Investigating the effects of the invasive *Euonymus fortunei* on populations of native species in an on campus forest and assessing campus population social value in developing a protection plan

A thesis
submitted to the Miami University Honors Program
in partial fulfillment of the requirements for
University Honors with Distinction
and to
the Department of Botany
in partial fulfillment of the requirements for
Departmental Honors

by

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May 2011

B.S. Botany, Environmental Science emphasis
B.A. Latin American Studies
Class of 2011
Miami University
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Abstract

As the world population continues growing and urbanization increases, efforts must be made to preserve natural spaces in urban areas. These spaces have great potential for the conservation of native biodiversity. In addition, edge areas between urban and rural areas play an important role in this conservation. At the edge of rural and urban, Oxford, Ohio is the home to Miami University, where various natural areas have been set aside for preservation. However, many of these areas have fallen victim to invasive species. Over the years, various efforts have been made to remove invasive species from Bishop Woods, a forest on the campus of Miami University. Several of these species have long been considered noxious invasive species with significant negative impacts on native plant diversity. One, however, has not received such significant attention as an invasive and until recently, was considered a harmless ornamental plant. The invasive *Euonymus fortunei* (winter creeper) has few studies demonstrating its negative impacts as an invasive plant or even how to eradicate it. This study tested one technique for the control of *E. fortunei*. In addition, this project focused on understanding the community’s perception of Bishop Woods and its protection.

I tested dormant season spray as a control technique for *E. fortunei*. seventeen 2-m x 2-m plots were randomly assigned treatment (receiving glyphosate spray) or control (receiving no spray). Treated plots were sprayed with 1% glyphosate in October 2010 and April 2011, and had a significantly greater decrease in percent cover by *E. fortunei* than control plots.

Surveys and interviews found that most respondents pass through Bishop Woods because they enjoy the natural feel of it, and they would be against a decision to tear down Bishop Woods. Even with differences in environmental value orientations, most respondents enjoy being in Bishop Woods and would support giving Bishop Woods full protection.
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Acknowledgements

I would like to express my deepest gratitude to the following people for their support and guidance throughout my years at Miami:

To my professors and advisors for their unmatched advice and the necessary gentle push to get things done,

Dr. David Gorchov
Dr. Hank Stevens
Dr. Chris Myers
Dr. Susan Barnum
Dr. Nancy Smith-Huerta
Professor Jack Keegan
Dr. John Kiss
Dr. Alfredo Huerta
Dr. Carolyn Haynes
Dr. John Forren
Amy Lorenz
Jeff Ruder

To other members of the university for their help with the logistics of the project,

Dr. Bob Schmidt, university archivist
Dr. David Russell, Zoology
Barbara Wilson, Botany
Dan Garber, Physical Facilities
Jeff Prater, Physical Facilities

To my colleagues and friends for their help in field work and discussion of my research ideas,

Adam Litz
Alex Harkess
Austin Murphy
Charlotte Freeman

And to my parents for their unceasing wisdom, love and support,

Drs. Rick and Vicki Hertzberg
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Introduction

Since the human population left the age of the hunter-gatherer, humanity’s use of agriculture has greatly changed the natural landscape across the globe (Groom et al., 2005). Later, the advent of the Industrial Revolution urbanization also had great impacts on land use. In the many cases of agricultural and urban development, natural vegetation is razed and then the land area is converted to its new use. This process of land conversion has had devastating effects on the world’s ecosystems and biodiversity overall. Almost concurrent with the Industrial Revolution in the U.S. was the establishment of the National Parks System, establishing areas for preservation and wilderness across the country. Over time these have played an important role in conserving biodiversity of the regions they protected, but biodiversity as a whole continued to decrease. U.S. national parks, like their counterparts in several countries, are removed from the vast majority of the human population. Many times, preservation away from dense urban areas leads many to neglect the potential of preservation within urban areas. In reality these areas can, and many already do, play an important role in biodiversity conservation.

Examples of urban conservation can be found in various cities and towns across the globe. Many of these projects involve restoration, with the intent of bringing the land closer to city-dwellers to give them a place for recreation that is not too far from their homes. Examples of this can be seen in Atlanta, GA and Chicago, IL. In Atlanta, the Atlanta Beltline is a railway conversion project to promote green-space and more livable communities within the city core (Atlanta BeltLine 2011). While also increasing acreage
of available green-space, the Atlanta BeltLine project would connect the city’s 40 parks by adding an additional 1,200 acres of green-space. In doing so the project recognizes the function of adding green-space as providing natural resources protection and mental health benefits to Atlanta citizens.

Brownfield sites, or abandoned industrial sites, in Chicago have been converted to small parks (Chicago Metropolitan Agency for Planning 2011). These areas are situated between buildings and roads, yet have great potential for biodiversity conservation. With the planting of native wildflowers and trees, these areas can serve as home to birds and other animals one might not normally find in a large city. In addition to the restoration of isolated sites, the Chicago Metropolitan Agency for Planning (CMAP) is currently working on a conversion project of an entire railway, in which it intends to convert the unused Bloomingdale rail line to green-space. With this plan the agency hopes to increase conservation open space from 250,000 to 400,000 acres, and increase the percentage of people with access to parks from 49% to 70% by the year 2040. While the details of the plan are not yet complete, CMAP has outlined biodiversity conservation as one of the goals and ultimate benefits of its restoration projects. However, there are many places worthy of conservation that simply do not have this amount of land to put into conservation management.

One such area that has not received much attention is that of natural areas on the campuses of colleges and universities. The college setting is one that necessitates many buildings built very close to one another, creating an urban setting of its own even if it is in a very rural region. Due to the pressures of constantly evolving technology and a
growing student population, colleges and universities are perpetually building new facilities and renovating old facilities. The constant construction on campus puts natural areas, such as those undeveloped spaces close to other university facilities, on the list for potential building sites. If these areas do become developed, the campus loses a vital resource of natural beauty, biodiversity, and educational potential. Educational institutions across the country struggle with these decisions from year to year.

However, some institutions have developed plans to protect such places. Emory University in Atlanta was recognized by the Arbor Day Foundation as a “Tree Campus USA University” in early 2011 for its comprehensive on-campus forest management plan (Campus News 2011). The management statement recognizes the uniqueness of the forests found on the campus, as well as the various values they hold (Beck 2010). The total area of land at Emory that is under protected status is very great in comparison to other colleges and universities, but the institution has outlined specific management plans for its smaller forests. These individual management plans can serve as a model for preserving the forests on any campus. If Miami University seeks to protect its natural areas, the institution must first recognize and assert that the on-campus forest, in particular, is worth protecting in perpetuity for its ecological, social, and aesthetic value, and such protection must be enforced via a university policy.
Natural History of Bishop Woods and the Miami Natural Areas

Bishop Woods of Miami have a particular mystique about them. At its founding, the university’s small campus was surrounded by forest, earning it the name of the “campus in Bishop Woods.” In the 1920s, Miami established a poet-in-residence program with Percy Mackaye as its first participant. Mackaye lived in an artist’s studio in Bishop Woods (Photo 1) and penned the poem “The Trees of Miami”, a verse of which is inscribed on the wall of Upham Hall (Appendix 1). Miami students used to collect firewood for their residence halls in the “Home Woods” (Photograph 2), or what is now known as Bishop Woods (Westhall & Crane, 2004). Since then, Bishop Woods have been transformed as the university grew around them, adding new buildings and roads to satisfy the growth of the student body (Photographs 3-9).

In 1992, former university president Paul Pearson established the university Natural Areas system, beginning with the Bachelor Preserve along Ohio Route 73. For almost two decades, the Miami University Natural Areas have served as preserves of biodiversity and native flora and fauna of the Southwestern Ohio region. The Natural Areas provide outdoor classrooms for students of all ages to learn about local ecology and land history. Managed with the Natural Areas is Bishop Woods, a forest less than 3 acres in area, which is often used for science coursework and by students walking through Bishop Woods on the paths going to their classes. However, the area of Bishop Woods is not protected in perpetuity. In fact, Bishop Woods has long been a site of contention. Bishop Woods is located in between various academic buildings, with Hughes Laboratories to the north, Shideler and Culler Halls to the south, Patterson Road
to the east and Upham Hall to the west. The location makes it a prime site for any new additions to campus.

Over the years, there has been controversy over how Bishop Woods were to be used. For instance, the area was mowed and maintained as a grassy area with a few large trees well into the 1980s. In 1982 the university board of trustees passed a resolution that recognized Bishop Woods as a site deserving permanent protection in university policy. In 1986 the Board of Trustees, at the urging of former university president Paul Pearson, decided to allow the area to return to wild growth forest. Even so, Bishop Woods were still being considered as a potential site for new construction. The 1982 resolution did not stand up against the proposal in 2004 to place the new business school building there. Fortunately, an outpouring by alumni and friends of the university requesting to save Bishop Woods led campus planners to designate another place for the new building to be located. However, it is possible that the only reason Bishop Woods was saved was because the plans for the business school were too large to fit in Bishop Woods (Vincent 2009). The real problem is that without a permanent protection plan in place, Bishop Woods could be torn down without giving students and faculty a voice in the decision process when they are the ones who use Bishop Woods the most.

With plans for multiple construction projects in the works, no one can say whether Bishop Woods will be protected from destruction in these decisions. As conservation managers reach out to local communities to better understand how to conserve the natural area around them (Smith 2004), it is fitting for the university to understand the values of its local community, which is its students, faculty, staff, and
friends. In fact, these values already have shown to be increasingly important in determining management policies (O’Brien 2003). Miami, however, has not yet shown interest in including these values assessments in its decision-making, particularly regarding Bishop Woods, which is a detriment to the university community who are the true stakeholders. As shown in the controversy surrounding the construction of the business school, Bishop Woods does not have full protection, as the administration showed that it can propose any plans it wants for Bishop Woods. As such, the permanent protection of Bishop Woods necessitates a formal act integrating it into the Natural Areas system.
Ecology of Bishop Woods

Ecological threats

The forests of southwest Ohio are located within the greater Eastern Broadleaf Deciduous forest of the United States, characterized by canopies of oak, hickory, sugar maple and beech (Barbour & Billings 2000). In order to understand the current state of the forests in this area, it is important to understand their history. Forests in this region were leveled almost entirely in the mid-1800s as agriculture dominated the region (Gramlich 1995). However, Medley and Krisko (2007) explain that past land use influences are not alone in their impact on succession from old, agricultural field to forest stand. Indeed, local plant communities are also affected by the prevalence of exotic species. Non-natives have shown to have enormous impact on the survival of native plants, showing a marked decline in native populations as exotics take over.

With its prime location on campus, there is a significant amount of human impact plaguing Bishop Woods. Biological science, chemistry, psychology, engineering and business students, as well as students in some dorms, cross through Bishop Woods nearly every day. Concrete paths laid in 1992 intended to reduce the level of off-trail walking (Blevens 2001). Trash often litters the path, including fruits with seeds. These seeds certainly have the potential to germinate and grow in a non-native environment. The concrete paths have also created an edge effect within Bishop Woods by dividing the area into segments. Pathways through Bishop Woods offer students a glimpse of nature in the plants and other life that exist along those paths. If students enjoy what they see while walking the paths, it is likely that they will desire to protect the area. Therefore we must
protect the plants in Bishop Woods, and especially what grows along the pathways to ensure that students do indeed enjoy walking through Bishop Woods. As we cannot eliminate human influence in Bishop Woods, future management goals need to include education about caring for Bishop Woods so that it applies to the entire university community in order to mitigate this impact.

The three-acre Bishop Woods oak-hickory stand is characterized as being within the Eastern Deciduous Forest region and is in the humid-continental climate region of southwest Ohio. Over the years, Bishop Woods has been invaded by a number of non-native species, such as *Lonicera maackii* (Amur honeysuckle), *Euonymus fortunei* (winter creeper), and *Alliaria petiolata* (garlic mustard). The current focus in Bishop Woods has been centered on eradicating invasive species, which have established dominance in the understory of Bishop Woods.

While garlic mustard (*Allaria petiolata*) has not proven to be as big of a nuisance in Bishop Woods as it has in other forests nearby (ie. Hueston Woods), Amur honeysuckle (*Lonicera maackii*) had nearly taken over the understory of Bishop Woods up until the last few years. Jack Keegan has been leading efforts for the removal of *L. maackii*. Keegan has met with students, professors, and community members multiple times a year to spend hours pulling the invasive plant in order to eradicate it from Bishop Woods eventually. In addition, Keegan and some of these students planted dogwood trees in 2008 in an effort to restore the diversity of Bishop Woods while maintaining its beauty for the many people who pass through Bishop Woods each day (Keegan 2010). As populations of native plants decrease in Bishop Woods, it is possible that there would be
a decreased inclination to protect it. The presence of deer and other herbivores may
decrease native populations by ingesting them (Nunez and Simberloff 2010). However,
the presence of invasive species can be related to decreased native diversity of forest
floor forbs (Slaughter et al. 2007). If invasive plants are to blame for the decrease in
natives, management strategies need to be changed to account for this.

**Ecological study of Euonymus fortunei**

*Ecology of* E. **fortunei**

The non-native vine *Euonymus fortunei* (wintercreeper) is also invasive in Bishop
Woods. *Euonymus fortunei* has long been used in landscaping as an ornamental, yet
recently has been shown to have characteristics of an invasive species (Glinka et al.
2008). However, the plant only exhibits noxious effects once it begins to climb (Johnson
2010). Populations of *E. fortunei* have been documented throughout Bishop Woods,
many of which have climbing individuals and are near the walkways. If the plant is
indeed negatively affecting the native forbs, Bishop Woods management plan should be
changed in order to address this issue.

**Methods**

First, I estimated the presence of *E. fortunei* in Bishop Woods by measuring
ground cover in nineteen 2-m x 2-m plots in Bishop Woods over a larger 8 m x 10 m area
(Figure 1). I measured ground cover of *E. fortunei* in the center 1 m x 1 m of each plot.
Cover of *E. fortunei* was calculated in October 2010 and April 2011 using a point frame.
Pins were dropped at 100 equally spaced points in each plot, and each “touch” of *E.*
**fortunei** to the pin was counted as 1% cover (Photograph 10). For example, a plot with 67 “touches” of *E. fortunei* would have a 67% ground cover of *E. fortunei* in that plot.

Each 1m$^2$ plot with at least 20% cover by *E. fortunei* was randomly assigned a treatment of sprayed or not sprayed. In these 17 plots I assigned treatments randomly so that half of the plots received spray and half did not. The sprayed plots’ treatment included coating leaves in herbicide solution. I treated the plots with 1% glyphosate solution (from Roundup Pro® concentrate, 41% glyphosate). Treatment occurred in mid October 2010 and early April 2011 (Photograph 11). Since glyphosate is a non-selective herbicide, it affects all photosynthetic vegetation (Monsanto 2005). Dormant season is the optimal time to perform treatments, in order to reduce the effects on other plants (Johnson 2010).

Three steps were used to determine the impact of the herbicide spraying. First, the percent coverage was evaluated at each sample time to determine if the samples are homogeneous (Figure 2). Second, the sample changes in percent coverage from Fall to Spring were calculated as the relative change (Figure 3).

$$\text{Seasonal change} = \frac{\text{Fall cover} - \text{Spring cover}}{\text{Fall cover}}$$

Last, the seasonal change for controls (no spray) was compared with the seasonal change for treated (spray) (Figure 4). All statistics were carried out using JMP 9.0.

I also measured percent cover of grasses in the study plots, since they were the only other species than *E. fortunei* in the plots in the spring. There was only *E. fortunei*
present in the plots in the fall. Differences in the sprayed and control plots showed no significant difference in the spring (Figure 5).

Results

Percent ground cover of *E. fortunei* in all plots decreased from Fall 2010 to Spring 2011. Comparing the relative change in cover from Fall to Spring for the two sample areas gives an indication of the impact of using the herbicide (Tables 2 and 3). The two areas are consistent when evaluated for Fall or for Spring. The t-test comparing the mean relative changes shows a significant increase in change because of the herbicide (Table 3). Because the vines of *E. fortunei* cross plot boundaries, the reduction of percent cover is likely due to the effects of spray. In other words, there was a significantly reduced cover following herbicide application beyond what the seasonal influence would predict.

**Enrichment planting of native perennials**

*Native species present*

I am interested primarily in native forbs present in Bishop Woods. In order to make Bishop Woods more attractive to aid the ultimate goal of preservation and value of Bishop Woods, an objective of this study was to perform enrichment planting of native spring perennials not currently found in Bishop Woods. I focused on perennials with showy, early- to mid-spring blooms. Native spring perennials currently present in Bishop Woods include nine species (Table 4).

*Methods*
Native plants were purchased from local nurseries and were planted in Bishop Woods to increase native species richness of the area. I selected species for planting in the spring of 2011 that met the following criteria: 1) Had showy flowers, 2) bloomed in early to mid-spring, 3) have been documented in the surrounding area (Willeke 1982), 4) were not currently documented in Bishop Woods (Table 4), and 5) had a Floristic Quality Assessment Index coefficient of conservatism score of 6 or greater (Andreas et al., 2004). The Floristic Quality Assessment Index accounts for species richness and abundance, but adds a weighting factor called the coefficient of conservatism (C of C). The C of C score allows qualification of the ecological fidelity of a species in a given community. C of C scores are assigned by experts on a particular plant community, and thus are partly subjective. The score is lower for a plant with a breadth of ecological tolerances, and increases with decreasing tolerance (Table 5).

Originally I had intended to select species with a C of C greater than or equal to 7, and selected five species: *Hydrastis canadensis*, *Isopyrum biternatum*, *Orchis spectabilis*, *Symlocarpus foetidus*, and *Viola palmata*. However, these five species were not available for purchase. Lowering the C of C requirement to a score of 6 or greater allowed me to purchase plants in relatively high quantities from local nurseries.

I selected three species for planting in Bishop Woods in spring 2011 (Table 6). *Stylophorum* and *Aquilegia* were purchased from Keystone Flora nurseries in Cincinnati, OH. *Mertensia* was not available at local nurseries, but should remain on the list for future enrichment plantings. Species were planted along pathways on the northwest side of Bishop Woods (Photographs 12 and 13).
Social Environmental Values at Miami University

Recent studies have documented various types of environmental value systems, in attempting to understand a person’s attitude and perception of environmental concerns. In Kellert’s (2005) nine value system, an individual’s value system can be impacted by a variety of life factors such as education, nationality, location, religion, income level, and other life experiences. The nine values range from utilitarian – where an individual values the environment for material benefits it brings to that individual, to aesthetic – where an individual values the beauty of nature and the environment; to negativistic – where an individual does not value the environment due to hostile sentiments toward nature. The six other value systems are moralistic, ecologistic-scientific, dominionistic, humanistic, symbolic, and naturalistic.

A second environmental value system surveys individuals on their level of concern about environmental problems as they relate to 12 different areas (Schultz 2001). The 12 areas can be broken into three groups of four, each representing one of three value systems – egoistic, social-altruistic, biospheric. The egoistic values self, self’s future, self’s lifestyle, and self’s health as the most important concerns. The social-altruistic (or simply altruistic) values future generations, children, people in the community, and all people. The biospheric values plants, animals, marine life, and birds. Survey respondents can be categorized as fitting one of these value areas based on their responses to their concern for the 12 areas. This categorization simply indicates the survey respondent’s current orientation in their environmental perceptions, and does not mean to identify the precise environmental values he or she may have. Using these survey questions, it is
possible to understand differences in environmental perceptions within a population. This also allows more targeted messaging to a given population, in that messaging will differ for groups of different value areas.

To investigate the perception of Bishop Woods, interviews and surveys were conducted. Interviews were conducted in 2009 and 2010 and included members of the faculty. Questions asked in the interviews included notable experiences in or concerning Bishop Woods, perspectives on nature and being outdoors, perspectives on the university’s role in protecting Bishop Woods, and ideas for how to engage the campus in protecting and caring for Bishop Woods (Appendix 3). In addition, previously conducted interviews were reviewed as support for protection of Bishop Woods.

Surveys were conducted in 2010 and 2011. In 2010 a survey was distributed to classmates and other listservs available to the investigator. These were evaluated to determine significant factors in their desire to protect or not protect Bishop Woods. Interviews were conducted in person or via email if the interviewee was not available. Six questions were asked in every interview, allowing for more questions as determined by the investigator (Appendix 2). Surveys were distributed electronically using the collector SurveyMonkey via email to students, faculty and staff. In both years, surveys were voluntary and could have led to some bias in the results. It is possible that people who would want to protect Bishop Woods would be more likely to participate voluntarily in a survey about Bishop Woods.

2010 surveys included many similar questions as the interviews, but will require a short specific answer (Appendix 3). In 2010 the survey was left open for a month, and the
responses were collected with time for analysis before submitting the final report for the project. In 2011 survey was left open for one week but sent to a wider sample population (Appendix 4). Survey questions were adapted from the 2010 survey to include questions that allowed evaluation of a survey respondent’s overall environmental concern (Schultz 2001). In addition, the 2011 survey further divided the responses for academic divisions to allow finer evaluation of the respondents. Individuals were then classified based on an orientation toward one of the three value categories: Egoistic, Altruistic, Biospheric. I defined a respondent’s orientation as having the maximum average score for that value category of 5 or more (out of 7), and having lesser average scores for the other two categories. For example, an individual with average scores of 7 for both Egoistic and Altruistic would not be included in the orientation analysis. These allowed better understanding of the differences in values for the various groups of people on campus.

Survey results

2010 Survey

Surveys were assessed and grouped so that a clear representation of value by group is shown. These were compiled with interviews from 2010 in order to show a clearer picture of the community’s response to Bishop Woods as it stands today. Surveys gathered 140 responses. Survey participants were mostly female (99 responses, 70.7%) and third year students (68 responses, 48.6%). Over half of the survey participants identified the College of Arts and Science as their academic division (74 responses, 53.2%). The majority of students identified that they “walk through Bishop Woods every now and then” when asked how often they walk through Bishop Woods on the way to
classes (59 responses, 42.1%). Many students do walk through Bishop Woods, yet they do so for a variety of reasons (Figure 6).

Using statistical analysis, we can accept that the majority of the sample population would in fact be against the decision to tear down Bishop Woods (Figure 7). The chi-square value of 158.4 has a probability of $p<0.001$ with three degrees of freedom. With a 0.05 level of significance, we can accept that these results did not occur by chance.

2011 Survey

The survey gathered 1,014 responses (91.2% answered every question). Survey respondents were mostly female (74.5%, 753 responses) and studying the Social Sciences in the College of Arts and Science (35.0%, 354 responses). Age of respondents was fairly even across the four undergraduate years (28.3% senior, 23.4% junior, 18.8% sophomore, 25.8% first-year). There was lower participation by faculty (2.3%, 23 responses) and graduate students (1.5%, 15 responses). This was likely due to the extent of email listservs available to the investigator.

The second page of the survey assessed a respondent’s level of environmental concern, based on the value system of egoistic, altruistic, and biospheric environmental concerns (Schultz 2001). Star graphs were generated for these questions based on year and academic division of respondents (Figures 9 and 10). The questions ask respondents to rank each of 12 items on a scale from 1 (least importance) to 7 (supreme importance). The 12 items can be broken into three groups, corresponding to the three types of environmental concern. Distances of the star arms represent the median ranking response
for that group. For example, the star graph for sophomores shows highly egoistic environmental concern, with very little concern in the altruistic and biospheric areas (Figure 9). However, the star graph for faculty respondents shows highly altruistic environmental concern, and more biospheric concern than undergraduates. There were also differences in value systems across academic divisions (Figure 10). Respondents identifying with the business school showed greater egoistic concern than the other two value systems. Respondents identifying with the College of Arts and Science – Natural Sciences division showed greater biospheric concern. These results demonstrate the differences in environmental value systems that can arise from differences in education, age, location, and other life experiences.

Survey respondents were also asked about their perceptions of Bishop Woods. Results were very similar to those from the 2010 survey. 58.9% of respondents believe that Bishop Woods is a protected area, while only 39.0% know about the Miami Natural Areas. In responses to why people choose to walk through Bishop Woods, 71.6% responded that it is the fastest route to where they need to be, and 62.0% responded that they enjoy nature and thus choose to walk through Bishop Woods. Respondents were permitted to select more than one response for that question. When asked what they thought Miami should do with Bishop Woods, 73.0% of respondents indicated that they want Miami to protect Bishop Woods. Comparing respondents’ value area orientation to their opinion on what Miami should do with Bishop Woods (Figure 11, Table 7), I found that opinion was independent of value area (p = 0.32). Even with differing values of the
environment, a majority of respondents enjoy Bishop Woods and would like it to be protected.
Management Plans

Examples in the Eastern Deciduous Forest

Management plans for particular ecosystems have potential applications to other natural areas of that same ecosystem type. Since Bishop Woods is a part of the Eastern Deciduous Forest, it is feasible to use an existing management plan from within the region as a model for a new management plan for Bishop Woods. Sycamore State Park is located in Montgomery County, Ohio, and is managed by the Ohio Department of Natural Resources (Ohio DNR). The 2,384 acres of the park are managed within Ohio DNR’s overall goal of encouraging and protecting the natural composition of native communities (Sycamore State Park 2008). The area lies within the Eastern Deciduous Forest and provides an example of natural area management that considers many of the same biotic and abiotic factors as Bishop Woods. The park’s five-year management plan for 2008-2013 emphasized two areas of improvement in its natural resource management, and many other areas for improvement in its aesthetics and accessibility (Appendix 7). In its natural resource management the park has chosen to focus on improving its prairie grass management by implementing control burns as needed. With this management goal, the plan also outlines the prairie grass area’s strengths, weaknesses, opportunities and threats, which give the plan some type of ability to measure the success of implementing this management goal.

The second area of focus on natural resource management in the park is the tree-planting program. The plan outlines the same four areas that allow it to measure the success of implementing the program. The strength of the tree-planting program is that it
provides aesthetic improvement to the park while also creating a site that can become woodland. The tree-planting project is also weakened by its size limitations. The program provides an opportunity for community service for the local community and local school districts. In addition to its two areas of current focus, the plan includes future natural resource management considerations for enhancing facilities and programs as well as partnerships with the local community. In 2013 the park will outline a new five-year management plan, and at that time the current plan’s success can be evaluated and new areas of natural resource management can become the next priorities.

**Protection plans at other campuses**

Other models for management plans can be found in areas with similar site locations. Universities and colleges with on-campus forests experience many of the same challenges with regard to human use, so a management plan for a forest on another campus will provide additional insight into management recommendations for Bishop Woods. One example is Emory University in Atlanta, GA. In 2002 Emory University’s Senate Committee on the Environment and its Campus Services office worked together to develop a management plan for its Lullwater Preserve, a large area containing ponds, streams, forest, and recreational areas (Hascall 2002). The preserve and other parts of Emory’s land holdings comprise some of the best-preserved hardwood forests in the Piedmont region of the southeastern United States (Beck 2010). Recognizing its unique position to further preserve these forests in its increasingly urban surroundings, Emory extended its work in 2010 to develop the Emory University Forest Management Plan, which would account for all the land holdings of the university (Appendix 8). The
The Lullwater Preserve Management Plan (Appendix 9) outlines overall recommendations and specific points of immediate action for the restoration and continuing maintenance of the area (Hascall 2002). The development of the management plan spanned from Spring 2001 to 2002, and included various steps by the university committee to better understand the current status of the preserve. The Lullwater Task Force Subcommittee, made up of faculty, staff, and student representatives, began with an inventory of the preserve’s vegetation, wildlife and waterways. In addition, they reviewed all available data on human use of the preserve to understand the number of visitors, what type and where recreational activities were concentrated. Then a review of the current campus forest guidelines allowed the task force to make recommendations on where enforcement of such guidelines may have encountered problems. These steps allowed the task force to develop the current Lullwater Preserve Management Plan.

The plan’s points of immediate action include restoring the bank of a specific stream by implementing a stream buffer, controlling erosion in woodland areas caused by high foot traffic by outlining trail maps and closing unapproved trails, controlling stormwater from newly developed areas of campus, and removing the invasive Privet (Ligustrum vulgare) as well as escaped English ivy from non-landscaped areas. Similar to the management recommendations in the Sycamore State Park plan, these points of
immediate action allow measured evaluation of the success of each point. The plan also incorporates plans for specific management area types within the preserve. Management areas include streams and lakes, native plant habitat, invasive species, wildlife management, teaching and research areas, and recreation areas. Of particular interest to this study are the native plant habitat recommendations. In addition to site-specific recommendations, the plan suggests general points for continuing maintenance of the native plant habitats. These include verification of the vegetation and strata every five years, with annual “check-ups” to identify problem areas, and focusing the restoration process as a holistic approach by not focusing on one single species. Each of these general recommendations are not novel ideas, but can be used more widely in the area of university natural area management.

Management Recommendations for Bishop Woods

The management plans for the two areas described above concern places that are much greater in acreage than Bishop Woods. However, they provide excellent starting points for developing a new management plan for Bishop Woods. I propose various recommendations for a future protection and management plan for Bishop Woods. First, I recommend that the university officially make Bishop Woods part of the Miami University Natural Areas system, giving it the same protection and management provisions as the current Natural Areas. In addition, I propose a joint resolution to be passed by the university Board of Trustees as well as Associated Student Government to protect Bishop Woods from being cut down and to recognize the unique aesthetic, scientific, and historic value Bishop Woods holds in its location on Miami’s campus.
Additionally, my recommendations consider the wealth of resources available to Miami as an educational institution and make use of the university’s most valuable resource, its students. This could facilitate growth of each student’s personal value of Bishop Woods, and would assist the Natural Areas committee in its management of the forest. I recommend that the biological sciences departments develop a new course for their majors or introductory level classes, in which each semester’s class would carry out small projects in Bishop Woods to restore native plant and trees and to assist in the eradication efforts for invasive species. Additional exercises can be added to existing classes that incorporate study in Bishop Woods. For example, Field Ecology (BOT/ZOO 333) could benefit from using Bishop Woods as a laboratory for learning plant survey methods and management of invasive species. Finally, the Natural Areas committee should develop closer relationships with student organizations to educate them and provide service opportunities in Bishop Woods. Outside of the university, the committee should strengthen relationships with local schools who might visit Bishop Woods on field trips, and community service groups who could provide volunteers.

The university’s Natural Areas committee developed a management plan for Bishop Woods in 2008 (Appendix 5). It is possible that budget restraints impeded the implementation of many of the original goals, such as seasonal species inventories and adding benches along the trails. My project has aided in some of the original goals, adding species of native wildflowers via enrichment planting and developing a brochure for visitor education (Appendix 6). However, Bishop Woods can benefit from Emory’s Lullwater Plan, by designating goals for immediate action. I recommend that the removal
of invasive species, such as continued removal of *Lonicera maackii* and *Euonymus fortunei* be made goals for immediate action.

The next few years present interesting possibilities for Bishop Woods. In 2010 the first steps of construction began for the Anderson Bicentennial Student Center, to be located just south of Bishop Woods where Culler Hall currently stands. To be completed sometime in the next few years, the building will take the place of Culler and Gaskill Halls, and will replace Shriver as a hub of student activity. This construction project presents a unique opportunity to managers of Bishop Woods. With higher use of the sidewalks around the new building, it is possible that foot traffic through Bishop Woods will increase, as it becomes a more convenient travel route between the student center and other buildings. By implementing the recommendations of this study and the original management goals of the Natural Areas committee, Bishop Woods can begin to be restored, beautified, and preserved as a resource for generations to come.
Conclusions and Next Steps

Further Study

This study can be extended to future students in the biological sciences. Further research on the extent of invasive species in Bishop Woods is necessary, and some type of regular inventory of the amount and location of invasives should be performed. Management of *E.fortunei* could be extended to the rest of Bishop Woods, and longer studies could include the effect the invasive has on native forbs and trees. In addition, the social perceptions survey data from this study could be evaluated further, and expanded to other surveys of Miami and other college campuses.

Significance in the context of conservation of biodiversity in urban landscapes

Urban landscapes present several opportunities for conservation, but they require conscientious management and protection from future development to be effective in conserving biodiversity. The urban setting has significant impacts on a natural area that are not present in rural settings. Indeed, the college and university campus as an urban setting has its own set of particular influences on a natural area, and thus deserves particular attention as a potential site for biodiversity conservation. In the educational environment of the university setting, Bishop Woods is valuable in promoting environmental awareness and stewardship among university students and other visitors. This study demonstrated the social perception of the on-campus forest Bishop Woods as being valued by the university community, and found feasible steps toward the restoration goals of management of invasive species and enrichment of native species.
The success of Bishop Woods as a site for urban conservation will not be known for many years to come, and more must be done.
Literature Cited


Johnson, K. 2010. Natural resources manager for Great Smoky Mountains National Park. E-mail correspondence.


Vincent, M. 2009, March. Interview.


Figure 1. General location of surveyed plots in Bishop Woods (plots not to scale). The x marks the one plot of the grid that was not surveyed due to too much interference by tree and shrub growth. Red S’s mark plots receiving treatment with glyphosate. Blue C’s mark control plots receiving no treatment. Italic NI’s mark two plots that had so little initial cover of invasive that they were removed from the study. (Schematic from Miami University Campus Map, 2009).
Figure 2. Box plots comparing Fall ("before") measurements for the two samples, showing substantial overlap of the distributions. Ends of the means diamonds indicate the 95% confidence intervals for the mean percent cover. (t = 4.2, P < 0.01)
Figure 3. Box plots comparing Spring ("after") measurements for the two samples, showing substantial overlap of the distributions. Ends of the means diamonds indicate the 95% confidence intervals for the mean percent cover. ($t = -2.16, P = 0.02$)
Figure 4. Box plots comparing the relative change in cover from Fall to Spring between the two samples, showing significant differences of the distributions. Higher values represent a larger change in cover; the higher values for the sprayed area indicates the effectiveness of the herbicide in reducing the Springtime cover. Ends of the means diamonds indicate the 95% confidence intervals for the mean relative change. (t = 1.92, P = .04)
Figure 5. Comparison of percent cover by grasses in study plots in spring. No significant difference was found between sprayed and control plots ($t = -0.603$, $p < 0.2795$).
Figure 6. 2010 responses to the question “What statement describes why you choose to walk through Bishop Woods?” separated by the survey participants’ number of times they walk through Bishop Woods, in number of responses. Survey participants were permitted to select more than one response.
Figure 7. 2010 responses to the question “If someone told you Bishop Woods was going to be torn down, what position best describes your feelings about that decision?” in number of responses and percent of total response.
Figure 8. 2010 responses to the question “What statement describes why you choose to walk through Bishop Woods” separated by the survey participant’s identified academic division, in number of responses. The survey participants were permitted to select more than one response.
Results of Concerns Questions

Category
- Egoistic: Me, My lifestyle, My health, My future
- Altruistic: People in the community, All people, Children, Future generations
- Biospheric: Plants, Marine life, Birds, Animals

Plots are sums of median scores for each category

Figure 9. Concerns for each academic class, represented by the sum of medians across the concern group.
Figure 10. Response scores for median degree of each category of concern for each academic division. E H & S: Education, Health and Society. Arm lengths are proportional to the maximum score (27).
Figure 11. Test of independence of opinion of what to do with Bishop Woods, showing independence between opinion and value area (ChiSquare = 10.192, p > 0.11). The top cells (orange, barely visible) are "Remove" and are less than 1% of the responses. The bottom (red) are "Do not care", less than 4% of the responses. Statistics performed with JMP 9.0.
Photographs

Photograph 1. Cabin used by Miami’s first poet-in-residence, Percy Mackaye, in Bishop Woods in the 1920s. The surroundings of the artist’s studio provided the inspiration for Mackaye’s poem “The Trees of Miami”.

Photograph 2. View looking east-northeast, with the “Home Woods” behind Elliot and Stoddard Halls in the foreground. No date, but must be prior to construction of Upham and Hughes Halls, could be around 1930s.
Photograph 10. Point frame used to measure percent cover in center square meter of each study plot.
Photograph 11. Spraying *E. fortunei* with 1% glyphosate.
Photograph 12. Planting *Aquilegia* individuals in April 2011.
Photograph 13. Planting *Stylophorum* individuals in March 2011.
**Table 1.** T-test assuming unequal variances of Fall ("before") measurements of mean percent cover for the two samples, showing no significant difference by the two-sided test of whether the control sample has less cover than the "to be sprayed" sample.

<table>
<thead>
<tr>
<th>Difference</th>
<th>21.9028</th>
<th>t Ratio</th>
<th>4.212593</th>
</tr>
</thead>
<tbody>
<tr>
<td>Std Err Dif</td>
<td>5.1994</td>
<td>DF</td>
<td>53.3424</td>
</tr>
<tr>
<td>Upper CL Dif</td>
<td>32.3298</td>
<td>Prob &gt;</td>
<td>t</td>
</tr>
<tr>
<td>Lower CL Dif</td>
<td>11.4757</td>
<td>Prob &gt;</td>
<td>t</td>
</tr>
<tr>
<td>Confidence</td>
<td>0.95</td>
<td>Prob &lt;</td>
<td>t</td>
</tr>
</tbody>
</table>

**Table 2.** T-test assuming unequal variances of Spring ("after") measurements of mean percent cover for the two samples, showing no significant difference by the two-sided test nor by either one-sided test.

<table>
<thead>
<tr>
<th>Difference</th>
<th>-5.542</th>
<th>t Ratio</th>
<th>-2.1674</th>
</tr>
</thead>
<tbody>
<tr>
<td>Std Err Dif</td>
<td>2.557</td>
<td>DF</td>
<td>36.1453</td>
</tr>
<tr>
<td>Upper CL Dif</td>
<td>-0.357</td>
<td>Prob &gt;</td>
<td>t</td>
</tr>
<tr>
<td>Lower CL Dif</td>
<td>-10.726</td>
<td>Prob &gt;</td>
<td>t</td>
</tr>
<tr>
<td>Confidence</td>
<td>0.95</td>
<td>Prob &lt;</td>
<td>t</td>
</tr>
</tbody>
</table>

**Table 3.** T-test assuming unequal variances of the relative change (Fall to Spring) in mean percent cover for the two samples, showing a significant reduction in cover (larger relative change) in the sprayed sample as indicated by the one-sided test (p=0.03).

<table>
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<tr>
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<th>t Ratio</th>
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<td>Prob &gt;</td>
<td>t</td>
</tr>
<tr>
<td>Lower CL Dif</td>
<td>-0.01629</td>
<td>Prob &gt;</td>
<td>t</td>
</tr>
<tr>
<td>Confidence</td>
<td>0.95</td>
<td>Prob &lt;</td>
<td>t</td>
</tr>
</tbody>
</table>
Table 4. Native spring perennials found in Bishop Woods, Miami University. From student surveys performed in Dr. Nancy Smith-Huerta’s Botany 204 class, spring 2009.

<table>
<thead>
<tr>
<th>Species name</th>
<th>Common name</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Dicentra cucullaria</em></td>
<td>Dutchman’s breeches</td>
</tr>
<tr>
<td><em>Podophyllum peltatum</em></td>
<td>May apple</td>
</tr>
<tr>
<td><em>Trillium sessile</em></td>
<td>Sessile trillium</td>
</tr>
<tr>
<td><em>Viola sororia</em></td>
<td>Common blue violet</td>
</tr>
<tr>
<td><em>Dentaria laciniata</em></td>
<td>Cutleaf toothwort</td>
</tr>
<tr>
<td><em>Erythronium albidum</em></td>
<td>White trout lily</td>
</tr>
<tr>
<td><em>Cardamine douglasii</em></td>
<td>Purple cress</td>
</tr>
<tr>
<td><em>Claytonia virginica</em></td>
<td>Virginia spring beauty</td>
</tr>
</tbody>
</table>
**Table 5.** Explanation of the scale of Coefficient of Conservatism scores. Taken from the Ohio Floristic Quality Assessment Index (Andreas et al., 2004).

**Table 1. Summary of coefficients of conservatism used in the FQAI for vascular plants.**

<table>
<thead>
<tr>
<th>C of C</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Plants with a wide range of ecological tolerances. Often these are opportunistic invaders of natural areas (e.g. <em>Phragmites australis, Phalaris arundinacea</em>) or native taxa that are typically part of a ruderal community (e.g. <em>Polygonum pensylvanicum, Ambrosia artemisiifolia</em>)</td>
</tr>
<tr>
<td>1-2</td>
<td>Widespread taxa that are not typical of (or only marginally typical of) a particular community like <em>Solidago canadensis</em> or <em>Impatiens capensis</em></td>
</tr>
<tr>
<td>3-5</td>
<td>Plants with an intermediate range of ecological tolerances that typify a stable phase of some native community, but persist under some disturbance (<em>Asclepias incarnata, Ulmus rubra, Spartina pectinata</em>)</td>
</tr>
<tr>
<td>6-8</td>
<td>Plants with a narrow range of ecological tolerances that typify a stable or near &quot;climax&quot; community (e.g. <em>Goodyera pubescens, Veronicastrum virginicum, Cephalanthus occidentalis</em>)</td>
</tr>
<tr>
<td>9-10</td>
<td>Plants with a narrow range of ecological tolerances that exhibit relatively high degrees of fidelity to a narrow range of habitat requirements (e.g. <em>Potamogeton robbinsii, Cypripedium candidum</em>)</td>
</tr>
</tbody>
</table>
Table 6. Species selected for planting for native wildflower enrichment in Bishop Woods in Spring 2011.

<table>
<thead>
<tr>
<th>Species name</th>
<th>Common name</th>
<th>Date of planting</th>
<th>Quantity planted</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Stylophorum diphyllum</em></td>
<td>Wild poppy</td>
<td>03/19/2011</td>
<td>30</td>
</tr>
<tr>
<td><em>Aquilegia canadensis</em></td>
<td>Red columbine</td>
<td>04/03/2011</td>
<td>30</td>
</tr>
<tr>
<td><em>Mertensia virginica</em></td>
<td>Bluebell</td>
<td>---</td>
<td>---</td>
</tr>
</tbody>
</table>
Table 7. Analysis of Value Label By Action indicating no statistically significant relations between the Value category and the recommended action on Bishop Woods.

<table>
<thead>
<tr>
<th>Value Label</th>
<th>Action</th>
<th>Count</th>
<th>Total %</th>
<th>Col %</th>
<th>Row %</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Do not care</td>
<td>8</td>
<td>1.28</td>
<td>61.54</td>
<td>2.03</td>
</tr>
<tr>
<td></td>
<td>Need more info</td>
<td>84</td>
<td>13.48</td>
<td>57.93</td>
<td>21.32</td>
</tr>
<tr>
<td></td>
<td>Protect</td>
<td>301</td>
<td>48.31</td>
<td>65.01</td>
<td>76.40</td>
</tr>
<tr>
<td></td>
<td>Remove</td>
<td>1</td>
<td>0.16</td>
<td>50.00</td>
<td>0.25</td>
</tr>
<tr>
<td></td>
<td></td>
<td>394</td>
<td>63.24</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Altruistic</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Biospheric</td>
<td></td>
<td>1</td>
<td>0.16</td>
<td>7.69</td>
<td>0.85</td>
</tr>
<tr>
<td></td>
<td>Need more info</td>
<td>25</td>
<td>4.01</td>
<td>17.24</td>
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<tr>
<td></td>
<td>Protect</td>
<td>91</td>
<td>14.61</td>
<td>19.65</td>
<td>77.78</td>
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<tr>
<td></td>
<td>Remove</td>
<td>0</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
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<tr>
<td></td>
<td></td>
<td>117</td>
<td>18.78</td>
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<td></td>
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<tr>
<td>Egoistic</td>
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<td>4</td>
<td>0.64</td>
<td>30.77</td>
<td>3.57</td>
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<tr>
<td></td>
<td>Need more info</td>
<td>36</td>
<td>5.78</td>
<td>24.83</td>
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<tr>
<td></td>
<td>Protect</td>
<td>71</td>
<td>11.40</td>
<td>15.33</td>
<td>63.39</td>
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<tr>
<td></td>
<td>Remove</td>
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<td>0.16</td>
<td>50.00</td>
<td>0.89</td>
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<tr>
<td></td>
<td></td>
<td>112</td>
<td>17.98</td>
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</tr>
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<td>13</td>
<td>2.09</td>
<td>30.77</td>
<td>3.57</td>
</tr>
<tr>
<td></td>
<td>Need more info</td>
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<td>23.27</td>
<td>24.83</td>
<td>32.14</td>
</tr>
<tr>
<td></td>
<td>Protect</td>
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<td>74.32</td>
<td>15.33</td>
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</tr>
<tr>
<td></td>
<td>Remove</td>
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</tr>
<tr>
<td></td>
<td></td>
<td>623</td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>
Appendix 1

“The Trees of Miami” by Percy Mackaye

A COLLEGE STORY

GOOD FELLOWSHIP

SCHOLARLY ATTAINMENT

HIGH IDEALS

MIAMI UNIVERSITY BULLETIN
SERIES XXII—DECEMBER, 1923—NO. 4
THE TREES OF MIAMI

By Perry MacKaye

(I)
Trees of Miami,—Miami,
Oleander word
In a far red dawn first uttered
By the wailing cry of a dawn-red bird
("Miami! Miami! Miami!")
Echoed there by the muttered Song of an ancient earth-red race
In a shadowy, sacred place,—
Trees of Miami, beautiful trees!
What do you brood in your reveries?

Where the flesherton
Clay-blue banks of the Tallavanda
Gape, to reveal forlorn
Relics of your rooted ancestors,
What do you ponder
There, on those primordial shores,
Out of the clay
Lifting green thoughts into the golden day?

What are the secret reasons
That stir your leaves to sing?
Out of a million seasons
Of sequestered life—
Wraths of autumn, rages of lyric spring,
Winter’s calm self-conquering,
And summer’s rise
Recurrent, apt foreseeing—
What are your verbal reasons
For this unintermittent Being?

—Miami!—
In answering choir
Leafy and sibylline,
Out of the shadowy green
Echoed that only word, opal with fire:
—Miami!—

(II)
Trees of Miami, what bird
Of your boughs will unbind that word?
Flicker,—flicker,
Resolute toller date,
What do you iterate, iterate.
Iterate,
Tapping it there with your elfin tick-er?

...Truth,—truth,—truth!
Redbird, burning
Heart of cestasy, what is your yearning?

...Youth,—youth,—youth,—youth!
Wood dove, wild dove,
You that call—
In passive music—all
Those that pass
Over and over over the grave
Beneath you, what are you Fultoning of?

...Truth,—rememberance,—youth!
Miami! Miami!

(III)
Ah, trees of Miami! now
The voice of a wailing bird—
Once, twice, thrice—from a secret bough
Has unbridled your sacred word:
Miami!

Truth—rememberance—youth! of these
You brood in your ancient reveries,
In the flow of universal sides
This is the knowledge that keeps you vernal:

Only beauty abides;
Youth is eternal.
Appendix 2

Interview questions

1. Do you believe Bishop Woods is important in the education of Miami students? If so, please explain.
2. In what ways do you use Bishop Woods as a means of educating your students?
3. Do you believe Bishop Woods should have permanent protection? Why or why not?
4. What is your perception of faculty's attitudes towards Bishop Woods and its protection?
5. What is your perception of administration's attitudes towards Bishop Woods and its protection?
   6. If you had one statement to make regarding the importance of Bishop Woods so that it would be fully protected, what would that statement be?
Appendix 3 – 2010 survey

**Bishop Woods Interest Survey**

1. Default Section

1. What best describes you?
   - First-year
   - Sophomore
   - Junior
   - Senior
   - Grad student
   - Faculty

2. What gender are you?
   - Male
   - Female

3. What academic division do you mainly identify with?
   - School of Education, Health and Society
   - School of Fine Arts
   - School of Engineering and Applied Science
   - College of Arts and Science
   - The Graduate School
   - Farmer School of Business

4. Do you know where Bishop Woods is on campus?
   - Yes
   - No

5. Do you walk through Bishop Woods going to class? If so, how often do you walk through the woods?
   - I do not walk through Bishop Woods on my way to class.
   - I walk through Bishop Woods every now and then.
   - Once a week.
   - 2-3 times a week.
   - 4-5 times a week.
   - 5+ times a week.
Bishop Woods Interest Survey

6. What statement below describes why you choose to walk through Bishop Woods? (Please mark all that apply).
   - [ ] It is the fastest route to where I need to be.
   - [ ] It is interesting to me.
   - [ ] I enjoy nature.
   - [ ] I like the wildlife.
   - [ ] I like the plants.
   - [ ] I feel removed from the rest of campus.

7. If you choose not to walk through Bishop Woods, what statement below best describes why you choose not to do so? (Please mark all that apply).
   - [ ] I do not like feeling removed from the rest campus.
   - [ ] I do not like the animals.
   - [ ] I do not like the plants.
   - [ ] I do not like the smell.
   - [ ] I do not like the sounds.
   - [ ] It is not the fastest way to where I need to be.

8. Do you think Bishop Woods is a protected area?
   - [ ] Yes
   - [ ] No

9. Do you know about the Miami Natural Areas?
   - [ ] Yes
   - [ ] No

10. If someone told you Bishop Woods was going to be torn down, what position below best describes your feelings about that decision?
    - [ ] I would be against the decision to tear down Bishop Woods.
    - [ ] I would need more information to make a decision about how I feel.
    - [ ] I would be in support of the decision to tear down Bishop Woods.
    - [ ] I would be apathetic.
Appendix 4 – 2011 survey

Bishop Woods Interest Survey

1. Default Section

1. What best describes you?
   - First-year
   - Sophomore
   - Junior
   - Senior
   - Grad student
   - Faculty

2. What gender are you?
   - Male
   - Female

3. What academic division do you mainly identify with?
   - College of Arts and Science - Social Sciences
   - Farmer School of Business
   - College of Arts and Science - Humanities
   - School of Education, Health and Society
   - The Graduate School
   - School of Engineering and Applied Science
   - College of Arts and Science - Natural Sciences
   - School of Fine Arts
Bishop Woods Interest Survey

2.

(Adapted from Shultz 2001)

People around the world are generally concerned about environmental problems because of the consequences that result from harming nature. However, people differ in the consequences that concern them the most. Please rate each of the following items from 1 (not important) to 7 (supreme importance) in response to the question:

I am concerned about environmental problems because of the consequences for:

1. Me
   - 1
   - 2
   - 3
   - 4
   - 5
   - 6
   - 7

2. Plants
   - 1
   - 2
   - 3
   - 4
   - 5
   - 6
   - 7
## Bishop Woods Interest Survey

### 3. Marine life
- 1
- 2
- 3
- 4
- 5
- 6
- 7

### 4. Birds
- 1
- 2
- 3
- 4
- 5
- 6
- 7

### 5. Animals
- 1
- 2
- 3
- 4
- 5
- 6
- 7
Bishop Woods Interest Survey

6. My lifestyle
   - 1
   - 2
   - 3
   - 4
   - 5
   - 6
   - 7

7. My health
   - 1
   - 2
   - 3
   - 4
   - 5
   - 6
   - 7

8. My future
   - 1
   - 2
   - 3
   - 4
   - 5
   - 6
   - 7
### Bishop Woods Interest Survey

9. People in the community

- 1
- 2
- 3
- 4
- 5
- 6
- 7

10. All people

- 1
- 2
- 3
- 4
- 5
- 6
- 7

11. Children

- 1
- 2
- 3
- 4
- 5
- 6
- 7
Bishop Woods Interest Survey

12. Future generations
   1
   2
   3
   4
   5
   6
   7
Bishop Woods Interest Survey

3.

1. Have you heard of the area called Bishop Woods?
   - Yes
   - No

2. Do you know where Bishop Woods is on campus?
   - Yes
   - No

3. Do you walk through Bishop Woods going to your class, your office or your residence? If so, how often do you walk through the woods?
   - I do not walk through Bishop Woods on my way to class.
   - I walk through Bishop Woods every now and then.
   - Once a week.
   - 2-3 times a week.
   - 4-5 times a week.
   - 5+ times a week.

4. What statement below describes why you choose to walk through Bishop Woods? (Please mark all that apply).
   - I like the plants.
   - It is interesting to me.
   - I enjoy nature.
   - It is the fastest route to where I need to be.
   - I like the wildlife.
   - I feel removed from the rest of campus.
5. If you choose not to walk through Bishop Woods, what statement below best describes why you choose not to do so? (Please mark all that apply).
- I do not like feeling removed from the rest campus.
- I do not like the animals.
- I do not like the plants.
- I do not like the smell.
- I do not like the sounds.
- It is not the fastest way to where I need to be.

6. Do you think Bishop Woods is a protected area?
- Yes
- No

7. Do you know about the Miami Natural Areas?
- Yes
- No

8. What position below best describes your feelings about what Miami should do with Bishop Woods?
- I would not care what Miami does with Bishop Woods.
- I want Miami to tear down Bishop Woods (regardless of whether a new facility will be there or not).
- I want Miami to protect Bishop Woods.
- I want Miami to tear down Bishop Woods (to make room for new buildings or other facilities).
- I would need more information to make a decision about how I feel.

9. If you answered yes to question 7, what best describes your position on placing Bishop Woods in the Miami Natural Areas?
- I would be in support of adding Bishop Woods to the Miami Natural Areas.
- I would oppose adding Bishop Woods to the Miami Natural Areas.
- I do not have enough information to make a decision.
Appendix 5

Bishop Woods – The Plan (Current as of 2008)

**Background:** Bishop Woods is less than 3 acres. In 1986 the decision by the Board of Trustees was to let this area of big trees, some as old as 150 years, revert back to a woods. With its underbrush, wildflowers and young trees of differing heights, it provides a natural contrast to Miami's neatly manicured campus of lawns, paved walkways and red brick buildings.

**The Bachelor Reserve and Other Natural Areas Committee:**

This Committee chaired by Dr. Douglas H. Taylor, reports to the President of the University, and is responsible for oversight and management of the Natural Areas, which are to be preserved and protected for approved uses in education, research, recreation and observation in perpetuity.

These lands include: Bachelor Wildlife and Game Reserve, College Woods, Reinhart Reserve, Silvoor Biological Sanctuary, Kramer Woods, Women's Recreational Association and Cabin Area, Brown Glover Tract, Western Woods, Beck Reserve, Peffer Woods, Marcum Woods, and Ecology Research Center. The Committee does not have singular oversight responsibility for Bishop Woods but shares this with the Botany and Physical Facilities Departments.

**Committee Members:**

Douglas H. Taylor - Chair, (Zoology)

Thomas O. Crist - Vice-Chair (Zoology)

Michelle Boone (Zoology)

W. Hardy Eshbaugh (Botany)

Thomas C. Klak (Geography)

Thomas W. Kopp (Teacher Education)

Richard E. Lee (Zoology)

David Gorchov (Botany)
John F. Keegan (Botany)

Jason Reynolds (Curator, Silvoor Biological Sanctuary)

Ann Rypstra - Director, Ecology Research Center (Zoology)

Martin H. Stevens (Botany)

Holly Wissing (Oxford Community member)

Orie Loucks (Zoology)

Education: Bishop Woods is a natural laboratory for Miami's zoology, botany, biology, ecology and environmental science classes.

Through Miami University’s Center For Environmental Education, Natural History and Conservation/Hefner Zoology Museum, in Partnership with Talawanda School District, several thousand elementary through high school students have used Bishop Woods for study and research over the years.

Today: Bishop Woods is a green haven of peace, beauty and tranquility, in the midst of buildings and mowed grounds, where nature can easily be observed, experienced, studied and appreciated.

The Problem: It may appear to the casual observer that Bishop Woods is in neglect and therefore unimportant to the University as this area progresses in its journey of succession. Nothing could be further from the truth.

The Goal: In partnership with interested parties, a plan has been developed for the enhancement and maintenance of Bishop Woods as an important resource for education, research and quiet solitude.

The Plan:

1. Develop walking trails to selected areas for study.

2. Build a nature garden to attract birds and butterflies.

3. Add bird-nesting boxes.

4. Add additional species of native wildflowers.

5. Add native understory trees.
6. Add rocks with fossils and glacial erratics.

7. Add benches for rest and reflection.

8. Add a kiosk at the top of the horseshoe circle to explain the story, purpose and uses of Bishop Woods.

9. Add discreet educational signage at key locations.

10. Remove invasive plant species and unsightly debris.

11. Conduct seasonal inventories of species.

12. Annually document the educational/research use of Bishop Woods.

13. Funding - provided through Miami University Natural Areas.

14. Oversight - The oversight and management of Bishop Woods would be directly administered by the Natural Areas Committee in partnership with Miami University’s Botany Department and the Vice President for Business and Finance Services Office with support from the Physical Faculties Department’s Manager and Grounds staff.

Douglas H. Taylor

Chairman – Bachelor Reserve and Other Natural Areas Committee

Department of Zoology
Appendix 6

Mock-up of brochure for use in Bishop Woods

BISHOP WOODS TODAY

Bishop Woods is a green haven of peace, beauty and tranquility, in the midst of buildings and crowded grounds, where nature can really be observed, experienced, studied and appreciated.

BISHOP WOODS

Miami University

For more information contact: Miami University Natural Areas Committee

BISHOP WOODS

Miami University

History of Bishop Woods

The woods of Miami have a particular mystique about them. At its founding, the university’s small campus was surrounded by forest, earning it the name of the “campus in the woods.” In the 1950s, Miami established a post-in-residence program with Percy MacKay as its first participant. MacKay lived in an artist’s studio in Bishop Woods and posed the press “The Tree of Miami”, a verse of which is inscribed on the wall of Upham Hall. Miami students used to collect firewood for their residence halls in the “Homestead,” or what is now known as Bishop Woods. Since then, the Woods have been transformed as the university grew around them, adding new buildings and roads to satisfy the growth of the student body.

BISHOP WOODS

Miami University

Miami University Natural Areas Committee

BISHOP WOODS

Miami University

Bishop Woods is less than 3 acres. In 1996 the decision by the Board of Trustees was to let this area of big trees, some as old as 150 years, revert back to a woods. With its underbrush, wildflowers and young trees, it provides a natural contrast to Miami’s campus courtyards and modern buildings.

Red balled woodpecker (top)
Ruby throated hummingbird (bottom)
Bishop Woods: Things to See

WILDLIFE

Bird species:

Mammals:

PLANT LIFE

Flowers:

Trees:

Conservation Efforts

With the help of students in the department of Botany, Bishop Woods has seen many conservation efforts. Recently, additional native willows were planted in the Woods to enhance native biodiversity. In addition, many projects are underway to manage invasive species in the Woods.

MAMI NATURAL AREAS

<table>
<thead>
<tr>
<th>Bishop Woods</th>
<th>Miami Woods</th>
<th>Western Woods</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bishop GBSC</td>
<td>Pepper Park</td>
<td></td>
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