorded data included site information, land ownership, animal species observed, current disturbances, potential threats and detailed habitat descriptions. In addition, an MNFI Special Animal Form was completed for any listed animals that were observed. Similarly, an MNFI Special Plant Form or MNFI Natural Community Form was completed when a listed plant or high quality natural community was documented. Data were then entered into the MNFI Database (Biotics 4.02). In addition, a Global Positioning System (GPS) unit was used to record satyr locations and these coordinates were then saved in an Arc View project file for each site.

### Surveys for Associated Rare Species

Observers were vigilant in searching for other rare plant and animal species while conducting Mitchell's satyr surveys at known or potential sites in 2004, 2005 and 2006. Some rare animals and plants were found incidental to satyr surveys.

The state threatened poweshiek skipper (*Oarisma poweshiek*) occurs in prairie fen communities and its flight period overlaps (at least in part) with that of the satyr. Because of its affinity for nectaring on yellow flowers, surveyors carefully looked for this skipper on shrubs and plants, such as shrubby cinquefoil (*Potentilla fruticosa*) and black-eyed-Susan (*Rudbeckia hirta*), while conducting satyr surveys.

The state special concern swamp metalmark (*Calephelis mutica*) is another fen inhabiting lepidopteran species. Its adult flight period also overlaps that of the satyr; however, it flies for an additional one to two weeks after the satyr flight ends. This species also shows an affinity for nectaring on yellow flowers so surveyors carefully looked for this butterfly on species such as black-eyed Susan and shrubby cinquefoil. In addition, this butterfly exhibits moth-like flight behavior (flying and alighting under the surface of leaves) so surveyors walked through the fen looking for any lepidopteran which exhibited this behavior and occasionally tapped the stem of certain plants to potentially knock roosting butterflies from their perches. These surveys focused on areas with concentrations of the larval host plant, swamp thistle (*Cirsium muticum*). In addition, some time was spent looking for larval feeding damage on the thistles.

Surveys for the eastern massasauga rattlesnake (*Sistrurus c. catenatus*, SC), were conducted at all occupied satyr sites while doing surveys for the satyr. Although daily activity cycles appear to vary widely, they tend to be the most active during the warmest parts of the day in spring and fall. In the summer months, they typically shift their activity periods to the cooler parts of the day and may even become nocturnal (Seigel 1986). Surveys for this species are difficult. When they are threatened, eastern massasaugas will typically remain motionless, relying on their cryptic coloration to blend into their surroundings. They are often difficult to see in the vegetation that occurs in their preferred wetland habitats. Thus, surveys are usually conducted by simply walking through suitable habitat during times of the year and times of the day when they are likely to be most active. During the numerous visits to occupied and potential satyr habitat that occurred in July, surveyors were always looking for massasaugas.

## Mitchell's Satyr Monitoring

The Mitchell's Satyr Working Group met on 24 May 1997 to discuss monitoring needs for the satyr. At that time it was agreed that Pollard transects conducted during the satyr flight period were the preferred method for monitoring this species (Pollard and Yates, 1993). The group also discussed a variety of factors that likely affect the number of adults seen during a Pollard walk and recognized the need to evaluate these factors. A Mitchell's satyr monitoring form was developed to document these factors as well as to record observations of satyrs and other butterflies. The group also identified priority sites where monitoring activities would be initiated. Monitoring was conducted at these sites in 1997, and 1998. On 24 February 1999, Working Group members agreed to re-evaluate the effectiveness of Pollard counts and to consider using a different technique, potentially a timed area search (meander survey). Members agree to do both a Pollard count and timed area search at several sites in 1999 to evaluate the effectiveness of the Pollards and develop an index relating satyr numbers to the Pollard counts.

On 19 January 2000, the Working Group determined that it was important to conduct meander surveys at occupied sites on more than one occasion during the field season to more effectively monitor these populations. It was decided that visiting sites three times during the flight period and conducting timed meander surveys would provide valuable data on the distribution and number of butterflies and would help determine long-term site viability as well as reflect the impacts of various management activities.

**Nine known occupied sites, in 6 southern Michigan counties, were monitored by MNFI staff in 2004** to assess the distribution and population status of the satyr using timed meander surveys. These sites include: Barry County South, Barry County Southwest, Berrien County East, Branch County Site, Cass County East, Jackson County East, Kalamazoo County North, St. Joseph County East and St. Joseph County West. MNFI staff assisted SWMLC on monitoring activities and survey efforts at Van Buren County Northwest. Assessments were conducted at these sites to document current and potential threats and to identify management needs.

**MNFI staff monitored 10 occupied sites, in 6 southern Michigan counties, in 2005** to assess the distribution and population status of the satyr using timed meander surveys. These sites include: Barry County South, Barry County Southwest, Branch County Site, Cass County East, Cass County Southeast, Jackson County East, Jackson County Central, Jackson County West, St. Joseph County East and Washtenaw County West. One of these sites, Cass County Southeast, was newly discovered by Dr. Doug Landis (MSU). MNFI staff conducted a survey at the site with Dr. Landis and the land manager. Assessments were conducted at these sites to document current and potential threats and to identify management needs.

**MNFI monitored 14 sites, in 8 southern Michigan counties, in 2006** to assess the distribution and population status of the satyr using timed meander surveys. These sites include: Barry County South, Barry County Southwest, Berrien County South, Berrien County North, Berrien County East, Branch County Site, Cass County East, Cass County Southeast, Jackson County East, Jackson County Central, Jackson County West, Kalamazoo County West, St. Joseph County East and Washtenaw County West.

## Mitchell's Satyr Oviposition Observations

In 2004, we attempted to document female satyr concentration areas and to test the methodology of observing satyr oviposition under field conditions. These tasks have become increasingly important, as we have begun to actively managing satyr occupied fens. Females were distinguished from males based on their larger average size, lighter coloration, enlarged abdomen, and characteristic flight.

Barton (2004) conducted an intensive oviposition study at Jackson County Central, and MNFI focused our oviposition observations at two other occupied sites where management was being planned, Barry

County Southwest and Cass County East. These sites were re-visited during the second full week of the satyr flight. Over a 4-day period a total of 32 person hours were spent observing several different female satyrs in hopes of observing oviposition. When oviposition was observed, these locations were marked with wire flags, the location was recorded with a GPS unit and photos were taken of the eggs on the oviposition host. Representative plants that looked identical to the oviposition host were vouchered for identification purposes.

## Mark-release-recapture Studies

### *Branch County Site*

A MRR study (using previously described methodology) was conducted in 2006 from 24 June to 5 July for a total of 11 sampling days. The initial intent of this study was to cover the entire site; however; the study area boundaries were adjusted due the size of the site and the dense shrub cover. Open meadow and shrub areas were surveyed on alternate days. All areas within the study site boundaries were thoroughly searched for satyrs. Population estimates were calculated using the Program Jolly (Pollack et al. 1990). The effects of habitat type (meadow, shrub-carr) and sex on home range sizes were determined using a two-way analysis of variance (ANOVA). The effects of sex, habitat type, and site on total distances traveled per recapture event and distance per day traveled by Mitchell's satyrs were analyzed using repeated measures ANOVA. If an individual was captured two or more times on the same day, those points were discarded from the analysis in order to standardize the data.

### *Jackson County Central*

In order to gain a better understanding of habitat use, movement patterns, and population size, we conducted the second mark-release-recapture (MRR) study at this site in 2005. We increased the number of field staff from the prior 2003 study to obtain higher recapture rates (which provides better vagility estimates). The study was conducted from 28 June - 15 July (no capturing was done on 4 July) using standard methods. Spatial data were obtained from all capture points using Trimble GeoExplorer GPS units. CAPTABLE (Entomological Consultants, Ltd., Pleasant Hill, CA) and Animal Movement Extension (Hooge and Eichenlaub 1997) were used to analyze population data and vagility. Jolly-Seber methods were used to estimate population size (Jolly 1963). ArcView 3.2 (ESRI, Redlands, CA) GIS software was used for mapping**.**

### *Washtenaw County West*

The effects of clearing on Mitchell's satyr movement and distribution were studied at this site in 2006. Three plots with two paired treatment blocks (50 m x 20 m) in each were designated at areas with high Mitchell's satyr densities. Treatment was defined as complete clearing of shrubs and trees $\leq$6" dbh (diameter at breast height) using hand-held brush cutters. Larger trees were girdled with the exception of tamarack trees, which were not treated. Treatments took place in February and March of 2006.

A mark-release-recapture (MRR) study was conducted from 22 June to 10 July 2006 for a total of 13 sampling days. Each plot was surveyed twice per sampling day by walking established linear transects approximately 3 meters apart. This was to minimize trampling within the habitat. Mitchell's satyrs were captured using hand-held nets and unique identifying numbers were placed on the ventral surface of the right hindwing using Sharpee Fine Point™ and Sharpee Ultrafine Point™ permanent markers. Individuals were released immediately after capture. Date, time, sex, and identification number were recorded. Identification number, sex, and date were written on plastic flags and placed at the point of first observation for each Mitchell's satyr captured. Locational information for capture points was collected using Trimble GeoExplorer I and II hand-held global positioning system (GPS) units. A minimum of 120 position readings were collected for each satyr location. Maps and movement statistics were analyzed with ArcView 3.2 Geographic Information Systems (ESRI, Redlands, CA).

The effect of treatment, characterized as the propensity of individuals to move into or out of a plot was analyzed using a logistic regression approach to see if there were any differences in the proportion of individuals. Population estimates were calculated using Program Jolly (Pollack et al. 1990). As with the distance analyses, duplicate records of individuals captured two or more times on the same day were discarded in order to standardize the data.

### Enclosure Study

The Nature Conservancy (TNC) conducted a prescribed burn in the spring of 2005 at Jackson County Central and we attempted to assess the impact of the fire on the larvae by monitoring adult emergence. Eight enclosures were placed within the burn unit and eight in a control plot in order to detect adult emergence. The cages were placed within 1m – 3m of wooded edges in areas known to have high concentrations of satyrs in 2003. The cages were placed on 24 June and removed at the end of the flight period. Cage frames were constructed using 2" PVC pipe and were placed over 2 ft pieces of rerod driven into the ground. A 6x6x6 ft Lumite screen cage (BioQuip Products, Inc.) was placed over each frame and staked into the ground using wire. Cages were checked daily after adult emergence. Temperature, relative humidity, and light intensity within and outside the cages were recorded every five days. All insects found flying inside the cages were recorded to species level if possible and released

## Results and Discussion

### Landowner Contact

In 2004, MNFI received permission to conduct surveys at 15 sites, which includes 34 properties. In 2005, we received permission to conduct surveys at 10 sites, including 26 properties and in 2006, MNFI received permission to conduct surveys at 14 sites, which includes 30 properties. During visits to monitor the satyr, MNFI staff had many positive discussions with landowners. In 2004, there were 11 landowners from eight satyr sites that expressed interest in actively supporting conservation efforts for the satyr on their property. In 2005, 15 landowners from eight satyr sites showed similar interest. Finally, in 2006, 8 landowners from eight satyr sites on their property expressed an interest in these types of efforts. As a result, some of these landowners are pursuing management activities on their land through the support of the LIP (Landowner Incentive Program) biologist and the LIP program, through the MDNR Wildlife Division and through TNC.

### Site Conservation Plans

The site conservation plan for Deep Lake Fen in Barry County was completed in 2005 (See Appendix 1). A site visit was conducted during the late fall at Deep Lake Fen with the Stewardship Program Manager and the Stewardship Ecologist from MDNR Parks and Recreation Division, who are supervising fen restoration activities at this site. The management strategy was determined and boundaries were marked. MDNR Parks contracted and supervised the clearing of 4.69 acres of shrubs at this site in 2005 and in 2006; a prescribed burn was conducted on 60 acres of adjacent oak-pine barrens.

The site conservation plan for Turner Creek North Fen in Barry County was completed in 2005 (See Appendix 2). This plan was co-written by an MNFI staff person and the wildlife biologist and wildlife technician at Barry State Game Area. During the process of completing the plan, we made several field visits, conducted satyr surveys during the flight, and had many discussions. As a result, we determined the most effective and feasible management strategy that will improve the fen community and positively affect the plant and animal species, which are found at this site. Management boundaries have been delineated and restoration activities were initiated in the winter of 2007. Shrubs were cleared from approximately 8 acres of dense shrub-carr to assist in expanding and connecting areas of suitable habitat.

The site conservation plan for Mill Creek East in Washtenaw County was completed in 2006 (See Appendix 3). We have worked closely with the three private landowners at this site to understand their concerns and goals for their land as well as to help them understand how to become good stewards of the satyr and its habitat. Some of the management recommendations from the plan were implemented as part of the research study that took place at this site in 2006.

## Surveys

**In 2004,** the flight occurred from 17 June through 20 July. **Visits to conduct surveys and monitoring for the Mitchell's satyr butterfly by MNFI were conducted at 15 sites on 34 properties**. Ten of these sites are known occupied sites and were monitored by conducting timed meander surveys two to three times during the flight. Four of these ten sites were undergoing fen restoration or were slated to have fen management activities initiated. Surveys were conducted at four sites that are associated with areas where satyrs were historically documented or are thought to have occurred in the vicinity at one time. In addition, a *de novo* survey was conducted at one site that appeared to have suitable habitat but that had no historical record for the satyr. Staff and volunteers from SWMLC conducted surveys for the satyr in 2004 at six known sites and conducted *de novo* surveys at three sites. (See Appendix 4).

**In 2005**, the flight occurred from 26 June through 23 July. **Visits to conduct surveys and monitoring for the Mitchell's satyr butterfly by MNFI were conducted at 10 sites on 26 properties**. One of these sites was discovered in 2005 by Doug Landis (MSU). Sites were monitored by conducting timed meander surveys two to three times during the flight. Six of these ten sites were currently undergoing fen restoration or were slated to have fen management activities initiated. A *de novo* survey was conducted at one site that appeared to have suitable habitat but that had no historical record for the satyr. Staff and volunteers from SWMLC conducted surveys for the satyr in 2005 at seven known sites and conducted *de novo* surveys at one site. Staff and volunteers from TNC and the USFWS conducted surveys at two additional occupied sites. The Michigan Nature Association (MNA) also conducted surveys at two sites, which they own and manage (See Appendix 4).

**In 2006**, the flight occurred from 20 June to 15 July. **Visits to conduct surveys and monitoring for the Mitchell's satyr butterfly by MNFI were conducted at 14 sites on 30 properties**. Fen restoration activities either are planned or are currently being implemented at 12 of these 14 sites. *De novo* surveys were conducted at a site owned by MSU, which is located within one mile of an occupied satyr site. This site has some suitable habitat but no historical records for the satyr. A private landowner, adjacent to an occupied site, provided boat transportation for surveyors from MFNI, MDNR-LIP, and SWMLC to conduct *de novo* surveys in fen habitat around the lake where she lives. Plenty of suitable habitat was found, although no new occupied sites were discovered. Staff and volunteers from SWMLC conducted surveys for the satyr in 2006 at six known sites and conducted *de novo* surveys at one site. Staff and volunteers from TNC and the USFWS conducted surveys at 6 occupied sites. (See Appendix 4).

## Extirpated Sites

During the past three years, we were unsuccessful in documenting the occurrence of the Mitchell's satyr butterfly at Cass County NW and at Kalamazoo County North. It is doubtful that the species still occurs at either of these sites. The Mitchell's satyr working group will need to determine the wisdom and feasibility of considering a reintroduction of satyrs at either of these historic sites. We have been unable to gain permission to conduct a survey at Van Buren County Site and it is unclear whether Mitchell's satyr has become extirpated at this site.

## Associated Rare Species

MNFI and cooperators documented several rare species associated with prairie fens during surveys for the Mitchell's satyr in 2004, 2005 and 2006. Care was taken to record the location (GPS point taken) description of the habitat, and any identified threats to rare species that were discovered during satyr surveys. This data was entered into the MNFI Database (Biotics 4.02).

**Table 1.** Associated rare species documented during Mitchell's satyr surveys from 2004-2006 in Southern MI.

| Species Documented | 2004 | 2005 | 2006 |
|---|---|---|---|
| **PLANTS** | | | |
| Cut-leaved water parsnip (*Berula erecta*) | X (2 sites) | X | X (2 sites) |
| Edible valerian (*Valeriana ciliata*). | X (2 sites) | | |
| Ginseng (*Panax quinquefolius*) | | X (adjacent upland) | |
| Goldenseal (*Hydrastis candadensis*) | | X (adjacent upland) | |
| Jacob's ladder (*Polemonium reptans*) | | X | |
| Tuberous Indian plantain (*Cacalia plantaginea*) | X (2 sites) | X | |
| Virginia snakeroot (*Aristolochia serpentaria*) | | X (adjacent upland) | |
| White lady's slipper (*Cypripedium candidum*) | | X (2 sites) | |
| **ANIMALS** | | | |
| Angular spittlebug (*Lepyronia angulifera*) | | X (*de novo site)* | |
| Blanding's turtle (*Emys blandingii*) | X | X | X (2 sites) |
| Duke's skipper (*Euphyes dukesi*) | | X | |
| Eastern box turtle (*Terrapene c.* carolina) | | X (3 sites) | X (3 sites) |
| Poweshiek skipperling (*Oarisma poweshiek*) | | X | |
| Spotted turtle (*Clemmys guttata*) | | | X |
| Swamp metalmark (*Calephelis mutica*) | | X | |

## Monitoring Activities at Managed Sites

***Barry County Southwest:***

The primary management need at this site is to reduce the encroachment of woody vegetation in the fen and open up areas that still contain a sedge understory. Monitoring was conducted at this site by MNFI staff on three occasions in 2004. Timed-meander surveys were conducted on 29 June and 6 July and oviposition observations were made on 14 July. Additional occupied habitat was discovered (approximately 1.0 acres) to the east of the known occupied site. An additional site visit was made by MNFI staff to provide expert review and help coordinate management activities with staff from MDNR Parks Division on 17 November. Occupied areas were delineated and areas slated for shrub control were marked with flagging as well as recorded with a GPS unit. As a result of the discovery of the new occupied patch, MDNR Parks and Recreation Division, Stewardship Staff decided to create a corridor to connect this area with the occupied patch located to the west.

MDNR parks supervised the clearing of shrubs from 4.69 acres of potential habitat in the winter of 2005. This activity resulted in the creation of new openings with a sedge understory as well as a connecting corridor (approximately 100 meters long) between two patches of occupied habitat. An MNFI ecologist and the MDNR Parks Division, Stewardship Ecologist conducted a timed-meander survey on 8 July. Due to staffing constraints, we were unable to conduct a second visit to this site this year. Six satyrs (two females) were documented in the newly created corridor. It will be interesting to learn if this newly created habitat will continue to be utilized by the satyrs in the coming years and to document the response of the vegetation in the cleared areas. In 2006, surveyors documented three satyrs (one female) in the newly created openings during timed meander surveys. It is encouraging that satyrs are using these restored areas. Time will tell if the expansion and creation of habitat will result in a boost to population numbers and viability.

***Berrien County East:* (*New Site*):**

In 2004, surveys confirmed the presence of the Mitchell's satyr at a new site in Berrien County. Although we learned of this site several years ago, this was the first year that we were able to obtain permission to survey the site. The site was visited on two occasions by an MNFI zoologist and ecologist and the satyr population and fen community were documented and described. A third site visit was made by a zoologist and conservation planner who met with the stewardship coordinator for the private land conservation organization, which owns this site as well as a LIP biologist. Restoration strategies and activities were discussed and areas where the satyr was documented were marked. Management to control shrub growth and non-native species was initiated in 2005 at this site by the private land conservation with funding from the LIP program.

Timed-meander surveys in 2005 documented 10 satyrs at this site. The private conservation organization conducted a prescribed burn in the spring of 2006 at this site, with support from the MDNR LIP program. The prescribed burn included 3 acres, primarily in areas adjacent to occupied habitat. In 2006, a timed meander survey recorded 19 satyrs at this site. MNFI will continue to coordinate with the private conservation organization to monitor the impacts of management at this site in the future.

***Branch County Site:***

The primary management needs at this site are to reduce the amount of woody vegetation and to control or eliminate invasive species (particularly purple loosestrife) that are encroaching into the fen. Monitoring was conducted at five different times in 2004 to support and evaluate the management activities at this site. On 10 March, two MNFI staff attended the purple loosestrife workshop at MSU, sponsored by Michigan Sea Grant, to be eligible to receive *Galerucella* beetles, a biocontrol insect used to control purple loosestrife. MNFI agreed to conduct spring and fall sampling to determine the progress and impact of the release, and the success or failure of the introduction.

On 20 May 2004, MNFI staff released 200 beetles in the northeast corner of the fen that has dense stands of purple loosestrife and established sampling quadrats. On 17 June MNFI staff conducted spring sampling at the release site. During this visit, they documented the beginning of the flight period for the Mitchell's satyr butterfly (earlier than was expected) and then proceeded to conduct a timed meander survey of the eastern portion of the fen. Two additional timed meander surveys were conducted at this site on 24 June and 8 July. Finally, fall sampling of the beetle release site was conducted on 4 August by MNFI staff. During the summer of 2004, staff from SWMLC conducted clearing of shrubs and trees in "priority one" unoccupied areas in the northwestern portion of the fen to expand habitat and create a connecting corridor between the eastern and western portions of occupied habitat. GPS data of satyr locations acquired during timed-meander surveys were provided to SWMLC staff to help guide proposed management activities that they planned to initiate in the winter of 2005 in the southwest area of the fen.

Monitoring was conducted at five different times in 2005 to support and evaluate the management activities at this site. On 17 May MNFI staff conducted spring monitoring at the site where the *Galerucella* beetles were released in 2004. The response of the vegetation and the satyrs to the clearing that was done in 2004 is not immediately evident and will take time to evaluate, although no satyrs have been documented using the cleared area to date. Four timed meander surveys were conducted at this site on 26 June, 27 June, 5 July and 6 July. In addition, MNFI staff assisted Peter Tolson and Mitch Magdivich from the Toledo Zoo on 5 July to capture and cage two female satyrs in an outdoor enclosure in order to collect eggs for a larval rearing study. The next day 38 eggs were successfully gathered and the females were safely released to the locations where they had been captured.

Monitoring was conducted at two different times in 2006 to evaluate the management activities at this site**.** On 6 June 2006, MNFI staff conducted spring monitoring at the site where the *Galerucella* beetles were released. Fall sampling of the beetle release site was conducted on 1 September 2006 by MNFI staff. It will be several years before the effectiveness of the beetle release can be evaluated as it generally takes five years for the beetles to impact the root stock of the purple loosestrife plants. Timed-meander surveys were conducted at this site in an attempt to correlate these counts with daily population estimates from the mark-release-recapture data. Unfortunately, weather events, prevented gathering sufficient data, and these analyses were not completed.

***Cass County East:*** The private conservation organization which owns this site (TNC) requested that MNFI conduct surveys to determine which areas of the fen are currently occupied in order to guide their management strategies at this site. They would like to conduct shrub removal in the northwest corner of this site where satyrs were previously recorded but have not been documented for several years. They are also considering implementing a controlled flooding in this area in order to set back vegetative succession. In 2004, timed-meander surveys were conducted on 2 July and 13 July and oviposition observations were conducted on 13 July. One satyr was documented ovipositing eggs and the location was recorded with a GPS unit. Additional occupied habitat (approximately 0.5 acres) was documented and this information was provided to the organization.

In 2005, timed-meander surveys were conducted on 8 July by MNFI and TNC staff. Again, no satyrs were documented in the northwest corner of the site, where management is being considered, although eight satyrs were found in another area to the west where satyrs have been found the past several years. In 2006, timed-meander surveys documented the first satyr of the flight period at this site on 20 June. Subsequent surveys had to be cancelled due to an MNFI volunteer encountering individuals harvesting marijuana at the site. The local and federal law enforcement officers recommended that no further surveys be conducted at this site for safety reasons. A survey was conducted on a parcel of private land that occurs approximately 1.5 miles to the west. Satyrs have been documented from this area in small numbers before and in 2006, 8 satyrs were confirmed from this area. Future surveys will concentrate in areas of suitable habitat, which occurs between this private parcel and the TNC property.

***Cass County Southeast (New Site):***
In 2005, surveys confirmed the presence of the Mitchell's satyr at this new site in Cass County. Doug Landis, (MSU) alerted MNFI, TNC and USFWS to his discovery of the satyr at a privately owned nature camp. An MNFI ecologist conducted surveys along with Dr. Landis, TNC staff, and a camp staff person. The satyr population and fen community were documented and described. MNFI and DNR staff made a second visit, although no satyrs were documented at this time due to it being late in the flight period. A third site visit was made in the fall to discuss management needs. The MDNR-LIP program and camp directors are currently discussing restoration strategies and activities. Management to control shrub growth and non-native species was initiated in 2006 by the LIP program and Dr. Landis. Some purple loosestrife does occur at this site but *Galerucella* beetles are present and should keep this invasive under control. Surveys were conducted on two occasions by MNFI staff during the flight period in 2006. Satyrs were documented in good numbers on the east side of the channel on Camp property. A prescribed burn is planned in unoccupied habitat for the spring of 2007. MNFI will continue to monitor the impacts of management at this site.

***Jackson County Central***
In 2006, the MDNR LIP program supervised a prescribed burn on a private parcel adjacent to the main fen at the Jackson County Central site. The burn included approximately 8 acres, which consisted of 2.1 acres of suitable habitat. Two timed meander surveys were conducted on 29 June and 7 July. Ten satyrs were found on the first survey and 29 were found during the second survey. It is unclear whether satyrs colonized the burned area from adjacent occupied habitat or whether any satyr larvae emerged from the burned area.

## Mitchell's Satyr Oviposition Observations

Oviposition was documented in 2004 at Cass County East. One satyr was documented ovipositing eggs and the location was recorded with a GPS unit. The eggs were deposited on the underside of a small forb very close (<10cm) to the ground. Previous observations of female satyrs laying eggs at two other sites were under similar circumstances, with eggs laid on the underside of small forbs close to the ground. Observers noted that most females laid eggs in the late afternoon or early evening, usually after 3:00 pm. In 2004, Barton (2004) spent many hours trying to observe oviposition at Jackson County Central without success. We determined that it takes a large investment of time to observe oviposition and it is not practical at large sites. When disturbed, females often fly away and drop down in the vegetation and it is difficult to relocate them. This technique is most appropriately used at small sites where it is important to know the location of eggs due to pending management or specific threats to the site.

## Mark-release-recapture Studies

***Branch County Site:***
In 2006, a total of 382 individuals (229 males and 153 females) were marked with 31% percent of males and 18% of females captured more than once. The estimated mean daily population size for males was 173.20 (range = 45.00-349.97) and for females 111.86 (range = 14.00-243.57). Assuming an equal sex ratio, the maximum daily population estimate was 699.94. It should be emphasized that population estimates are only for Mitchell's satyrs within the designated boundaries of the study area and not the entire fen.

The median distance/day traveled by males in the meadow was 15.04 m/day and in the shrub areas was 24.97 m/day; distance/day for females was 6.38 and 7.17 respectively. There was a significant effect of sex on distance/day traveled with males traveling greater distances than females. There was no effect of habitat type or interaction between sex and habitat on distance/day traveled. The median distance traveled per recapture event was 38.34 m for males and 17.37 m for females. There was an effect of sex, but not habitat nor interaction. Males had larger travel distances overall. The longest distances recorded between consecutive captures for males were 710.30 m for males and 478.24 m for females. Home ranges for both

sexes were under 0.10 ha. There were no significant effects of sex, habitat type, or interaction on home range sizes at the Branch County Site.

***Jackson County Central:***

**Mark-release-recapture Study**

Jackson County Central was one of the original study sites identified for this project. During 2003, an intensive mark-release-recapture study was conducted (Barton 2003, Barton and Bach 2005). An additional research project was undertaken here in 2004 to study the population ecology and oviposition of the Mitchell's satyr (Barton and Bach 2005). In 2005, another mark-release-recapture study was undertaken to assist in documenting the impacts of management on the population at this site.

In 2005, a total of 819 individuals were marked; 509 males and 310 females (See Appendix 5). This represents an increase from 554 marked individuals in 2003 (Barton and Bach 2005). Forty-nine percent of marked females and 42% of marked males were recaptured for a total recapture rate of 44%. Daily population estimates for both 2003 and 2005 are presented in Appendix 6, with a maximum for males in 2005 of 606.15 and 528.96 for females. The average distance moved for males was 98.29 m (n=302) and for females 57.7 m (n=164). The maximum distance flown between captures by males was 607.8 m and by females 376.9 m. The average minimum home ranges (minimum convex polygons) were .37 ha for males (n=78) and .06 ha for females (n=30).

***Washtenaw County West***

**Mark-release-recapture Study**

A total of 81 individuals (53 males and 28 females) were marked with 53% percent of males and 64% of females captured more than once. The estimated mean daily population size for males was 21.99 (range = 3.00-80.00) and for females 10.03 (range = 2.00-32.00). Assuming an equal sex ratio, the maximum daily population estimate was 160.00 (twice the maximum daily estimate for males). These estimates apply to plot areas only and not the entire fen.

The majority of both males (61%) and females (64%) were recaptured within the same plots of their first captures. Of the remaining satyr movements, there was no effect of treatment on whether they moved out of or into plots. Seven males and two females were recaptured in plots different from their original capture (i.e. first capture plot one control block, second capture plot three treatment block).

**Conclusions of Mark-release-recapture Studies**

The Branch County Site has the second largest known population size and conservation efforts should be targeted to maintaining this site. The population at Washtenaw County West was larger than previously thought (Barton 2004), and it is possible that by concentrating MRR activities in areas of high densities, more individuals were captured than would have been had the entire site been surveyed.

Clearing at the Washtenaw County West Site had no effect on Mitchell's satyr distribution and dispersal, but this may have been influenced by 1) the size of the blocks, 2) small home range sizes, or 3) temporal effects. The fact that there were no statistical differences between movements into or out of the treatment blocks indicates clearing has not yet produced more favorable conditions for the satyrs. It should be emphasized that this study was conducted during the first growing season and movement patterns may change as vegetation in the cleared blocks recovers over time. The effectiveness of clearing to enhance habitat and increase Mitchell's satyr populations can only be determined with long-term studies that monitor vegetation changes as well as satyr movements and distribution, as the benefits of clearing for the Mitchell's satyr may not be realized for several years.

It appears that habitat type (shrub vs. open meadow) does not significantly affect the movements of Mitchell's satyrs. However, in examining the densities of individuals in both habitat types at the Branch

County Site, females were found in greater numbers and densities in the shrub area versus the open meadow, while males exhibited the opposite (Barton, unpublished data). Females may be seeking oviposition sites in the shrub-covered areas, but it we would expect males to simultaneously be seeking mates and thus be found in the vicinity of females. The Branch County Site is the only site with both habitat types where MRR studies have been conducted and further work at other similar sites may provide more insight into this behavior.

Future studies are needed to define habitat requirements and complete the life history description of the Mitchell's satyr. Concurrent research should focus on the effects of management (prescribed fire, clearing) on the Mitchell's satyr, and long term monitoring should be implemented to document the temporal effects with the goal of providing land managers information that can be used to prescribe the best management practices for conservation of the Mitchell's satyr.

**Enclosure Study**

Barton (2005) attempted to document the effects of a prescribed burn at Jackson County Central (conducted in the spring of 2005) on satyr emergence by setting up enclosures within the burn unit and in a control plot. Two satyrs emerged from two different enclosures, one in each study plot. The enclosure in the burn unit was actually located very close to the edge of the burned area and it is unclear whether the satyr in that cage emerged from burned or unburned vegetation. Three other species of invertebrates were identified in the burn unit enclosures; Tiger Moths (Arctiidae), Pearl Crescents (*Phycoides tharos*), and Little Wood Satyrs (*Megisto cymela*). Bluets (Odonate-*Enallagma* spp.) were found in unburned unit enclosures.

The use of enclosures to monitor adult emergence was not effective in this study. There are several reasons that may have contributed to the negative results: 1) enclosures were not placed in areas where satyrs pupate and eclose, 2) different environmental variables within the enclosures affected pupation, 3) predation in the enclosures may have been high, and 4) trampling of the vegetation during set up of the enclosures may have impacted satyrs. In considering other methods to determine the impacts of fire, detecting adult emergence may be the only useful method if it can be successfully executed. Population estimates are not useful in determining the effects of fire on a site as large as Jackson County Central because satyrs can easily move into the burn unit from adjacent areas. Additionally, it is not possible to survey for larvae due to their cryptic nature and small size.

***Historical Sites*:**

In 2004, surveys were conducted at or in the vicinity of four sites where satyrs were documented historically. Surveys were conducted at a fen in the vicinity of Kellogg Biological Station (KBS) in Kalamazoo County where (we just recently learned) satyrs were documented in 1956. This fen has been mined for marl and the small amount of remaining fen habitat is too small to support the satyr. There are no remaining areas of fen at KBS to survey and it is assumed that this population has been extirpated.

Surveys were conducted at Lamberton Lake Fen and Emerald Lake Fen in Kent County. These two sites are believed to contain the only remaining fen habitat in the vicinity of the location where the satyr was recorded in Kent County in 1885. Very little suitable habitat was found at these sites although permission to access one parcel was not secured and may be pursued in 2005.

Two areas along a stream south of the occupied area at Kalamazoo County North (where satyrs were last recorded in 1984 and 1968) were surveyed. A small area of suitable habitat was found at the location of the 1984 sighting but no satyrs were observed here. Intensive management would be needed at this site to restore the fen if satyrs were to be reintroduced here in the future, including restoring the hydrology of the area. The older historical site is very overgrown with shrubs and trees and has little if any potential for restoration. Satyrs do occur in a small area of fen along this stream just north of these historical locations

(Kalamazoo County North) but the viability of this site is very poor due to the limited amount of suitable habitat.

Surveys were conducted in 2004 at Cass County Northwest where satyrs were last recorded in 1993. No satyrs were found and limited suitable habitat is available. It is likely that the satyr has been extirpated from this site.

In 2005 and 2006, surveys were conducted in historical habitat located just south of the Barry County South Site. Satyrs were last recorded from this area in 1986. No satyrs were found although the quality of the habitat here is very good. There are no significant areas of invasive species and it is not heavily invaded with shrubs. Hopefully, as connecting habitat is created between this area and occupied habitat to the north, satyrs will re-colonize this historic site. Another alternative worth exploring would be to translocate satyrs from occupied habitat into this area. This idea will need further discussion with USFWS, the Mitchell's satyr working group, and the local college, which owns this property.

***Additional occupied habitat identified at known sites*:**

In 2004, surveys at the Branch County Site documented satyrs in an area (approximately 1.3 acres) that was identified as potential habitat in the site conservation plan but where satyrs had never been previously recorded. This discovery will likely shift the management priorities outlined in the plan in order to create a connecting corridor between this area and adjacent occupied patches of habitat.

Surveys at Barry County Southwest in 2004 resulted in the documentation of satyrs in a newly discovered area of fen habitat (approximately 1.0 acres) to the east of the known occupied site. As a result of this discovery, MDNR Parks and Recreation Division, Stewardship Staff will create a corridor to connect this area with the other occupied patch. In 2005, six satyrs (two of them, females) were documented in the newly created corridor that was cleared in the winter. In 2006, surveyors documented three satyrs (one female) in the newly created openings during timed meander surveys. It is encouraging that satyrs are using these restored areas.

Additional occupied habitat was discovered at the Jackson County East site in 2004. The new area of occupied habitat (approximately 1.4 acres) is located approximately 0.06 miles (90 meters) west of the original area of occupied habitat.

Surveys in 2004 at Cass County East, owned and managed by a private conservation organization, revealed an additional area of occupied habitat (approximately 0.5 acres) to the east and north of the areas where the satyrs had previously been documented. This information was shared with the organization so they can incorporate this into their management strategy for this site. Surveys in 2005 and 2006 documented continued occupation of this area by the satyrs and it seems that this area may act as an important deme in a metapopulation structure at this site.

MNFI assisted staff from Southwest Michigan Land Conservancy on a survey of an adjacent parcel at Van Buren County Northwest, which had not been previously surveyed due to lack of landowner permission. The landowner provided access to his property in 2004. He accompanied the surveyors on one occasion and allowed them to conduct further surveys one additional time. Surveyors confirmed additional occupied habitat (approximately 5 acres) just west of the known area of habitat. Surveys in 2005 and 2006 confirmed the importance of this habitat and continued to document occupation of additional adjacent habitat. As a result, numbers of satyrs recorded at this site doubled.

## *Acknowledgements*

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# Appendix 1.

Cover Page: Site Conservation Plan for Barry County Southwest, Deep Lake Fen

# Site Conservation Plan for Mitchell's Satyr Butterfly: Deep Lake Fen Complex Barry County, Michigan

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Michigan Natural Features Inventory

MICHIGAN STATE UNIVERSITY EXTENSION

**Cover Photo Identification and Credits:**
Prairie fen habitat photo, Deep Lake Fen: by Glenn Palmgren
Mitchell's satyr photo by Daria Hyde

# Appendix 2.

Cover Page: Site Conservation Plan for Barry County South, Turner Creek Fen

# Site Conservation Plan for Mitchell's Satyr Butterfly: Turner Creek Fen Complex Barry County, Michigan

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**For:**
**U.S. Fish and Wildlife Service**
**Region 3 Endangered Species Office**
**Federal Building, Fort Snelling**

Michigan Natural Features Inventory

MICHIGAN STATE UNIVERSITY EXTENSION

**Cover Photo Identification and Credits:**
Prairie fen habitat photo, Turner Creek Fen: by Christine Hanaburgh
Mitchell's satyr photo by Dave Cuthrell

# Appendix 3.

Cover Page: Site Conservation Plan for Washtenaw County West, Mill Creek East Fen

# Site Conservation Plan for Mitchell's Satyr Butterfly: Mill Creek East Fen Complex Washtenaw County, Michigan


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**Report Number 2006-09**
**September 30, 2006**


Michigan Natural Features Inventory

MICHIGAN STATE UNIVERSITY EXTENSION

**Cover Photo Identification and Credits:**
Prairie fen habitat photo, Mill Creek East Fen: by Daria Hyde
Mitchell's satyr photo by Daria Hyde

# Appendix 4.

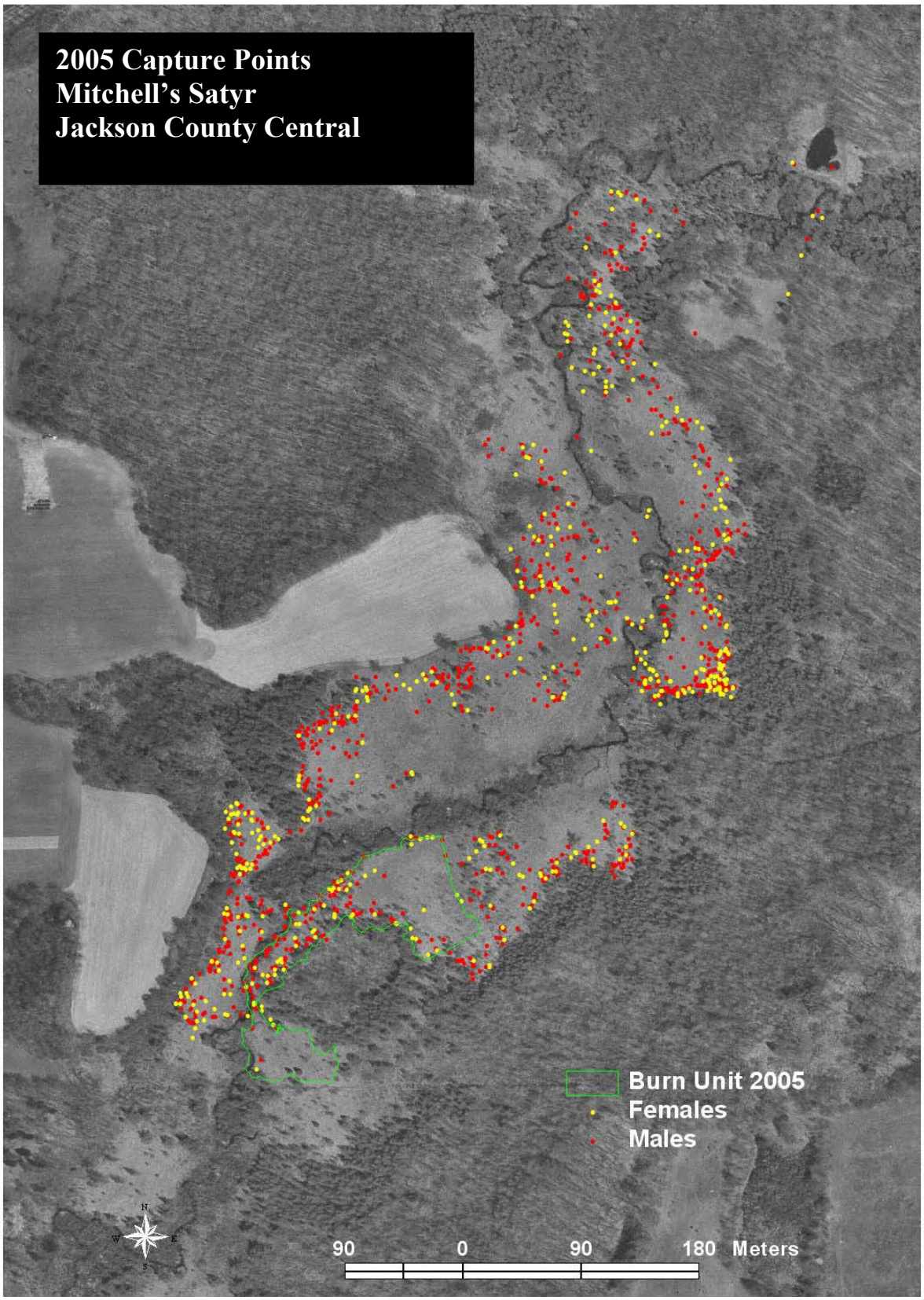
Table 1. 2000-2006 Satyr Survey Data

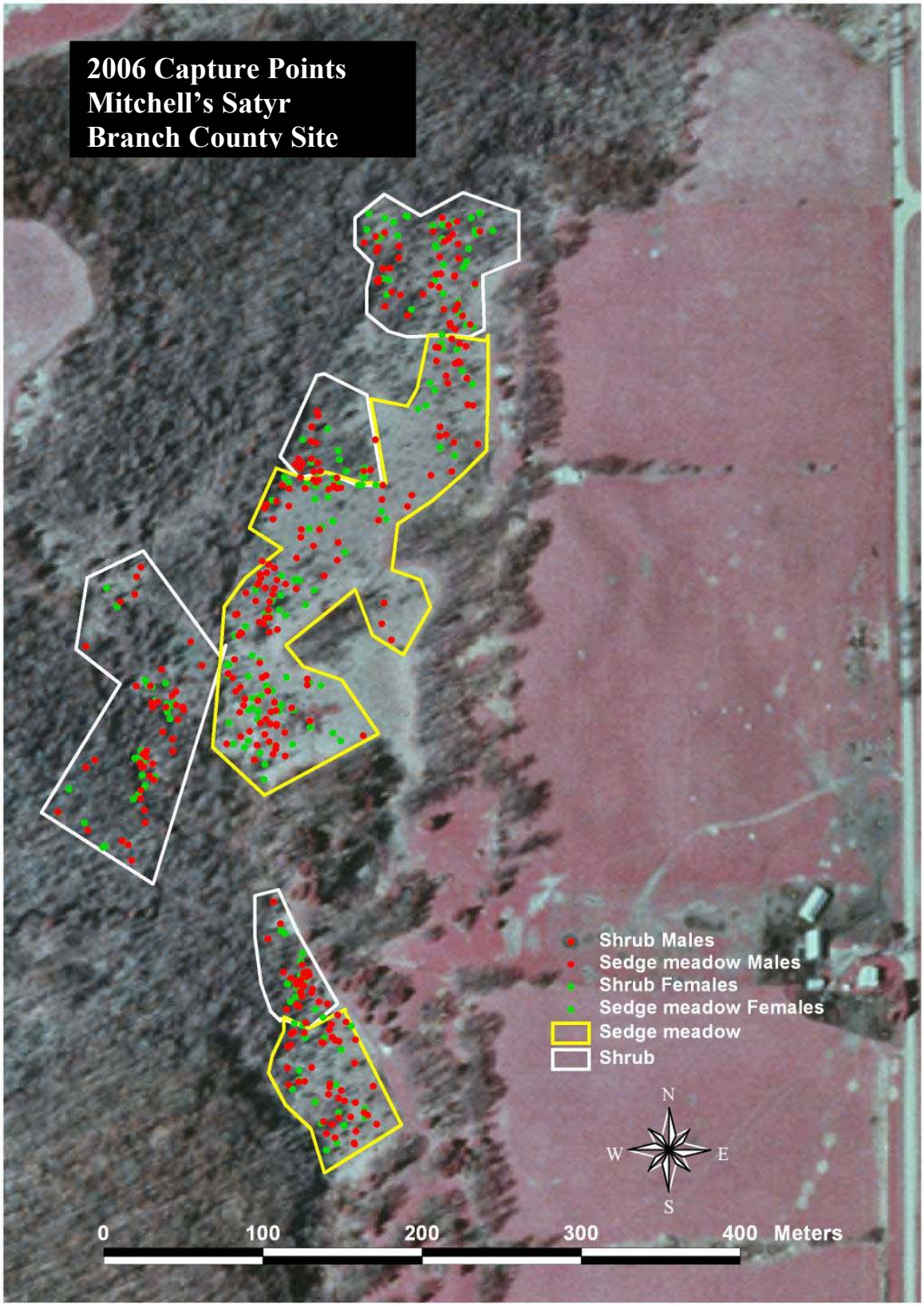
| | | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 |
|---|---|---|---|---|---|---|---|---|
| **Site Name** | **EO #** | **#satyrs/# surv/hr** | **#satyrs/# surv/hr** | **#satyrs/# surv/hr** | **#satyrs/# surv/hr** | **#satyrs/# surv/hr** | **#satyrs/# surv/hr** | **#satyrs/# surv/hr** |
| Barry Co. S. | .007 | **15**/1/3 | **14**/3/.5 | ***8**/1/.5 | **6**/1/1 | **19**/2/2 | **69**/4/1 | **24**/3/.65 |
| Barry Co. SW | .005 | **8**/2/.75 | **4**/3/.25 | ***8**/1/.5 | **1**/2/1 | **3**/2/2 | **16**/2/1 | **7**/6/1.5 |
| Berrien Co. S. | .022 | **transect data** | **34**/3/.75 | ***6**/2/2 | **7**/2/.75 | **15**/2/2 | **7**/3/? | ***35**/3/.5 |
| Berrien Co. N. | .009 | **transect data** | **32**/4/1 | **60**/2/1.5 | **28**/2/.5 | **10**/2/2 | **19**/6/4.5 | **31**/2/1.5 |
| Berrien Co. E. | | **no data** | **no data** | **8** | **no data** | **15**/2/2 | **10**/5/.5 | **19**/2/1.2 |
| Branch Co. Site | .016 | **147**/2/4.75 | **103**/2/3.75 | **110**/1-2/4.25 | **130**/2/5 | **74**/2/2 | **160**/3/6 | ***382 marked** pop. est. 700 in approx. 2/3 of habitat |
| Cass Co. SW | .021 | **86**/2-3/4.25 | **77**/2-4/? | ***57**/2/3 | **47**/2/3 | **90**/2/4 | **75**/3/2.75 | **58/2/3** |
| Cass Co. E. | .001 | **24**/2/3 | ***7/1/1** | **14/2/2** | **no data** | **11**/2/3 | **8**/2/2 | ***12**/2/1.5- One private parcel only |
| Cass Co. NW | .008 | **no survey** | **0** | **0** | **0** | **0** | **no survey** | **no survey** |
| Cass Co. SE | .026 | - | - | - | - | | **10**/3/1.5 | ***26**/2/3.25 |
| Jackson Co. W | .002 | **14**/1/.5 | **no survey** | **no survey** | **no survey** | **no survey** | **11**/4/2 | **2**/4/1.3 |
| Jackson Co. Cen. | .003 | **15**/1/3.5 | **24**/1/2.5 | **58**/2/2.5 | **MR est-1106** | **MR est. 1106** | MR est. **1200** | ***29**/1/1.25 on one private parcel. only |
| Jackson Co. E. | .012 | **26**/1/7 | **no survey** | **no survey** | **no survey** | **10**/2/2 | **18**/2/3 | **38**/4/1.5 |
| Kalamazoo Co. W. | .018 | **17**/2/2 | **10**/3/2.75 | **4**/2/1.75 | **8**/2/2.5 | **4**/2/1.5 | **5**/1/2 | ***8**/4/.25 |
| Kalamazoo Co. N. | .020 | **8**/2/2.5 | ***3**/2/.5 | ***1**/2/.25 | **2**/2/2 | **0**/2/0.5 | **0**/1/.5 | **0**/2/2.5 |

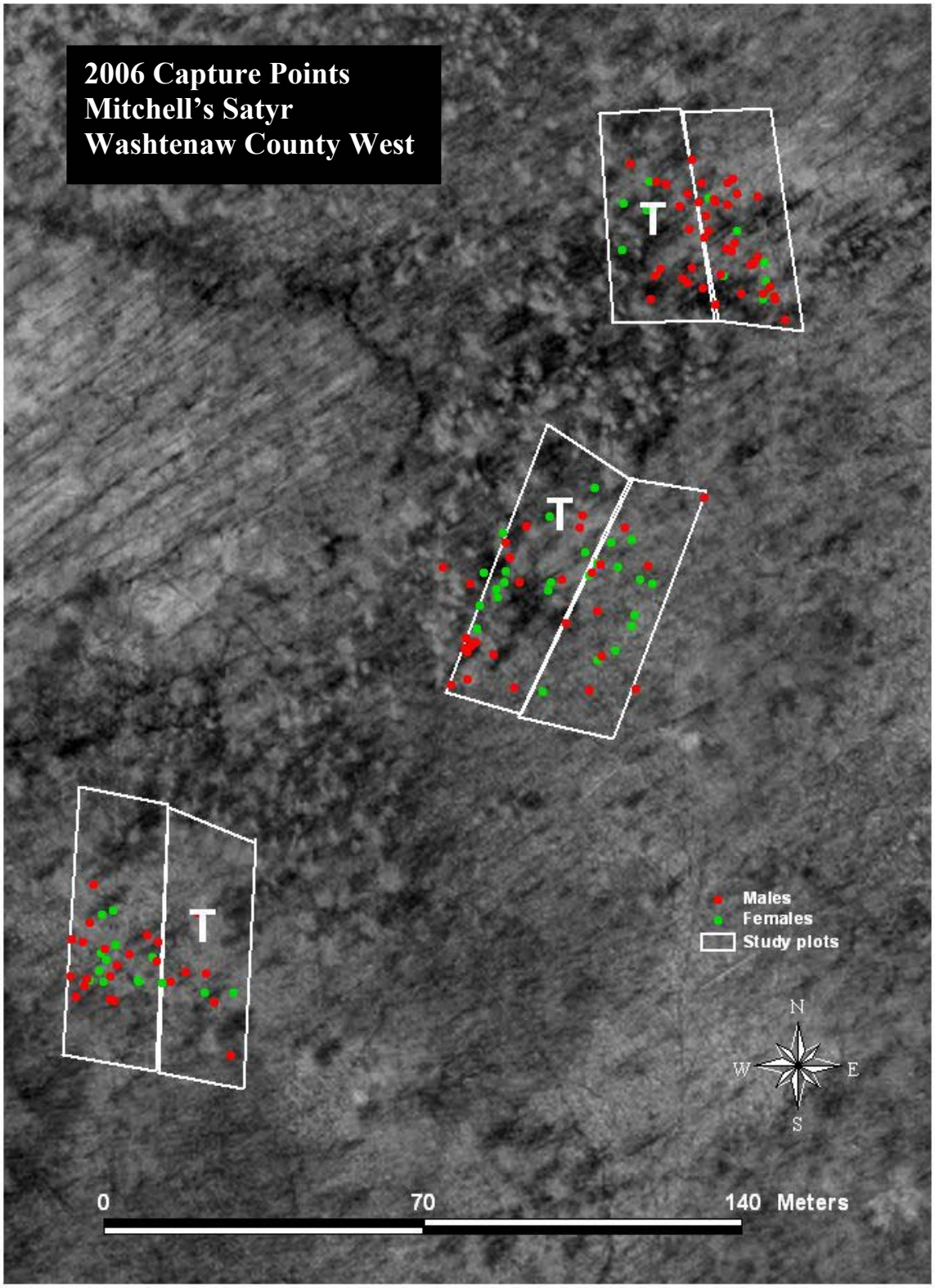
| Site Name | | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 |
|---|---|---|---|---|---|---|---|---|
| St. Joseph Co. W. | .006 | **15**/1/3.75 | **10**/3/3.5 | **23**/2/2.5 | **17**/3/2 | **15**/2/2 | **28**/3/1.75 | ***7**/2/2 |
| St. Joseph Co. E. | .010 | **6**/2/2.5 | ***2**/2/1.5 | **8**/1/1.25 | **0**/1/1 | **8**/3/3 | **1**/2/4.5 | **3**/2/2.25 |
| Van Buren Co. NW | .013 | **11**/1/.5 | **12**/2/.5 | **18**/2/2 | **9**/2/1.75 | **42**/3/3.5 | **121**/5/3.5 | **71**/2/2.15 |
| Van Buren Co. Site | .015 | **no survey** | **no survey** | **no survey** | **no survey** | **no survey** | **no survey** | **no survey** |
| Washtenaw Co. W. | .011 | **16**/2/1.25 | **6**/1/.5 | **12**/2/2 | **32**/3/2 | **MR-32captured** | **39**/6/3 | ***81 marked, max daily equals 160** in study area; approx. 2/3 of habitat |
| **Michigan Natural Features Inventory- (Daria Hyde)- 3/20/2007 DO NOT DISTRIBUTE- CONFIDENTIAL INFORMATION** | | **note: Numbers reflect satyrs counted on one visit (highest recorded/visit/year)** | ***** not all occupied habitat surveyed** | | | | | |

# Appendix 5.

Maps of Satyr Captures at Three Study Sites


2005 Capture Points
Mitchell's Satyr
Jackson County Central
Burn Unit 2005
Females
Males
N
W
E
S
90
0
90
180
Meters


2006 Capture Points
Mitchell's Satyr
Branch County Site
Shrub Males
Sedge meadow Males
Shrub Females
Sedge meadow Females
Sedge meadow
Shrub
N
W
E
S
0
100
200
300
400 Meters


2006 Capture Points
Mitchell's Satyr
Washtenaw County West
T
T
T
Males
Females
Study plots
N
W
E
S
0
70
140 Meters

# Appendix 6.

Table 2. Summary of Population and Vagility Studies at Five Satyr Sites

Vagility and population statistics for Mitchell's satyr sites in Michigan that have undergone mark-release-recapture studies. Average daily population densities were calculated as average daily population estimate/survey area (ha). Mill Creek Fen data are from three plots within the site. BCF = Blue Creek Fen, SNC = Sarrett Nature Center, GRF = Grand River Fen, MCF = Mill Creek Fen. Data from Szymanski (1999), Barton (2004, 2005, 2007, unpublished data).

| | Males | | | | | | | | Females | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | BCF 1997 | BCF 1998 | SNC 1997 | SNC 1998 | GRF 2003 | GRF 2005 | CLF 2006 | MCF 2006 | BCF 1997 | BCF 1998 | SNC 1997 | SNC 1998 | GRF 2003 | GRF 2005 | CLF 2006 | MCF 2006 |
| Number marked | 83 | 82 | 92 | 82 | 285 | 509 | 229 | 53 | 27 | 34 | 37 | 62 | 269 | 310 | 153 | 28 |
| Ave. daily population estimate | 26.01 | 27.28 | 49.86 | 24.76 | 369.33 | 311.40 | 173.20 | 21.99 | 8.29 | 13.51 | 9.55 | 26.07 | 220.14 | 248.99 | 111.86 | 10.03 |
| Ave. daily population density (#/ha) | 11.16 | 11.71 | 30.97 | 15.38 | 46.75 | 40.97 | 33.70 | 46.79 | 3.56 | 5.80 | 5.93 | 16.19 | 27.87 | 32.76 | 21.76 | 21.34 |
| Survey area (ha) | 2.33 | 2.33 | 1.61 | 1.61 | 7.9 | 7.6 | 5.14 | .47 | 2.33 | 2.33 | 1.61 | 1.61 | 7.9 | 7.6 | 5.14 | .47 |
| Median distance traveled between recaptures (m) | 15.17 | 22.12 | 20.32 | 24.90 | 56.86 | 62.25 | 38.33 | n/a | 15.15 | 10.38 | 21.38 | 21.90 | 35.78 | 33.93 | 17.38 | n/a |
| Maximum distance traveled between consecutive captures | 290.04 | 148.35 | 420.64 | 89.21 | 509.52 | 710.30 | 352.75 | n/a | 48.70 | 54.11 | 21.38 | 88.27 | 445.27 | 478.24 | 162.74 | n/a |
| Mean minimum home range (ha) | - | 0.0325 | - | 0.0262 | 0.1818 | 0.3900 | 0.0395 | n/a | - | 0.0008 | - | 0.0361 | 0.0383 | 0.1154 | 0.0556 | n/a |

# Appendix 7.

Summary of 2004-2006 Activities

# Summary of 2004 Mitchell Satyr Activities

## Occupied Satyr Sites:

- Satyrs are **known to be extant at 15 sites** (all reconfirmed in 2004) in Barry, Berrien, Branch, Cass, Jackson, Kalamazoo, St. Joseph, Van Buren and Washtenaw counties. **One of these sites is a new site confirmed in Berrien County!**
- Satyrs are **presumed to be extant at 1 site** (confirmed in Jackson County in 2000, no surveys since)**.**
- Satyrs have **potential to be extant** at **2 additional sites** – last observed in 2003 in Kalamazoo and in1993 in Van Buren County (permission to survey had been denied by landowner at Van Buren site).
- Satyrs are **believed to be extirpated at 3 sites** in Cass, Kalamazoo and Lenawee counties (last observed in 1993, 1978, and 1980 respectively).

## Surveys:

**1) Barb Barton (EMU- Graduate Student)-** Conducted a mark-recapture study **at 1 site** in Washtenaw Co. and an oviposition study at **1 site** in Jackson County.

**2) MNFI-** Conducted multiple surveys (2-3 visits) at **10 known satyr sites** (large habitat complexes with multiple landowners) in 6 southern Michigan counties. The satyr was confirmed from **1 new site** in Berrien County (MNA property). The satyr was discovered occupying additional habitat at two sites in Barry and Jackson County (Yankee and Skiff Lake). MNFI also conducted de novo surveys at **10 sites** in Barry, Berrien, Jackson, Kalamazoo, Kent and St. Joseph counties but did not find the satyr.

**3) Southwest Michigan Land Conservancy (SWMLC) -** Conducted multiple surveys (2-3 visits) at **6 known satyr sites** (large habitat complexes with multiple landowners) in 4 southern Michigan counties. The satyr was discovered occupying additional habitat at two sites in Berrien and Van Buren Co. SWMLC also conducted de novo surveys at **2 sites** in Cass and in Kalamazoo County but did not find any new populations.

**4) MDNR Wildlife Biologist's and LIP Program-** Assisted with surveys at **10 sites.**

**5) USFWS** Conducted a survey at **1 site** in Berrien County**.**

**Total: 17 known satyr sites surveyed by 5 groups, (satyrs recorded at 15 sites)**

## Associated Fen Species:

- Four box turtles (*Terrapene c. carolina* SC) at 3 satyr sites in Berrien, Cass and Jackson counties.
- The massasauga rattlesnake (*Sisturus c, catenatus*)- one satyr site in Cass County.
- Blanding's turtle (*Emys blandingii*) at one satyr site in Washtenaw County.
- Swamp metalmark ( ) at one satyr site in Jackson County
- Poweshiek skipper (*Oarisma poweshiek)* at one satyr site in Jackson County.
- Cut-leaved water parsnip (*Berula erecta*) at one satyr site in Van Buren County
- Edible valerian (*Valeriana edulis*) at one satyr site in Van Buren County
- Prairie Indian-plantain (*Cacalia plantaginea*) at one satyr site in Van Buren County**.**
- White lady's slipper (*Cypripedium candidum* ) at one satyr site in Jackson County

## Landowner contact:

- MNFI received permission from a landowner at a site in Branch County to initiate purple loosestrife control by releasing the *Galerucella* beetle.
- MDNR-LIP Biologist's have met have met with many landowners and organizations in several counties to discuss habitat mgt which is currently being initiated.
- MNFI, Barb Barton, and an MDNR- LIP Biologist visited a landowner at a site in Washtenaw County to discuss management opportunities.
- SWMLC received permission to begin habitat management from one landowner in Berrien County, one landowner in Van Buren County, and six landowners in Cass County.

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## Local stewardship:

- **MNFI** released the *Galerucella* beetle at **a satyr site** in Branch County and conducted spring and fall monitoring as required by requirements of The Purple Loosestrife Project administered by MSU.
- **SWMLC** conducted management at **4 sites in 4 counties**. This included brush removal, herbicide application and corridor creation.
- **TNC** conducted management at **2 sites in 2 counties**.

## Site Conservation Planning:

MNFI and SWMLC completed site conservation plans for **9 sites** in Southwest Michigan and will complete 5 additional plans by September of 2006.

## Future Funding:

MNFI has received funding from USFWS Sec. 6 (through FY 2005) to conduct monitoring of sites receiving management, to conduct surveys at historic sites and to complete site conservation plans for remaining sites. TNC and SWMLC have received funds for a Private Stewardship Grant through USFWS to work with local landowners to implement or continue stewardship activities on their land. SWMLC has applied for a grants through the Landowner Incentive Program to support additional management at a multiple sites. SWMLC has received a grant through USFWS Sec. 6 to purchase a parcel of land, which is occupied by the satyr. SWMLC and TNC are discussing a collaborative proposal for an additional Private Stewardship Grant for work in 2005.

# Summary of 2005 Mitchell Satyr Activities

## Occupied Satyr Sites:

- Satyrs are **known to be extant at 17 sites** (all reconfirmed in 2005) in Barry, Berrien, Branch, Cass, Jackson, Kalamazoo, St. Joseph, Van Buren and Washtenaw counties. **One of these sites is a new site confirmed in Cass County!**
- Satyrs have **potential to be extant** at **2 additional sites** – last observed in 2003 in Kalamazoo and in1993 in Van Buren County (permission to survey had been denied by landowner at Van Buren site).
- Satyrs are **believed to be extirpated at 5 sites** in Cass, Kalamazoo (2), Lenawee and Washtenaw counties (last observed in 1993, 1956, 1978, 1980 and 1950's respectively).

## Surveys:

- **MNFI-** Conducted multiple surveys (2-3 visits) at **10 known satyr sites** (large habitat complexes with multiple landowners) in 6 southern Michigan counties. The satyr was confirmed from **1 new site** in Cass County (Private camp). MNFI also conducted de novo surveys at 1 site in Barry County and one site in Van Buren county but did not find the satyr.
- **Southwest Michigan Land Conservancy (SWMLC) -** Conducted multiple surveys (2-3 visits) at **7 known satyr sites** (large habitat complexes with multiple landowners) in 4 southern Michigan counties. SWMLC also conducted de novo surveys at **1 site** in Van Buren County but did not find any satyrs.
- **MDNR Wildlife Biologist's and LIP Program-** Assisted with surveys at **2 sites.**
- **USFWS** Conducted a survey at **1 site** in Berrien County**.**
- **TNC-** Conducted surveys at 1 site in Berrien County and 1 site in Cass County, and assisted with surveys at 1 site in Jackson County and 1 site in Washtenaw County.

## Associated Fen Species:

- Blanding's turtle (*Emys blandingii*) at one satyr site in St. Joseph County.
- Box turtle (*Terrapene carolina*) found at satyr sites in Berrien, Jackson and Van Buren counties.
- The massasauga rattlesnake (*Sisturus c, catenatus*)- found at a satyr site in Jackson County
- Poweshiek skipperling (*Oarisma poweshiek*) found at. a satyr site in Jackson County
- Swamp metalmark (*Calephelis mutica*) found at a satyr site in Jackson County
- Dukes skipper (*Euphyes dukesi*) found at a satyr site in Jackson County
- Virginia snakeroot (*Aristolochia serpentaria*), ginseng (*Panax quinquefolius*) and goldenseal (*Hydrastis canadensis*) documented adjacent to a satyr fen in Cass County.
- Cut-leaved water parsnip (*Berula erecta*) at a satyr site in Cass County
- White lady's-slipper (*Cypripedium candidum*) found at sites in Berrien and Jackson County.
- Jacob's ladder (*Polemonium reptans*) found at a satyr site in Berrien County.
- Pale Indian-plantain (*Cacalia plantaginea*) found during a *denovo* survey of a fen in Van Buren County (not a satyr site).
- Angular spittlebug (*Lepyronia angulifera*) found during a *denovo* survey of a fen in Van Buren County (not a satyr site).

## Landowner contact:

- MNFI, TNC and the Washtenaw County Land Trust visited with two landowners at a site in Washtenaw Co. to discuss management opportunities and the potential to purchase development rights at this site.
- MNFI, and the LIP biologists have been in contact with the manager of the private camp where satyrs were newly documented this year. The LIP biologist will continue these discussions to implement management there. They have also met with many landowners and organizations in several counties to discuss habitat management options.
- SWMLC is working closely with landowners at four sites where they are conducting management. They are also discussing potential management options with landowners at a site in Cass County.

## Local stewardship:

- **SWMLC** conducted management at **3 satyr sites in Berrien, Branch and Cass Counties**. This included brush removal, herbicide application and corridor creation.
- **TNC** conducted management at **1 satyr site in Jackson County.**
- **MDNR Parks** contracted and supervised the clearing of 4.69 acres of shrubs at a site in Barry County.

## Research:

- Barb Barton, MNFI, conducted an MRR study at Jackson County Central.

## Site Conservation Planning:

- MNFI and MDNR completed one site conservation plan for Barry County South.

# Summary of 2006 Mitchell Satyr Activities

## Occupied Satyr Sites:

- Satyrs are **known to be extant at 17 sites** (all reconfirmed in 2006) in Barry, Berrien, Branch, Cass, Jackson, Kalamazoo, St. Joseph, Van Buren and Washtenaw counties.
- Satyrs have **potential to be extant** at **2 additional sites** – last observed in 2003 in Kalamazoo and in1993 in Van Buren County (permission to survey had been denied by landowner at Van Buren site).
- Satyrs are **believed to be extirpated at 5 sites** in Cass, Kalamazoo (2), Lenawee and Washtenaw counties (last observed in 1993, 1956, 1978, 1980 and 1950's respectively).

## Surveys:

- **MDNR Wildlife Biologist's and LIP Program Biologists-** Conducted or assisted with surveys at **8 sites** and denovo surveys at 3 sites in Jackson, Kalamazoo and Washtenaw Co**.**
- **MNFI-** Conducted multiple surveys (2-3 visits) at **14 known satyr sites** (large habitat complexes with multiple landowners) in 8 southern Michigan counties. MNFI also conducted de novo surveys at 2 sites in Jackson County, one site in Kalamazoo county and one site in Washtenaw Co. but did not find the satyr.
- **MSU**- Conducted surveys at 1 site in Jackson County and 1 site in Cass County and conducted de novo surveys at a site in Jackson County
- **Southwest Michigan Land Conservancy (SWMLC) -** Conducted multiple surveys (2 visits) at **6 known satyr sites** (large habitat complexes with multiple landowners) in 4 southern Michigan counties. SWMLC also conducted de novo surveys at one site in Kalamazoo County but did not find any new satyr populations.
- **TNC**- Conducted surveys at **3 sites** in Berrien and Jackson Counties
- **USFWS** Conducted a survey at **4 sites** in Berrien and Cass Counties**.**

## Associated Fen Species:

- Blanding's turtle (*Emys blandingii*) at satyr sites in Barry and St. Joseph Counties.
- Spotted turtle (*Clemmys guttata*) at a satyr site in Branch County.
- Cut-leaved water parsnip (*Berula erecta*) at a satyr sites in Cass and St. Joseph Counties.
- Box turtles (*Terrapene carolina*) found at satyr sites in Barry (2 locations), St. Joseph, Van Buren counties (3 locations).
- Spotted turtle (*Clemmys guttata*) found at a satyr site in Branch County.

## Local stewardship:

- **SWMLC** conducted or supervised management at **2 satyr sites in Cass and Van Buren Counties**. This included brush removal, herbicide application and corridor creation.
- **MNA** conducted a prescribe burn at a satyr site in Berrien County
- **TNC** conducted management at **one satyr site in Jackson County.**
- **MDNR Wildlife Division** contracted and supervised the clearing **of approx 8 acres of shrubs** at a site in Barry County.
- **MDNR LIP Program** contracted and supervised work at 9 satyr sites (1-2 additional sites slated for management in 2007).
- **MDNR Parks Division** contracted and supervised a prescribed burn in the adjacent oak-pine barrens at a site in Barry County. (60 acres, 4-18-06). Proposed burn 400 acres north of site this spring,

## Research:

- Barb Barton, MNFI, conducted a MRR study at the Branch County Site and the Washtenaw County West Site

## Site Conservation Planning:

- MNFI completed one site conservation plan for Washtenaw County West.