WHITE'S WOODS NATURE CENTER:
CURRENT VALUE AND FUTURE CARE

Appendices

Appendix A

Invasive Plant Inventory and Management Report for
White's Woods Nature Center
Indiana, Pennsylvania
Prepared by Sara Kuebbing,
Ph.D. Marion Holmes, Ph.D.
FINAL REPORT 14 October 2021

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Invasive Plant Inventory and Management Report for White's Woods Nature Center, Indiana, Pennsylvania

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FINAL REPORT

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Report Purpose

This report was commissioned by the Friends of White's Woods to understand the extent and potential impact of nonnative, invasive plants within White's Woods Nature Center. While developing this report, we conducted two vegetation surveys in May and August 2021. Our goal in writing this report is to provide the following information:

1) an inventory and map of populations of nonnative, invasive plants;
2) a summary of current scientific knowledge about the ecological, economic, or humanhealth impacts on forested ecosystems for each species found in White's Woods;
3) a summary of best management practices for each species found in White's Woods;
4) a list of resources about detecting and managing nonnative, invasive plants.

This report provides a status assessment that can help inform the development of an invasive plant management plan for White's Woods but should not be considered a management plan on its own. Development of an invasive plant management plan should involve the following additional components: a) input from all relevant constituents and stakeholders for the property; b) identification of conservation, recreation, or other goals for the property; and c) budget of funding and labor available to implement various management options. We do not provide criteria for prioritizing management actions or objectives, but we do outline the benefits and risks of each possible management action.

Definition of Terms

We use define the following terms based on the USDA National Invasive Species Council.[1]

a) Ecosystem means the complex of a community of organisms and its environment.
b) Introduction means the intentional or unintentional escape, release, dissemination, or placement of a species into an ecosystem as a result of human activity.
c) Invasive species means a nonnative species whose introduction does or is likely to causeeconomic or environmental harm or harm to human health.
d) Native Species means, with respect to a particular ecosystem, a species that, other than asa result of an introduction, historically occurred or currently occurs in that ecosystem.
e) Nonnative Species means, with respect to a particular ecosystem, any species including its seeds, eggs, spores, or other biological material capable of propagating that species, that isnot native to that ecosystem.
f) Species means a group of organisms all of which have a high degree of physical andgenetic similarity, generally interbreed only among themselves, and show persistent differences from members of allied groups of organisms.

We also use the following terms and definitions to describe specific populations of nonnative, invasive plants found at White's Wood.

a) Encroaching means an invasive plant we detected on White's Woods property, but primarilyfound along the forest exterior around trailheads, roadsides, and margins of the forest.
b) Uncommon means an invasive plant species that was detected in the forest interior, but onlyscattered individuals or small populations in a single or few locations.

[1] National Invasive Species Council website: https://www.doi.gov/invasivespecies; President William Clinton's Executive Order 13112 on Invasive Species. Issued on February 3, 1999 and available online: https://www.doi.gov/sites/doi.gov/files/uploads/eo_13112.pdf.

c) Well-established means an invasive plant species that was found in the forest interior withmultiple non-contiguous populations within the forest.

Site Description

White's Woods Nature Center is a 250-acre park owned and managed by the White Township. The property was purchased in 1968 through Pennsylvania's Project 70 Land Acquisition and Borrowing Act to protect the area for recreation, conservation, and history preservation.

Site history

Most of White's Woods was forested in 1938 (Map 1). The exception, an area that is now some of the youngest forest in the park, is a section of the ridgetop and south-facing slope in the Northern and Western section of the park (a). This area appeared to be old-field vegetation that grew following recent abandonment from agriculture, most likely pasturing. Erosion channels are visible on the soil surface in the westernmost area. The present forest includes a few trees with spreading, open-grown branching that indicates they grew in an open habitat. Several of these isolated trees are visible in the 1938 aerial photo within the old field matrix (b). This area is one of the flattest parts of White's Woods, and flat sites are often maintained in agriculture longer than steeper slopes and rocky areas. It is possible that other parts of White's Woods were used for agriculture in the past, but these sites would have been abandoned no later than the early 1900s.

Map 1: Aerial map of White's Woods from 1938.

The forests in 1938 were not uniform in age or history. Canopy texture in the central upland area indicated that forest here was comparatively young (c) and likely dates to the early 1900s. The Eastern slope (d) appears to have been fairly open, with individual trees visible. This suggests possible selective logging. The northeastern corner (e) appears to have been a shrubland or very young forest recruiting on previously cleared land that may have been used for agriculture. The only old forest in 1939 was the North-facing slope just outside the park (f). We can conclude, based on canopy texture, that all the forest stands in White's Woods have been cleared, at least partially, prior to 1938. Most clearance likely took place in the 1800s, most forest present in 1938 had regrown following prior cutting.

Forest Description

The forest communities at White's Woods are dominated by broadleaf deciduous species. The community is typical of forests in the Unglaciated Allegheny Plateau and contains sections that

resemble the Tuliptree-Beech-Maple, Red oak-Mixed hardwood, and Dry oak-Heath communities[2]. Oaks (*Quercus* spp.), maples (*Acer* spp.), and sweet birch (*Betula lenta*) are common. Other canopy species include hickories (*Carya* spp.), black gum (*Nyssa sylvatica*), and cucumber magnolia (*Magnolia acuminata*). The tree canopy composition varies by slope position: American beech (*Fagus grandifolia*) is most common on steep slopes and valleys while the ridgetop community—the driest, highest-elevation area—is dominated by oaks, especially black oak (*Q. velutina*) and chestnut oak (*Q. montana*).

Photo 1: goldenseal

Native Species of Interest

Native plant communities at White's Woods include a diverse assemblage of species (Appendix 1). A large population of state-threatened goldenseal (*Hydrastis canadensis*) is present (Photo 1). Species typical of older forests such as black cohosh (*Actaea racemosa*), maidenhair fern (*Adiantum pedatum*), and wild leeks (*Allium tricoccum*) are also common in parts of the forest.

Observed ecological threats to native vegetation

The forest floor plant community is the most biologically diverse part of eastern temperate forests with an estimated 80% of forest plant biodiversity occupying this forest layer. Protecting the integrity of the forest floor is critical for maintaining plant biodiversity at White's Woods. Both invasive plant species and overabundant white-tailed deer are present at White's Woods and pose two of the largest ecological threats to native flora in the region. Overabundant deer inhibit regeneration of canopy trees, browse native understory plants, and promote invasion by nonnative plants or clonal native species like hay-scented fern (*Dennstaedtia punctilobula*) and New York fern (*Thelypteris noveboracensis*).
. Evidence of heavy browse pressure can be observed in the sparse herbaceous layer in many parts of the forest (Photo 2), browse line on forest shrubs and small trees (absence of branches and leaves within reach of deer, Photo 3), and presence of large colonies of deer-resistant native plant species like hay-scented fern at White's Woods (Photo 4). We did not detect native plants that are favored by deer, including pink lady's slipper orchid (*Cypripedium acaule*) and trillium (*Trillium* spp.), suggesting that overbrowse by deer may have significantly reduced or extirpated populations of these plants previously found at the site. Removing widespread nonnative, invasive plants that can suppress native plant species or reducing the grazing pressure of overabundant deer can protect or increase native understory plants. However, reducing invasive plants or deer populations may not be sufficient to restore diverse understory flora if native soil seedbanks are depleted or native plant seeds cannot disperse back into the forest.

Photos 2, 3, and 4:

[2] Communities defined in *Terrestrial & Palustrine Plant Communities of Pennsylvania* by Jean Fike. Pennsylvania Natural Diversity Inventory, 1999. Available Online: https://www.naturalheritage.state.pa.us/fikebook.aspx.

Invasive Plant Inventory

We detected a total of 12 nonnative, invasive plants at White's Woods, including herbaceous forbs and grasses found in the forest understory and woody vines and shrubs common to the forest midstory (Table 1). These are all typical nonnative invasive plants within deciduous forests in Pennsylvania. Most of these species were uncommon within the forest interior with only a few scattered individuals present. Many species were congregated around the trailheads (12th Street and along Fulton Run Road near the transformers) and along the forest edge running along the powerlines (see Map 1). The three most common species found within the forest were garlic mustard (*Alliaria petiolata*), Japanese barberry (*Berberis thunbergii*) and Japanese stiltgrass (*Microstegium vimineum*). Barberry was found in a few large patches within the forest while stiltgrass and garlic mustard were widespread (Map 2).

Table 1: Overview of nonnative plants deemed invasive by PA Department of Conservation and Natural Resources (DCNR) found in White's Woods in the spring and summer of 2021.

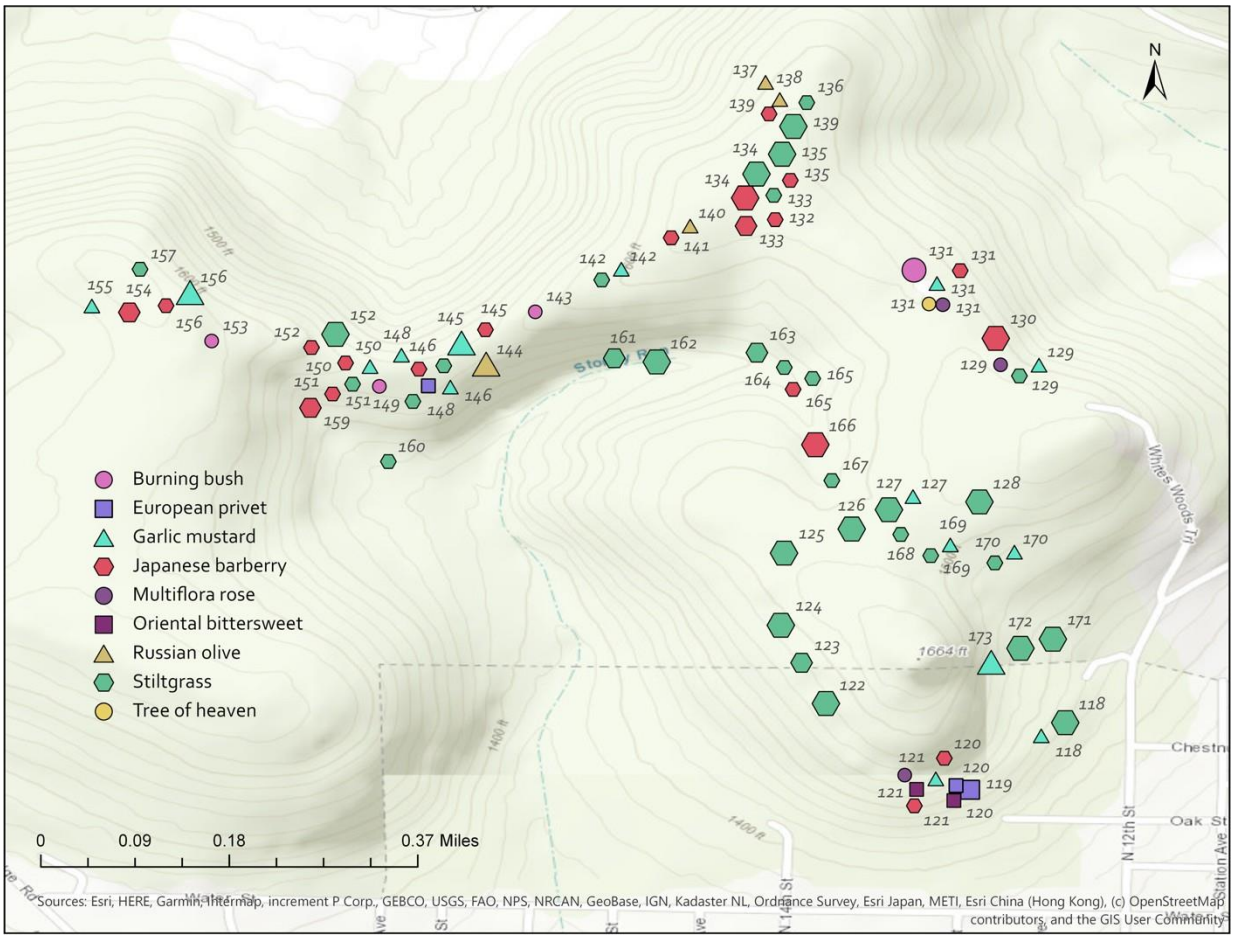
Common Name	Scientific Name	Plant form	DCNR Rank[3]	Site Status	Management options
Tree of heaven	*Ailanthus altissima*	tree	1	uncommon	Chemical
Garlic mustard	*Alliaria petiolata*	biennial forb	1	widespread	Mechanical, chemical
Japanese barberry	*Berberis thunbergii*	shrub	1	widespread	Mechanical, chemical
bittersweet	*Celastrus orbiculatus*	vine	1	uncommon	Mechanical, chemical
Autumn olive	*Elaeagnus umbellata*	shrub	2	uncommon	Mechanical, chemical
Burning bush	*Euonymus alatus*	shrub	2	uncommon	Mechanical, chemical
English privet	*Ligustrum vulgare*	shrub	2	uncommon	Mechanical, chemical
Japanese honeysuckle	*Lonicera japonica*	vine	1	uncommon	Chemical
Japanese stiltgrass	*Microstegium vimineum*	annual grass	1	widespread	*prevention of increasing infestations*
Jetbead	*Rhodotypos scandens*	shrub	1	Uncommon	Mechanical, chemical
Multi-flora rose	*Rosa multiflora*	shrub	1	uncommon	Mechanical, chemical
Common periwinkle	*Vinca minor*	vine	3	Uncommon	Chemical

[3] DCNR Rankings are from the PA DCNR Invasive Plant List that was created to guide management of DCNR lands. Rankings are as follows: Rank 1 – Severe Threat. Exotic [nonnative] plant species that possess characteristics of invasive species and spread easily into native plant communities and displacenative vegetation. Includes species that are or could become widespread in Pennsylvania; Rank 2 – Significant Threat. Exotic [nonnative] plant species that possess characteristics of invasive species but are not presently considered to spread as easily and aggressively into native plant communities as thosespecies listed as Rank 1; Rank 3 – Lesser Threat. Exotic [nonnative] plant species that spread in or neardisturbed areas, and are not presently considered a major threat to undisturbed native plant communities

Map of Invasive Plants White's Woods Nature Center

We note the location of nine of the twelve invasive plants detected at White's Woods. The size of the point represents the density of the invasive population at that location ranging from a single plant (smallest points), to moderate infestations (medium points), to dense infestations (large points).

Map 2: Map of nonnative invasive plants found during surveys of White's Woods in the spring and summer of 2021.



Overview of Common Invasive Plant Management Practices

We summarize the most common invasive plant management techniques used in temperate forest deciduous ecosystems in the eastern United States. Broadly, these techniques fall into the following three categories: mechanical control, chemical control, and biological control. Most nonnative plants will respond to multiple control options. In the "Invasive Species Descriptions" sections below, we outline the current best management options for each species we detected at White's Woods. While the goal of invasive plant management is to reduce the spread and impact of nonnative invasive plants on natural systems, the tools and techniques for managing invasive plants can have unintended consequences. Unintended consequences can include soil disturbance or compaction that might facilitate the spread of further invaders ("secondary invasions"), negatively impact non-target native plant populations in the vicinity, or human health and safety risks such as the application of herbicides. Therefore, for each species' specific management options, we also provide possible unintended consequences that should also be considered when making decisions about what type (if any) management strategy should be undertaken at the site.

Mechanical Control

One of the most common forms of invasive plant management is the physical removal of invasive plants. This can be completed manually with non-mechanical tools like hands, shovels, saws, axes, or other digging and cutting implements or mechanically using tools such as mowing equipment, brush-cutters, or chainsaws. The method is generally most appropriate when the invasive plant population is small or you are treating scattered individuals throughout a site.

Advantages – Manual control methods require minimal training for safe use of equipment and the costs of equipment are low. Mechanical control methods will require increased training to safely use equipment, and for larger equipment may require certification or insurance. While mechanical control methods tend to have a larger need for more labor, many management programs have successfully overcome this hurdle by organizing volunteer workdays with community members and other users of the natural area. Importantly, volunteer workdays can build volunteers' appreciation for the natural area and sense of place. Mechanical control can be quite successful at reducing the size of existing invasive plant populations or eradicating populations with thorough long-term planning and commitment.

Disadvantages – The most common unintended consequence of most mechanical control methods is soil disturbance and/or compaction at the invaded site. Uprooting invasive plants, especially larger woody vines and shrubs, will lead to localized soil disturbance depending on the size of the root system. Use of any heavy equipment will likewise disturb and compact the soils in larger areas and could kill existing vegetation at the site. Disturbed soils and loss of native vegetation are likely to lead to reinvasion of the site, either by new nonnative plants that disperse into the site or reinfestation of the target invaders. Likewise, volunteer work crews can also trample native vegetation while on site, but typically the disturbance caused by human foot traffic is significantly less that soil and vegetation disturbance caused by heavy machinery. Volunteers can avoid trampling sensitive vegetation with proper training and oversight. Finally, invasive plant seeds can be easily dispersed into and out of a management site on large, heavy mechanical equipment or mowers. Soils stuck in tire treads or vegetation caught in mowers can be transported into and out of a management site quite easily.

Mitigation Measures – Well-trained volunteers and site supervisors can keep volunteers out of high-value areas, which can reduce vegetation trampling or soil compaction. Following species-

specific guidelines for properly disposing of harvested plant material and managing invasive plants when they are not actively setting seed or fruiting can reduce the change of unintentional spread of the plant. There are limited means to reduce the impacts of large mechanical equipment on vegetation and soils; however, requiring all motorized vehicles to clean their tire treads or mowers to remove all soil and vegetation can reduce the spread of seeds into a site (by cleaning before entering) or out of a site to a new location (by cleaning before exiting).

Chemical control

Chemical control methods are also quite common for invasive plant management, especially for larger infestations. This method can take the following forms: foliar application where herbicides is sprayed directly on green leaf tissue, basal bark application where herbicide is sprayed directly onto stem bark 12-18 inches from the ground (only for woody trees, shrubs or vines), cut-stump where herbicide is applied to a cut stem near the ground (typically for small trees and shrubs), or hack-and-squirt where herbicide is applied to large cuts made into the plant trunk (only for larger woody trees and shrubs).

Advantages – Chemical control is very effective at reducing or eradicating invasive plants when applied correctly and can reduce the number of years of follow-up treatment for woody invasive plant control. For example, cutting stumps can remove woody trees or shrubs, but most invasive plants will resprout from cut stumps if not treated after cutting and will require multiple years of treatment for effective control. Chemical control methods are typically used for larger infestations or when there is limited labor to achieve effective control mechanically.

Disadvantages – Adding chemicals to a forest can be unsafe for human applicators and other plants and wildlife if applied incorrectly. Some forms of herbicides can impact water quality or soil quality if incorrect forms are used at sites or mixed at the wrong concentrations. Foliar herbicide applications may have the greatest risk of negatively impacting non-target plant at a site because of herbicide drift. Herbicides can also have human health implications if applicators are not wearing proper safety equipment or improperly trained. The application of certain herbicides or in certain areas may be regulated by municipal or state guidelines. More information on pesticide regulation in Pennsylvania can be found here: https://extension.psu.edu/pesticide-laws-and-regulations.

Mitigation Measures – Many conservation and land management organizations safely use targeted chemical control to effectively manage populations of nonnative, invasive species. Groups like Penn State Extension have species' specific established guidelines for selecting the correct type of herbicide, the correct timing of herbicide application, and the correct application rates. Groups can mitigate environmental and human safety risks by following established guidelines for application, working with or hiring someone who is a registered herbicide applicator, and wearing proper safety equipment. A person with appropriate licensing and training should be involved in determining an herbicide treatment plant and always be present when applying herbicides.

Biological control

Biological control methods involve the introduction of predators, parasites, herbivores, or pathogens to attack an invasive plant species. Today, all biological control agents go through an exhaustive regulatory and research program overseen by the US Department of Agriculture (USDA). There are currently no USDA-approved biological control organisms for any of the invasive plant species found at White's Woods.

Invasive Species Descriptions

We provide brief descriptions of all nonnative, invasive plants detected during our surveys. We describe the species, provide a status overview of populations at the site, outline the known ecological economic, or human health impacts of the species, provide viable management options for the species based on our site surveys, and provide links to additional references on identifying and managing the species.

Ailanthus altissima (Tree-of-heaven)

Species description

Tree-of-heaven is deciduous tree that can grow up to 80 feet tall and 6 feet in diameter. The bark is light gray or brownish-green and smooth when young, turning slightly textured and lighter brown-grey as it ages. The leaves of the tree are pinnately compound, and a single leaf can range in size from 1-4 feet. Leaflets are dark green with smooth margins and have two glands at the base of each leaflet that emit a strong, foul odor when crushed. Mature female trees (the plant is dioecious) can produce thousands of wind-dispersed seeds (samaras) each year. Trees also spread through root suckering that can emerge as far as 50 feet from the parent plant. Typically, a single stand of tree-of-heaven stems are the same individual.

Photo 5: Tree-of-heaven seedling near Fulton Run Road trailhead.

Tree-of-heaven can grow in a wide variety of soils, including polluted mine spoils, compacted urban soils, or forest edges (Photo 5). It most quickly colonizes disturbed, high-light areas but can also be found in semi-shaded light conditions. It does not grow in dense shade, such as an intact forest canopy, but can quickly move into interior forests when canopy trees are removed and more light reaches the forest floor.

This plant is native to northeastern and central China and Taiwan. It was first introduced in the late 1700s to the Philadelphia, Pennsylvania area as an ornamental planting. It was initially an economically valuable plant, especially in urban areas where it was touted as a fast-growing ornamental shade tree that could withstand a wide range of soil conditions and poor air quality. However, its aggressive spread through root sprouting and foul-smelling leaves (described by some as “rotting peanut butter”) eventually decreased the popularity of the species as an ornamental tree. It is not sold ornamentally today. The first collected specimen of tree-of-heaven in Indiana County, PA was in 1901 east of Blairsville intersection (Carnegie Museum of Natural History Herbarium, Catalog # CM060564).

Status at White’s Woods

Tree-of-heaven is localized to a single location at White’s Woods (Map 2, Photo 5) near a trailhead entrance along Fulton Road Run, the power lines and the transformer station.

Impacts

Although tree-of-heaven is widely distributed in the eastern United States, it is less frequently viewed as an ecological threat to in-tact forest ecosystems because of its intolerance to dense shade and prevalence in disturbed soils and urban ecosystems.

Ecological – The most frequently cited ecological impact of tree-of-heaven is its potential to reduce the growth of other tree seedlings and plants through the production of several allelopathic compounds in the soil (Gómez-Aparicio and Canham 2008, Sladonja et al. 2015). Researchers have shown in field studies that red maple (*Acer rubrum*), sugar maple (*A. saccharum*), and red oak (*Quercus rubra*) seedlings were smaller and grew more slowly in tree-of-heaven stands relative to tree-of-heaven stands where soil allelopathic chemicals were neutralized (Gómez-Aparicio and Canham 2008). The dense, clonal growth of tree-of-heaven is also implicated in reduced plant diversity in invaded areas. However, because the plant is predominantly found in highly disturbed environments that also tend to have lower plant diversity the relationship between tree-of-heaven abundance and impacts on native plant diversity and abundance are not clear.

The recent introduction of a new nonnative, invasive insect pest—the spotted lanternfly (*Lycorma delicatula*)—has heighted ecologist and foresters concerns about the prevalence of tree-of-heaven in the landscape. Tree-of-heaven is a preferred host to the spotted lanternfly adults (Murman et al. 2020). Adults lay significantly more egg masses and juvenile spotted lanternfly survival and growth rates were higher on tree-of-heaven relative to other native trees (Uyi et al. 2021). Spotted lanternfly feeds on over 70 species of plants in North America, including economically valuable plants for the forestry (maple, oak, walnut, tulip trees), horticultural (willow, birch), and agricultural (apples, grapes, and stone fruits) industries, and can rapidly kills plants through its feeding behavior and secretion of sweet excrement that leads to damaging sooty mold infections on vegetation.

Economic – There has been no formal assessment of the economic costs or benefits of tree-of-heaven in the US. However, because tree-of-heaven serves as a preferred host of the spotted lanternfly, tree-of-heaven is implicated in the extreme economic losses surrounding spotted lanternfly infestations (Urban 2020). For example, vineyards infested with spotted lanternfly can lose up to 90% of their annual grape yield (Murman et al. 2020) and the economic values of vineyards and orchards is $915 million in US states with known lanternfly infestations. Because of the strong association between these two species, land managers are actively managing and targeting tree-of-heaven infestations to reduce population sizes of spotted lanternfly to protect a wide-range of economically valuable plant species (Urban 2020).

Human Health – Likely because of its prevalence in cities around the globe, tree-of-heaven has a range of potential impacts on human health. The tree's pollen is allergenic and can cause allergic responses and respiratory ailments. Sap from the trees can cause a body rash or dermatitis (Sladonja et al. 2015).

Management Options

Tree-of-heaven can be difficult to control because of its clonal nature, tendency to resprout from cut stems, and ease of developing root suckers. Small individual seedlings can be hand-pulled, but not small root suckers off a main plant. Managers report the most effective means for controlling tree-of-heaven is chemical herbicides. For any chemical applications, please see Penn State Extension resources for further details on the types of herbicides and recommended application rates. Management is most successful when treatments are timed correctly and applied over several years.

Chemical (foliar)– Penn State Extension recommends treating low growing trees with foliar chemical spray in late summer as the plant is shunting resources into its root system. Smaller tree-of-heaven stems at White's Woods could be treated with a foliar herbicide.

Chemical (basal bark or hack-and-squirt) – For larger individuals, direct herbicide application to the bark in the late summer is effective and controlling tree-of-heaven that is too tall to apply foliar herbicides. For individuals generally less than six inches in diameter, application

of herbicide 12-18 inches from the ground around the entire stem can girdle a plant. For individuals larger than six inches, “hack-and-squirt” application provides effective control. Using a hatchet, chemical applicators will cut into the bark tissue in regular intervals around the stem and apply herbicide to the cuts. As with foliar application, bark application is most effective when applied in late summer.

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Alliaria petiolata (garlic mustard)

Species description

Garlic mustard is a biennial, herbaceous forb in the mustard family (Brassicaceae). The plant spends its first year as a rosette of dark green, deeply toothed, kidney-bean shaped round leaves. The rosettes can overwinter, and second year plants begin growing new leaves in the early spring (March-April), bolt and flower in late spring (April-May). Second year plants have mature fruits by mid-summer (June-July). Leaves off the flowering stalk tend to be more triangular and have a strong garlic odor when crushed. Garlic mustard flowers are small, white with four petals and found at the top of the bolting stem. Fruits are produced in long, green, branching stems (called siliques) found along the upper half of the bolting stem and the siliques turn brown as the seeds ripen. Second year plants senesce quickly after flowering, but dead stalks can remain standing in the forest through the summer. Individual plants can produce hundreds of seeds that typically fall to the ground below the plant but can also be dispersed during management if dried stalks with seeds are pulled and shaken. Seeds are likely to remain viable in the soil upwards of five years, suggesting that management of established populations will require multiple years of control to exhaust the existing seed bank.

This plant is native to Europe and was thought to be introduced as a potted herb by early English colonists to North America. Young leaves are edible and are sometimes wild harvested. It was first documented in New York State in 1868 and has spread widely within forests and forest edges in the northeastern United States. The first collected specimen of garlic mustard in Indiana County, PA was in 2002 along Crooked Creek near the Thomas Covered Bridge (Carnegie Museum of Natural History Herbarium, Catalog # CM499875).

Status at White's Woods

Garlic mustard is well-established within the forest interior and exterior at White's Woods. We recorded 15 locations of garlic mustard, ranging from a few individuals to larger patches found along slopes adjacent to North 12th street and IUP property (Map 2).

Impacts

Garlic mustard is a well-studied forest invader with hundreds of scientific articles discussing the ecology of the species in its nonnative range.

Ecological – Garlic mustard is typically found in sites with lower plant species diversity, and there is some evidence that garlic mustard can reduce the growth and fitness of nearby forest herbs and woody seedlings through the excretion of an allelopathic secondary chemical compound (sinigrin, a glucosinolate) thorough its roots and decomposing leaf and stem tissue (Cipollini 2016). High levels of sinigrin in the soil are associated with reductions of beneficial mycorrhizal fungi populations, which in turn can reduce the growth of native tree seedlings and perennial herbaceous forbs that rely heavily on these mycorrhizal fungi (Rodgers 2008, Cipollini 2016). Changes to mycorrhizal fungi populations, as well as other soil microbial fauna, can also alter the decomposition rates of leaf litter in invaded forests (Rodgers 2008). Older garlic mustard populations appear to produce reduced amount of allelochemicals relative to younger garlic mustard populations, and some native herbaceous plants (clearweed, *Pilea pumila* and jewelweed, *Impatiens capensis*) have showed adaptive capacity and evolved resistance to the allelopathic impacts of garlic mustard. It is unknown whether other herbaceous species or woody plants have also evolved resistance (Cipollini 2016).

Garlic mustard can also impact food webs in forests. It has been implicated in the population decline of an insect herbivore (the West Virginia white butterfly, *Pieris virginiensis* and the mustard white butterfly, *Pieris napi oleracea*). Garlic mustard is an alternative host for eggs and caterpillars of these butterflies, which would typically use other native species in the mustard

family, but fewer eggs hatch on garlic mustard relative to the preferred native host species (Rodgers et al. 2008). Garlic mustard can increase the abundance of cobweb-building spiders in a forest, which colonize dead garlic mustard stalks for web building. The increased abundance of spider predators leads to decreased abundance of herbivore and parasitoid arthropod species and can increase soil phosphorus levels within garlic mustard patches, which may benefit some native plant species (Smith-Ramesh 2017).

Economic – There has been no formal assessment of the economic costs or benefits of garlic mustard. However, the reduction in tree seedling growth owing to allelopathic chemical production suggests that the plant could affect forest canopy tree regeneration with economic consequences for forests under commercial management.

Human Health – There are no associated human health impacts with garlic mustard.

Management Options

Because garlic mustard can form long-lasting seed banks (>5 years), management will generally require multiple years of treatments to treat germinating seeds from the seed bank.

Mechanical (hand pulling) – Garlic mustard is typically found in moist soils that allows for easy hand pulling of plants and roots. Stems, especially of second-year larger plants, can snap off at the base, leaving roots in the soil; however, because garlic mustard is not known to resprout from the tap root removing stems is an effective control. This method is most appropriate for small or sparsely scattered populations, like at White's Woods, because it has the lowest probability of impacting non-target plants or creating large soil disturbances. First-year plants (rosettes) can be pulled at any time of the year and are most obvious in the early spring when most native plants are still dormant. Second-year plants are ideally pulled before they produce fruit to reduce unintentional seed spread and are most conspicuous while flowering. Hand pulled plants should be placed in trash bags and removed from the site, which reduces the introduction of allelopathic chemicals into the soil and reduces the chances of spreading early matured seeds of fruiting second-year plants.

Chemical (foliar spraying) – Large, dense infestations of garlic mustard may also be treated with glyphosate- or triclopyr-based herbicides. These herbicides degrade in the soil and do not stop germination of seeds from an existing seed bank. Because first-year garlic mustard plants retain the rosette leaves throughout the winter and new leaves emerge very early in the spring, this plant can be treated from late to early spring when most native vegetation is dormant. This reduces accidental treatment of nontarget species.

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Berberis thunbergii (Japanese barberry)

Species description

Barberry is deciduous shrub that grows 2-8 feet tall and can form dense thickets in the forest understory (Photo 6). The most notable aspect of the plant are the short, abundant spines found in sets of three along the entire stem. Barberry leaves are distinct, small, and spatula-shaped that emerge in the early spring (April-May) before canopy tree leaf out, which may allow for the species persistence in closed-canopy forests (Silander and Klepeis 1999). The plant produces small yellow flowers in the spring (April-May), shortly after leaf-out, which are somewhat inconspicuous and dangle below the branches. The plants don't produce fruit until late summer into the fall (August-September), and fruits can remain on the branches through mid-winter. Most fruit falls below mature barberry canopies, but long-range dispersal of fruits is possible as some forest birds including Ruffed grouse, cedar waxwings, American robins, and other thrushes have been observed consuming fruit, although there is limited evidence that it is a preferred food source (Silander and Klepeis 1999).

Photos 6 &7: Barberry patches (top) and individual plants (bottom) were detected at White's Woods

Barberry invasions tend to be associated with second-growth forests that were previous agricultural fields, pasture, or surface mine sites. Notably, the timing of Japanese barberry's rapid spread within eastern North America aligns nicely with the widespread agricultural land abandonment in the mid-20th century. This suggests that many barberry invasions are relics of past land use patterns. While they are shade-tolerant and persist within closed-canopy forests, this also suggests that barberry is perhaps most likely to spread or increase in population size when forest canopies are disturbed, and more light is allowed to reach the forest floor (Silander and Klepeis 1999).

Barberry is native to China and Japan. It was first introduced as an ornamental shrub in the 1875 to the Arnold Arboretum in Boston and was later promoted as a substitute for another nonnative shrub, English barberry (*Berberis vulgaris*) that was susceptible to black stem rust disease (Silander and Klepeis 1999). Japanese barberry is still an ornamental commodity sold widely at home garden centers and frequently planted in commercial and private landscaping. Although it comes in multiple varieties that vary in size and leaf color (red, golden yellow, variegated), offspring of ornamental plants have been detected in nearby forests and appear to readily revert to green-leafed varieties. The first collected specimen of barberry in Indiana County, PA was in 1942 in a cut-over forest near the north end of 15th Street (Academy of Natural Sciences of Drexel University, Catalog # PH00516670).

Status at White's Woods

Mature patches of Japanese barberry are widespread within White's Woods, with the multiple large patches found within the preserve (Map 2). Scattered individual barberry are also found in other sites in the forest (Photo 7) away from dense patches.

Impacts

There are a wide range of potential impacts of barberry invasions in eastern deciduous forests.

Ecological – There are few studies on the impact of Japanese barberry on forest plant communities. Dense barberry patches with >90% aerial cover are associated with significantly lower tree seedling density than nearby uninvaded forested areas (Link et al. 2018), although survivorship of one-month old black cherry (*Prunus serotina*) seedlings was higher in barberry plots relative to uninvaded forested areas or areas where barberry had been managed (Link et al. 2019). However, in a survey of the impact of more scattered, individual barberry plants, there was no evidence that single barberry shrubs reduced native plant diversity or abundance (Flinn et al. 2014).

Barberry invasions are also associated with changes to soil food webs and soil nutrient cycles. Predatory arthropods are less frequent in barberry stands, suggesting that the species might alter soil food webs by reducing their complexity (Clark and Seewagen 2019). Likewise, the presence of barberry leaf litter can decrease soil fungal abundance, increase soil bacteria abundance, and increased litter decomposition rates, which all can lead to faster nutrient cycling and reduced leaf litter on the forest floor (Elgersma and Ehrenfeld 2011). Increasing nutrient cycling in invaded sites is common and is generally associated with higher abundance and diversity of other invasive plants.

Economic – While there are no comprehensive assessments of the economic costs or benefits of Japanese barberry in the US, barberry is an economically valuable plant to the horticulture industry. In 2019, the USDA Census of Horticultural Specialties assessed barberry crops were valued $21,253,000 within the US (USDA National Agricultural Statistics Service 2019). Natural areas invaded by barberry may impose economic costs to communities. Because barberry invasions in forests may increase risks of contracting Lyme disease or other tick-borne illnesses (see below), communities with recreation areas containing dense barberry stands may also bear the costs of higher human infection rates and associated health care costs. Environmental economists argue “cost of illness” studies can help weigh restoration costs against community health costs of infection to aid in management decision-making (Morlando et al. 2012).

Human Health – Blacklegged ticks (*Ixodes scapularis*), which vector the bacteria (*Borrelia burgdorferi*) that causes Lyme disease in humans, are more abundant and have a higher probability of infection *Borrelia* bacteria in patches of Japanese barberry relative to uninvaded areas of the forest. Management of barberry shrubs reduced number of ticks and prevalence of Lyme disease to levels of uninvaded areas (Williams et al. 2017).

Management Options

Japanese barberry is troublesome to control because of its sharp spines and large taproot. Please see Penn State Extension Fact Sheet for more details on appropriate herbicides, application rates, and safety information.

Mechanical (hand-pulling)– Small seedlings of barberry can be easily hand-pulled (heavy gloves highly recommended!). Larger, more mature plants may require a hoe, mattock, or specialized tool (the UpRooter ®, https://www.theuprooter.com or the Extractigator ®, https://extractigator.com) for uprooting deep shrub tap roots. This form of management is highly labor intensive and is typically recommended for smaller infestations.

Chemical (foliar) – Because of Japanese barberry’s extended leaf phenology relative to most native species (early leaf-out in the spring, delayed leaf senescence in the fall), foliar chemical sprays can be applied while other forest plants are dormant and reduce non-target plant impacts.

Chemical (basal bark) – For larger individuals, direct herbicide application to the bark 12-18 inches above the soil is effective any time throughout the year.

Mechanical+ (cut-stump + stump treatment) – For larger individuals, barberry stems can be cut near the soil surface and the top shoots and stems can be removed. This immediately removes the upper canopy of the shrub and may allow for quicker recovery of native plants. Removed brush can be taken off-site for mulching or composting or can be piled or spread around the forest. If shrubs have mature fruits on them, taking off site is not recommended as it may further the spread of the plant to new locations. Cut stumps will resprout if they are not treated after cutting. Using a small amount of herbicide applied immediately after cutting has the highest mortality rate (~90% of treated stems) but use of a directed propane flame torch (100,000 BTU) caused high mortality as well (~40% of treated stems; Ward et al. 2009). Note that cut stump herbicide application decreases the total amount of herbicide applied in a forest relative to foliar application.

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Celastrus orbiculatus (Asiatic bittersweet)

Species description

Bittersweet is deciduous woody vine that can be found as a dense groundcover or climbing up and over 50-foot trees. The stem diameter of mature vines can reach up to 4 inches and can strangle tree or shrub trunks and smoother tree canopies. Bittersweet leaves are round, glossy, and finely toothed. The plant's flowers are green and inconspicuous and unripe fruits are a dull yellow color. Once the fruit mature, usually in the fall, the yellow fruit casing split open to reveal a bright red, fleshy fruit that remain on the vine through early winter. Wildlife eat and disperse the fruits but humans also collect the fruiting vines for indoor fall decorations (wreaths, flower bouquets, etc.) that spread the plant to new locations.

Photo 8: Asiatic bittersweet vines on forest floor near 12th street entrance of White's Woods. Native vine American hog peanut also present in photo (lighter green leaves with three leaflets).

Dense bittersweet patches are most common in high-light forest edges, open fields, or canopy gaps. However, once established, the vine can penetrate from the forest edge into closed canopy forest and persist as a dense understory vine. In open fields, bittersweet invasions can arrest succession to forested communities and turn open areas into 'vinelands' (Fike and Niering 1999). There is some evidence that bittersweet has a higher chance of establishment in certain habitat types. A field experiment in New Jersey forests found that bittersweet seed germination and survival was higher in post-agricultural forests dominated by tulip poplars (*Liriodendron tulipifera)* relative to non-disturbed forests dominated by oaks (*Quercus* spp.), which may have been driven by higher soil moisture in tulip poplar forests (Kuhman et al. 2013). Conversely, a study in northern Michigan found that bittersweet germination rates were higher in oak-hickory forests relative to oak forests and beech-maple forests (Leicht-Young et al. 2013). Bittersweet vine can be one of the first nonnative plants to establish and spread quickly after timber harvesting because of its quick growth.

Bittersweet is native to eastern China, the Korean peninsula, and Japan. The introduction history of the plant is unclear but the plant was likely first introduced in the latter half of 19th century. However, the plant did not start spreading and invading natural habitats until the 1960s after the National Arboretum in Washington, D.C. widely distributed the plant to nurseries in 30 US states (McKenzi-Gopsill and MacDonald 2021). The first collected specimen of bittersweet in Indiana County, PA was in White's Woods in 2009 in the same location we found plants - along the 12th street trailhead entrance (Carnegie Museum of Natural History, Catalog #CM521409).

Status at White's Woods

Bittersweet is uncommon at White's Woods and was only detected at a single location near the 12th Street trailhead entrance (Map 2).

Impacts

There are a wide range of ecological impacts of bittersweet invasions in eastern deciduous forests.

Ecological –

Bittersweet has been documented as affecting native plant communities, soil characteristics, and ecosystem processes. Riparian forests invaded by bittersweet are associated with

decreased native plant richness, abundance, and diversity (Browder 2011). Bittersweet leaf litter is higher in nitrogen than the leaf litter of many native species and increased bittersweet leaf litter on the forest floor can lead to increased soil nitrogen levels, soil pH, and rates of nitrogen mineralization (Leicht-Young et al. 2015).

Economic – There is no comprehensive assessment of the economic impacts of bittersweet in forested ecosystems. Large invasions could impede canopy tree growth and regeneration, although the evidence for the impact of bittersweet on the growth economically valuable trees is limited and mixed (Horton et al. 2014, Ladwig and Meiners 2009). While the plant was once available for purchase, it is infrequently sold today. However, there is evidence that many garden retailers selling native American bittersweet (*Celastrus americana*) are mislabeling and selling the nonnative, invasive *C. orbiculatus* (Zaya et al. 2017). The two species can be distinguished when flowering and fruiting; the native vine will only have flowers and fruits at the terminal end of each branch while the nonnative invasive can flower and fruit all along the stem.

Human Health – There are no known human health impacts of bittersweet.

Management Options

Bittersweet can be difficult to control when it is wrapped around the stems of other woody plants or the vine's canopy is high in the tree canopy. For these reasons, most management strategies focus on chemical application. Please see Penn State Extension Fact Sheet for more details on appropriate herbicides, application rates, and safety information.

Mechanical (cutting) – A single bittersweet plant can have multiple stems that wind around multiple trees or shrubs. Cutting a "window cut" of each vine stem (one cut near the ground and another cut 2-3 feet up the vine) can effectively kill the vine canopy. After cutting, do not try to pull vines out of the tree canopy, as it may cause more damage to the host tree. Cut stumps of vines will resprout vigorously after cutting if not treated with herbicide.

Chemical (foliar) – Spraying the leaves of bittersweet that is growing as ground cover or new resprouts after cutting the vine's main stem can provide good control of plants. Care should be taken to reduce the chance of applying herbicides to non-target plant species, and it is not recommended to spray foliage of mature vines that are climbing living vegetation.

Chemical (cut-stump) – For larger individuals, bittersweet stems can be cut near the soil surface and immediately treated with a small amount of herbicide to reduce resprouting. Note that cut stump herbicide application will introduce lower total herbicides on the landscape because of its direct application.

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Elaeagnus umbellata (Autumn olive)

Species description

Autumn olive is deciduous shrub or small tree that grows up to 20 feet tall. It can form dense thickets, but typically in open, high-light habitats along forest edges, roadsides, or abandoned fields (Photos 9 &10). The leaves of the plant are narrow lance-shaped, dark green on top, and distinctively silver on the underside with visible scales. Yellow flowers appear shortly after the plant's leaves emerge in the spring (May-June) and mature into red fruits in the late summer that are dispersed by birds and sometimes mammals. The fruits also have silver scales on them once ripe and are sometimes collected by humans for jams and preserves. This too can spread the species if human-collected berries are improperly disposed of or placed in household garbage or compost. The stems of the plant are grey-brown, very flexible, and often have thorns. Autumn olive can form mutualistic affiliations with nitrogen-fixing bacteria in soils (*Frankia* spp.) depending on the site and soil conditions.

Photos 9 & 10: Autumn olive at White's woods. An individual shrub at the forest's edge near the Fulton Street trailhead (top) and a larger patch, likely intentionally planted, near a gas wellhead in the forest interior.

Autumn olive is native to eastern China and Japan. It was first introduced as an ornamental shrub in the 1830s and was extensively promoted by the US Soil Conservation Service (now, US Natural Resources and Conservation Service) as a good plant for wildlife and windbreaks (Allan and Steiner 1972, Dittberner et al. 1992). It began spreading from cultivation in the mid-20th century, and now is considered an extremely problematic invader in riparian woodlands where it forms dense, impenetrable stands. There first recorded specimens of Autumn olive in Indiana County, PA was in 1993 in Conemaugh Township approximately 2 km northeast of Tunnelton (Carnegie Museum of Natural History, Catalog # CM388565).

Status at White's Woods

There are two large patches of mature Autumn olive in open canopy areas near gas wells within White's Woods and a few scattered individuals around the forest edge (Map 2). Based on their arrangement and dense planting, these individual olive trees might have been intentionally planted near the gas wells to provide a windbreak or screen the wells from view.

Impacts

Autumn olive is typically found in open, high light environments in open fields, canopy openings within forests, or along forest edge and rarely deep in the forest interior. Though common, there is limited knowledge on the ecological, economic and human health impacts of this species.

Ecological – Autumn olive is a nitrogen-fixing woody tree with leaf litter that is higher in nitrogen than most native forest species. These traits lead to increased plant-available nitrogen (ammonia and nitrate) in soils near autumn olives, and also are linked with changes in the composition of soil bacterial communities (Malinich et al. 2017).

Autumn olive fruits appear to be a preferred food source for European Starlings and American Robins, over other nonnative fruit and native fruit common in forest ecosystems. This suggests that birds may disproportionately spread autumn olive over other species into new areas in the forest (Lafleur et al.2007). However, migratory songbirds appear to prefer high-fat fruit in the Fall prior to migration, and Autumn olive fruits are high carbohydrate but low fat and may be of lower nutritional value for migratory versus resident bird species (Smith et al. 2007). Autumn olive fruit is also edible to humans, and some people harvest the fruit to make jams and preserves. However, we recommend extreme caution if harvesting autumn olive fruit as humans can also aid in the dispersal of the plant if collected seeds are dropped, lost, or put into home compost bins.

Economic –There are no comprehensive assessments of the economic costs or benefits of Autumn olive in the US, or specifically in the northeastern US.

Human Health – There are no known human health impacts of Autumn olive.

Management Options

Management of autumn olive is similar to management of other woody invasive shrubs. Please see Penn State Extension Fact Sheet for more details on appropriate herbicides, application rates, and safety information.

Mechanical (hand-pulling) - Small seedlings of Autumn olive can be hand-pulled, but this species can resprout from remaining roots. For this reason, larger individuals tend to be too hard to remove because of the large root system.

Chemical (foliar) – Foliar herbicides are effective when applied mid-May through the summer, before Autumn olive leaves begin to change color. While effective, this method has more potential for herbicide drift to non-target plants and a more limited application window than other chemical treatment options.

Chemical (basal bark) – For larger individuals, direct herbicide application to the bark 12-18 inches above the soil is effective for controlling mature Autumn olive. This can be done any time throughout the year.

Chemical (cut-stump) – For larger individuals, Autumn olive stems can be cut near the soil surface and the top shoots and stems can be removed. This immediately removes the upper canopy of the shrub and may allow for quicker recovery of native plants. Removed brush can be taken off-site for mulching or composting or can be piled or spread around the forest. If shrubs have mature fruits on them, taking off site is not recommended as it may further spread of the plant. Cut stumps should be treated with a targeted herbicide application to prevent resprouting, as this provides better long-term control of the plant (Franke et al. 2018).

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Euonymus alatus (Burning bush, winged euonymus)

Species description

Burning bush is deciduous shrub that can grow up to 20 feet tall and can produce dense thickets in some forested settings, primarily southern New England states. The most notable characteristics of the plant is its corky ridged stems and the fuchsia-colored leaves in the fall. The shrub is one of the earlier shrubs to leaf out in the spring and holds its leaves longer than most native shrubs in the fall. The plant produces small, inconspicuous, yellow-green flowers in the in the early spring and bright red fruit in the late Fall.

Burning bush is native to central and northeastern China and Japan. It was first introduced as an ornamental shrub in the 1860 and is still an ornamental commodity sold widely at home garden centers and frequently planted in commercial and private landscaping. Although it comes in multiple varieties and cultivars, nearly all of them produce hundreds to thousands of seeds each year with a ~30% germination rate (Brand et al. 2012). The first collected specimen of burning bush in Indiana County, PA was in 2012 along the Conemaugh River at the foot of High Street in Saltsburg, Conemaugh Township (Carnegie Museum of Natural History, Catalog # CM526598).

Photo 11: Single burning bush shrub in wood interior near Fulton Run Road trailhead. Note deer browse line where deer have over-browsed lower branches.

Status at White's Woods

Burning bush was uncommon at White's Woods with scattered mature individuals detected at four locations around the property (Map 2, Photo 11). Burning bush is a preferred shrub by white-tailed deer, which can prevent the spread and development of dense burning bush patches (Faison 2013) and it is likely that the high deer population is preventing population growth and expansion of burning bush at this site. Should deer population density be reduced at the site, this plant may be expected to spread with reduced browsing pressure unless mature, fruiting individuals are removed to reduce the seed source within the forest interior.

Impacts

There is limited information on the impacts of burning bush.

Ecological – There are very few studies on the ecological impact of burning bush in deciduous forests. Burning bush appears to be a preferred food for white-tail deer (Faison 2013, Photo 11), which may control spread of burning bush in forests with high-density deer populations. Burning bush is also a potential food source for the nonnative, invasive gypsy moth (*Lymantria dispar*) and could sustain high gypsy moth populations during outbreaks (McEwan et al. 2009).

Economic – While there are no comprehensive assessments of the economic costs or benefits of burning bush in the US, it is an economically valuable plant to the horticulture industry. In 2019, the USDA Census of Horticultural Specialties assessed euonymus crops were valued $28,649,000 within the US (USDA National Agricultural Statistics Service 2019). Although this value includes other *Euonymus* species including a closely related nonnative, invasive vine *E. fortunei* (wintercreeper), a nonnative shrub *E. japonicus* (golden euonymus) as well as native *Euonymus* shrubs *E. atropupureus* (eastern wahoo) and *E. americanus* (strawberry bush), burning bush is by far the most commonly sold *Euonymus* species in the horticultural trade.

Human Health – There are no known human health impacts of burning bush.

Management Options

Because burning bush does not typically form dense stands in southwestern Pennsylvania, management of the species can be less work than other nonnative, invasive shrubs. Please see Penn State Extension Fact Sheet for more details on appropriate herbicides, application rates, and safety information.

Mechanical (hand-pulling)– Small burning bush seedlings can be easily hand-pulled. Larger, more mature plants may require a hoe, mattock, or specialized tool (the UpRooter ®, https://www.theuprooter.com or the Extractigator ®, https://extractigator.com) for uprooting shrub tap roots. This form of management is highly labor intensive and is typically recommended for smaller infestations.

Chemical (foliar) – Because of burning bush's extended leaf phenology relative to most native species (early leaf-out in the spring, delayed leaf senescence in the fall), foliar chemical sprays can be applied while other forest plants are dormant and reduce non-target plant impacts.

Chemical (basal bark) – For larger individuals, herbicide application to the bark 12-18 inches above the soil is effective any time throughout the year.

Chemical (cut-stump) – For larger individuals, burning bush stems can be cut near the soil surface and the top shoots and stems can be removed. This immediately removes the upper canopy of the shrub and may allow for quicker recovery of native plants. Removed brush can be taken off-site for mulching or composting, or can be piled or spread around the forest. If shrubs have mature fruits on them, taking off site is not recommended as it may further spread of the plant. Cut-stumps will resprout if they are not treated after cutting.

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Ligustrum vulgare (European privet)

Species description

European privet is semi-evergreen shrub that can grow up to 20 feet tall and prefers moist soils and riparian areas. The plant's leaves are small, dark green, and smooth and can remain on the shrub throughout the winter. The plant produces white flowers in the summer (June and July) and fruit that turn dark blue in the late summer and fall (September-October). Fruits remain on the plant through the winter and into the following spring. The plant is difficult to distinguish from Chinese privet (*Ligustrum sinense)* and can only be distinguished when flowering. Chinese privet is much more common in the southeastern United States while European privet is more common in the northeastern United States.

European privet is native to Europe, Morocco, and western Asia and was originally introduced as an ornamental shrub for hedge rows. There are no recorded herbarium specimens of European privet in Indiana County, PA. The first records of the species in the region were in 1982 at Powdermill Nature Preserve in Westmoreland County (Carnegie Museum of Natural History, Catalog #CM285011) and in 1992 in Crooked Creek Lake State Park in Armstrong County (Carnegie Museum of Natural History, Catalog #CM473430).

Status at White's Woods

Privet was uncommon in White's Woods and only detected in two locations, one along the 12th Street trailhead and another group of individuals on the slopes above Story Run creek (Map 2). White-tailed deer forage on privet year-round and it is a preferred food source over other nonnative, invasive plants including plants found at White's Woods like garlic mustard, Japanese barberry, and Japanese stiltgrass (Averill et al. 2016). Intense deer browse pressure may be preventing the spread of privet at White's Woods.

Impacts

There is limited research on the impacts of European privet in forested ecosystems.

Ecological – There is some evidence that European privet changes the composition and abundance of beneficial soil organisms. In a greenhouse experiment, native plants had lower colonization of roots by beneficial arbuscular mycorrhizal fungi when soils had previously held privet plants relative to soils without privet growing (Shannon et al. 2014).

Economic – There are no comprehensive assessments of the economic costs or benefits of European privet in the US.

Human Health – There are no known human health impacts of European privet.

Management Options

Managers have many options for controlling privet in forests. Please see Penn State Extension Fact Sheet for more details on appropriate herbicides, application rates, and safety information

Mechanical (hand-pulling)– Small privet seedlings can be hand-pulled, but it is sometimes difficult to remove the larger tap root system. Larger, more mature plants may require a hoe, mattock, or specialized tool (the UpRooter ®, https://www.theuprooter.com or the Extractigator ®, https://extractigator.com) for uprooting deep shrub tap roots. This form of management is highly labor intensive and is typically recommended for smaller infestations.

Chemical (foliar) – Because of privet's extended leaf phenology relative to most native species (early leaf-out in the spring, delayed leaf senescence in the fall), foliar chemical sprays can be applied while other forest plants are dormant and reduce non-target plant impacts.

Chemical (basal bark) – For larger individuals, direct herbicide application to the bark 12-18 inches above the soil is effective for controlling mature privet plants. This can be done any time throughout the year.

Chemical (cut-stump) – For larger individuals, privet stems can be cut near the soil surface and the top shoots and stems can be removed. This immediately removes the upper canopy of the shrub and may allow for quicker recovery of native plants. Removed brush can be taken off-site for mulching or composting or can be piled or spread around the forest. If shrubs have mature fruits on them, taking off site is not recommended as it may further spread of the plant. Cut stumps will resprout if they are not treated after cutting, and a small amount of herbicide can be applied directly after cutting to reduce the chance of resprouting. Note that cut-stump herbicide application will introduce lower total herbicides on the landscape because of its direct application.

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Lonicera japonica (Japanese honeysuckle)

Species description

Japanese honeysuckle is a perennial evergreen to semi-evergreen vine that is typically found trailing along the forest floor. In high light areas of the forest like canopy gaps or forest edges, it can twirl and grow up and around other plants creating a dense mat of vines (Schierenbeck 2004). Leaves are light green, slightly pubescent, and oval. Some leaves may be lobed. The vine produces very fragrant yellow and white flowers in summer (April to July) and again in the fall (September to November). Fruit production is typically lower than flower production on the plant, but dark blue to black berries appear in late summer on some plants and are eaten and dispersed by a many forest birds.

Japanese honeysuckle is native to eastern China, Korea, and a Japan and was first introduced to the US in the early 19th century. It was previously planted throughout the eastern US as an ornamental vine and for erosion control and wildlife habitat. The first record of the species in the county was in 1995 along Reynolds Road ~1 mile from PA 259 and Blairsville (Carnegie Museum of Natural History, Catalog #CM399709).

Status at White's Woods

Japanese honeysuckle was uncommon in White's Woods and only detected in scattered places during initial spring surveys.

Impacts

Ecological – There is some evidence that sites with heavy Japanese honeysuckle infestations can have reduced native plant diversity and abundance, and that disturbance to the canopy cover can increase the growth and size of honeysuckle vine populations (Larson et al. 2007, Schierenbeck 2004). Some foresters report that honeysuckle vines can prevent tree seedling regrowth after harvesting (Larson et al. 2007, Schierenbeck 2004). Honeysuckle leaves and vines are a preferred food source for white-tailed deer, while the berries are eaten by a variety of forest birds (Munger 2002).

Economic – There are no comprehensive assessments of the economic costs or benefits of Japanese honeysuckle in the US. Although Japanese honeysuckle is available for sale online and at some nurseries, a 2004 estimate of its economic value in Florida found that its value was less than 1% of the total horticultural industry sales (Wirth et al. 2004).

Human Health – There are no known human health impacts of Japanese honeysuckle.

Management Options

Because of the trailing and climbing nature of this plant, it typically grows interspersed among other vegetation making management of the species more difficult than other invaders than grow in dense monoculture patches.

> *Chemical (foliar)* – Japanese honeysuckle has an extended leaf phenology (early leaf out in the spring, delayed leaf senescence in the fall) relative to other native species and sometimes retains its leaves throughout the winter. Foliar chemical sprays can be applied while other forest plants are dormant and reduce the chances of non-target plant impacts. The Missouri Department of Conservation has a fact sheet with more details on appropriate herbicides, application rates, and safety information (https://mdc.mo.gov/trees-plants/invasive-plants/japanese-honeysuckle-control).

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Microstegium vimineum (Japanese stiltgrass)Species description

Stiltgrass is a shade-tolerant annual grass species (Poaceae) that can grow up to three feet high by the end of the summer. It can grow in upland forests, but it typically is found in moister microsites and along trails and roads through forests (Photo 12). Seedlings begin germinating in late spring or early summer (May), but plants do not reach full maturity to fruit and flower until late summer or early Fall (August-September). The leaves are usually a pale green, long and lance shaped, with a shiny grey or white line along the midrib. The plant stalks and leaves senesce and turn brown in the Fall and are very slow to decompose leaving a notable layer of hay-like thatch on the landscape through winter and early spring. Individual plants can produce hundreds of seeds that typically fall to the ground below the plant but can also be dispersed during management if grass stalks with seeds are pulled and shaken. Seeds are likely to remain viable in the soil upwards of three years, suggesting that management of established populations will require multiple years of control to exhaust the existing seed bank. The modes of seed dispersal are unknown, but the plant is known to move quickly (1-2 years) into forest interiors along logging trails and establish large populations in logged areas of forests. It is likely that seeds, carried in mud in tire treads of vehicles, is major local source of seed dispersal.

Photos 12 &13: Dense patches of stiltgrass line most of the trails within White's Woods (top) with barely any other vegetation growing within patches (bottom).

This plant is native to eastern Asia and was first identified in Tennessee in 1919. It is thought to have arrived accidentally within packing material. Since its introduction, the species has spread widely within forests and forest edges and is now found from Florida to Vermont and New Hampshire. The first collected specimen of stiltgrass in Indiana County, PA was in 2008 along Black Lick Creek west of Josephine, Center Township (Carnegie Museum of Natural History Herbarium, Catalog # CM469167).

Status at White's Woods

Stiltgrass is widespread throughout much of the forest interior and exterior at White's Woods, including along major trail corridors and near existing infrastructure (wells) at the site. Most of the populations are robust, dense, and contain few other native plants (Photo 13). We recorded 33 locations of stiltgrass patches found along trails especially larger trails and near gas wells (Map 2).

Impacts

Stiltgrass is a well-studied forest invader with hundreds of scientific articles discussing the ecology of the species in its nonnative range.

Ecological – Stiltgrass is common in disturbed locations, including riparian areas with river scour, or areas disturbed by human foot or vehicle traffic, or recently logged forests. Winter leaf litter disturbance is also associated with increased invasion potential of the grass (Oswalt et al. 2007, Oswalt and Oswalt 2010). Heavy stiltgrass infestations are associated with lowered plant diversity and abundance and its annual growth habit allows populations to rapidly expand and create dense monospecific stands that can suppress natural native plant regeneration—including native trees, shrubs, forbs, and grasses—in disturbed forests (Oswalt et al. 2007, Oswalt and Oswalt 2010). One way stiltgrass may suppress native plant germination and growth is through the creation of a thick thatch layer of dead stiltgrass stems that are slow to decompose and can build-up through time. A dense thatch layer can reduce germination or emergence of native forbs, change the soil microclimate to cooler and wetter, and potentially increase levels of certain plant pathogens in the soil (Benitez et al. 2021). There is mixed evidence of the impact of stiltgrass invasions on arthropods, with one study showing increases in diversity and abundance of arthropods in invaded relative to uninvaded forest areas (Landsman et al. 2020) and one study showing decreases in diversity and abundance of arthropods in experimentally invaded areas relative to areas with higher native plant diversity (Simao et al. 2010).

Stiltgrass also is also associated with a range of impacts on forest soil nutrients and carbon. Stiltgrass can increase rates of litter decomposition and carbon cycling, which can lead to lower quantities of total carbon stored in forest soils (Strickland et al. 2010, Craig et al. 2015). Stiltgrass invasions also increases rates of soil nitrification in forests, which can create a positive feedback loop that benefits the growth of *Microstegium vimineum* plants over native forest herbs (Lee et al. 2012). The likelihood of changes to soil nutrients and carbon cycle can depend on multiple features of the invaded forest, including its prior land-use history, the types of tree species at the site, and levels of continued soil disturbance (Craig et al. 2015, Lee et al. 2012).

Economic – There has been no formal assessment of the economic costs or benefits of stiltgrass. The reduction in tree seedling growth and regeneration could impact commercially managed forests (Oswalt et al. 2007), while declines in soil carbon pools in invaded areas may decrease the ecosystem services provided by invaded forests.

Human Health – There are no associated human health impacts with stiltgrass. However, there is evidence that survival of the lone start tick (*Amblyomma americanum*) and American dog tick (*Dermacentor variabilis*)—two species that vector multiple human diseases—is lower in areas invaded by stiltgrass relative to uninvaded areas (Civitello et al. 2008)

Management Options

Stiltgrass is extremely difficult to control because of its annual growth form and ability to establish long-lasting seed banks (>3 years). Management of established populations will generally require multiple years of treatments to continue removal of germinating seeds from the seed bank. No matter the management option, because this plant is an annual, treatment should occur before late August when flowers and fruits begin to develop. Treatment after this period is more likely to spread seeds or have limited effect on population growth. By far the best management option is to reduce or prevent the further spread of the species by establishing early-detection protocols that can remove new plants found in new areas of the forest, where a seed bank has not established. Additionally, the species will respond quickly to increased light availability when canopy trees are disturbed or removed (through natural tree fall or intentional tree harvesting) by increasing the population size and density of individuals within a patch. The references, below, provide more detailed information on the timing and application of each management option.

Mechanical (hand pulling) – Stiltgrass is typically found in moist soils, which allows for easy hand pulling of plants and roots. This method is most appropriate for small patches of stiltgrass, but many of the stiltgrass patches at White's Woods are large enough that this method may not be feasible. Plants will generally not reach a large enough size to hand-pull until mid-summer, and if pulled early a second flush of germinating seeds will likely emerge. Pulled plant material can be left in the forest (it will create a thatch layer), which will reduce the likelihood of spreading stiltgrass seeds to new sites. Hand weeding can reduce stiltgrass abundance at the end of each growing season, which allows for recovery of native plants. However, hand weeding requires multiple years of effort to successfully reduce stiltgrass populations through time (Flory 2010).

Mechanical (mowing or cutting) – Stiltgrass can also be mowed or cut along the stalks, but this treatment must be completed during a small time window that is late enough in the growing season that the plant does not have time to resprout from cut stems but before the plant begins producing flowers and fruit. Penn State Extension reports that hand-held string trimmer is more effective than mowing equipment at reducing regrowth of cut stalks. All mowing equipment should be cleaned well on site to reduce the likelihood that seeds will be transported off site. Note that larger mowing equipment may also move soil with seeds stuck in wheels or tire treads.

Chemical – Penn State Extension has detailed protocols for applying pre-emergent herbicides to the soils to reduce germination in the seed bank and post-emergent foliar sprays for stiltgrass. However, pre-emergent herbicides are likely to affect any plant seeds (native or nonnative) within the soil seed bank and suppress natural regeneration (Flory 2010). Likewise, because stiltgrass actively grows when many native plants are active, foliar spray may have a higher likelihood to also impact non-target plants growing within or near stiltgrass patches.

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Rhodotypos scandens (jetbead)

Species description

Jetbead is a deciduous shrub that can grow up to 6 feet tall and is highly tolerant of deep canopy shade. The plant's leaves are dark green with deep ribbed veins and doubly serrate edges. The plant produces large, four-petaled white flowers in the spring and distinctive, red fruit that turn black and bead-like in the late summer. The fruits tend to grow in sets of four.

Jetbead is native to eastern Asia and was originally introduced as an ornamental shrub. There are no recorded herbarium specimens of jetbead in Indiana County, PA and few records outside of Allegheny County in southwestern PA. The first record of the species in the region was in 2017 in Upper Burrell Township of McIntrye Lane in Westmoreland County (Carnegie Museum of Natural History, Catalog #CM534660).

Photo 14: Jetbead growing in the woods near the Fulton Run Road trailhead.

Status at White's Woods

Jetbead was uncommon in White's Woods and only detected around the transformer station and trailhead near Fulton Run Road.

Impacts

There is no research on the ecological, economic, or human health impacts of jetbead in forested ecosystems. There are many reports of dense stands of jetbead in closed-canopy forests in southeastern Pennsylvania (Albrecht 2001), New York City and southern Hudson Valley, and jetbead is on the "watch list" for the mid-Atlantic states (Swearingen et al. 2010)

Management Options

There is limited specific information on the management of jetbead in forested ecosystems. It is reasonable to assume that it will respond similarly to the following management techniques used for other nonnative, invasive woody shrubs. Please see Penn State Extension Fact Sheet and the Lower Hudson Partnership for Regional Invasive Species Management (PRISM) for more details on appropriate herbicides, application rates, and safety information.

Mechanical (hand-pulling)– Small seedlings or saplings can be hand-pulled, but it is likely difficult to remove the larger tap root system of bigger plants. Larger, more mature plants may require a hoe, mattock, or specialized tool (the UpRooter ®, https://www.theuprooter.com or the Extractigator ®, https://extractigator.com) for uprooting deep shrub tap roots. This form of management is highly labor intensive and is typically recommended for smaller infestations.

Chemical (foliar) – Foliar chemical sprays can be applied to green leaf tissue but may need to be repeated multiple times during the growing season.

Chemical (basal bark) – For larger individuals, direct herbicide application to the bark 12-18 inches above the soil is effective for controlling mature plants. This is recommended to be done between July and September.

Chemical (cut-stump) – For larger individuals, jetbead stems can be cut near the soil surface and the top shoots and stems can be removed. This immediately removes the upper canopy of the shrub and may allow for quicker recovery of native plants. Removed brush can be taken off-site for mulching or composting or can be piled or spread around the forest. If shrubs have mature fruits on them, taking off site is not recommended as it may further spread of the plant. Cut stumps will likely resprout if they are not treated after cutting, and a

small amount of herbicide can be applied directly after cutting to reduce the chance of resprouting. Note that cut-stump herbicide application will introduce lower total herbicides on the landscape because of its direct application.

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Rosa multiflora (Multiflora rose)

Species description

Multiflora rose is deciduous shrub with large, recurved thorns growing along arching, wandering stems. Typically growing as a shrub, the stems can sometimes act like vines and climb over vegetation or up trees. The shrubs can form, dense, impenetrable thickets in fields, forest edges, or sometimes closed canopy forests. The leaves are divided into 5-11 sharply toothed leaflets with distinctive fringed leaf stipules that look like eyelashes. The shrub is one of the earliest to leaf out in the spring. The shrub produces large white flowers prolifically in mid-spring (May) that develop into bright red fruit in the last summer (August) than can persist on the shrub through the fall (October).

Multiflora rose is native to eastern China, the Korean peninsula, and Japan. It was first introduced as rootstock for other ornamental roses in 1866. It was later promoted by the US Soil Conservation Service in the mid-1900s as 'living fences' for fields to confine livestock and for erosion control. It is today common in secondary forests that were formerly agricultural pastureland in the mid-1900s. The first collected specimen of multiflora rose in Indiana County, PA was in 1993 in a disturbed field 2 km west of Tunnelton, Conemaugh Dam (Carnegie Museum of Natura History, Catalog # CM484020).

Status at White's Woods

Mature multiflora roses are found in scattered locations in the eastern side of White's Woods, including near the 12th street trailhead (Map 2).

Impacts

There is limited research on the impact of multiflora rose on forested ecosystems.

Ecological – Dense multiflora rose stands are associated with decreased leaf litter layers on the forest floor (Adalsteinsson et al. 2016), although the reason for this association has not been determined.

Economic – Although originally introduced in the US for ornamental horticultural purposes, multiflora rose is no longer sold today as an ornamental plant. There is no comprehensive economic impact assessment of this species.

Human Health – As with other invasive woody shrubs, dense thickets of multiflora rose can increase the infection rates of ticks carrying the bacterium that causes Lyme disease in humans (*Borrelia burgdorferi*). However, while tick infection rates are higher in forests invaded by multiflora rose, lower amounts of leaf litter covering the forest floor associated with lower number of total ticks in invaded forests (Adalsteinsson et al. 2016, Adalsteinsson et al. 2018).

Management Options

Large infestations of multiflora rose can hard to control because of the longevity of seeds in the seed bank (estimated to up to 20 years) and potential for resprouting root and stem fragments. Please see the Penn State Extension Fact Sheet for more details on appropriate herbicides, application rates, and safety information.

Mechanical (hand-pulling)– Small seedlings of multiflora rose can be hand-pulled (heavy gloves highly recommended to protect hands from thorns). The entire root system of the shrub needs to be removed to prevent resprouting, and this method is only recommended for infestations that are small or young.

Chemical (foliar) – Rose responds to foliar chemical herbicides at any time during the year. Sprawling, mature plants can be cut once before treating, allowed to resprout, and then

treated. Cutting first can stress the plant and make foliar treatment more effective. Applicators should take care to avoid application of herbicide to nearby plants.

Chemical (cut-stump) – For larger individuals, multiflora rose stems can be cut near the soil surface and the top shoots and stems can be removed. This immediately removes the upper canopy of the shrub and may allow for quicker recovery of native plants. Removed brush can be taken off-site for mulching or composting or can be piled or spread around the forest. If shrubs have mature fruits on them, taking off site is not recommended as it may further spread of the plant. Cut stumps will resprout if they are not treated after cutting. Note that cut-stump herbicide application will introduce lower total herbicides on the landscape because of its direct application. Please see Penn State Extension Fact Sheet for more details on appropriate herbicides, application rates, and safety information.

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Vinca minor (common periwinkle)

Species description

Periwinkle is mostly evergreen woody vine that grows as a dense, tailing groundcover on the forest floor. Periwinkle leaves are dark green, oval, glossy, and thick and persist throughout the winter. The plant's flowers are purple and bloom in the spring (March-June) but infrequently produces fruit, which likely limits the spread of this plant. Instead, the plant's predominate mode of dispersal is vegetatively through rhizomes

Periwinkle is native to Europe and was first introduced to the US in the 1700s as an ornamental vine. Because of its low likelihood of producing and spreading by fruit, large patches of periwinkle in forests are typically found near old homesteads where the plant was likely first planted. The first collected specimen of periwinkle in Indiana County, PA was in 1946 at the edge of the woods across from Crete Church 4 miles northwest of Homer City (Academy of Natural Sciences at Drexel University, Catalog #PH00386207).

Status at White's Woods

Periwinkle is uncommon at White's Woods and was only detected at a single location near houses along 12th street at the site. This population likely is an expansion of periwinkle that was once planted nearby as an ornamental plant.

Impacts

There is limited research on the ecological, economic, or human health impacts of periwinkle in forested ecosystems.

Ecological – Dense periwinkle patches are associated with lower tree seedling abundances than nearby forested areas without periwinkle, which is likely owing to shading and competitive effects of the vine mats (Darcy and Burkart 2002). A study of predatory spiders, an important component of the soil food web, found that the spider community changed in invaded forest sites relative to uninvaded sites. In dense periwinkle stands, spider diversity was lower and comprised different feeding guilds of spiders, which likely reflects changes to leaf litter environment in periwinkle stands (Bultman and DeWitt 2008).

Economic – There is no comprehensive assessment of the economic impacts of periwinkle in forested ecosystems.

Human Health – There are no known human health impacts of periwinkle.

Management Options

There are limited recommendations for managing this species relative to other nonnative, invasive species in forested ecosystems.

> *Chemical (foliar)* – A study in Michigan where periwinkle was growing among native forest wildflowers found that cutting periwinkle in the late summer (after wildflowers were dormant) and then treating the resprouting periwinkle with a 2% glyphosate herbicide solution reduced periwinkle abundance 3-fold and did not alter the abundance of native wildflowers in plots (Tatina 2015). Similarly, a study in Kentucky found that two alternative herbicides, pelargonic acid (sold under trade name, Scythe, Mycogen Corporation) and a combination of cinnamon oil and clove oil (sold under trade name Weed Zap, J.H. Biotech), provided similar control of periwinkle vines as glyphosate herbicides (Carreiro et al. 2020). However, these alternative herbicides are most costly than glyphosate and required one additional application to reach the same reduction in periwinkle density.

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Early Detection of New Nonnative-Invasive Plants

We provide brief descriptions of non-native plants that we did not detect at White's Woods but could become invasive on the property. This list was curated from two sources. First, a larger list of potentially invasive plants for Indiana County, PA created by the EDDMapS *Invasive Range Expanders Listing Tool* (https://www.eddmaps.org/rangeshiftlisting/). This listing tool provides a list of invasive plants that are already present within the contiguous United States and that are expected to expand their range into Indiana County by the middle of this century (Allen and Bradley 2016). Second, we selected potentially invasive species from a list of nonnative plants that are currently listed as invasive by the Pennsylvania Department of Natural Resources (https://www.dcnr.pa.gov/Conservation/WildPlants/InvasivePlants/Pages/default.aspx). We only selected species from these lists that are known to invade closed-canopy forests. This list could be used for monitoring for early detection efforts of future invasive plants at the site.

Scientific Name	**Common Name**	**Growth Habit**	**Currently Present in Indiana County?***
Acer platanoides	Norway Maple	Tree	Yes
Akebia quinate	Chocolate vine	Woody vine	No
Aralia elata	Japanese Angelica tree	Tree	No
Cardamine impatiens	Narrowleaf bittercress	Annual herb	Yes
Cardamine flexuosa	Woodland bittercress	Perennial herb	Yes
Catalpa ovata	Chinese catalpa	Tree	No
Eleutherococcus sieboldianus	Five-leaf aralia	Shrub	No
Euonymus fortunei	Wintercreeper	Woody vine	No
Ficaria verna	Lesser celandine	Perennial herb	Yes
Frangula alnus	Glossy buckthorn	Tree	No
Koelreuteria paniculata	Goldenrain tree	Tree	No
Oplismenus hirtellus	Wavyleaf basketgrass	Perennial grass	No
Prunus avium	Sweet cherry	Tree	No
Pyracantha coccinea	Scarlet firethorn	Perennial shrub	No
Pyrus calleryana	Callery pear	Tree	No
Rhamnus cathartica	Common buckthorn	Shrub/Tree	No
Rubus phoenicolasius	Wine raspberry	Shrub	No
Spiraea japonica	Japanese spirea	Shrub	Yes
Ulmus parvifolia	Chinese elm	Tree	No
Ulmus pumila	Siberian elm	Tree	No
Viburnum dilatatum	Linden viburnum	Shrub	No
Viburnum opulus	Guelder rose	Shrub/Tree	No
Viburnum plicatum	Doublefile viburnum,	Shrub	No

* We used the Mid-Atlantic Herbaria database (https://midatlanticherbaria.org) to search for records of each species in Indiana, County.

Author Biographies

Dr. Sara Kuebbing is an ecologist with expertise in forest ecology and invasive species. She has 5 years of professional experience working with local and regional conservation organizations on the management and conservation of protected lands, including invasive plant management. Dr. Kuebbing is currently an Assistant Professor at the University of Pittsburgh, where she runs an invasion ecology research lab.

Dr. Marion Holmes is an ecologist working as a postdoctoral fellow in Dr. Sara Kuebbing's lab. She has over 15 years of experience with wild plant identification and has participated in conservation projects, including mapping and management of non-native species, on both public and private lands. Dr. Holmes specializes in understanding the impacts of past land use on plant populations and communities, including the distributions of non-native species.

References

Writing an Invasive Plant Management Plan

U.S. Fish and Wildlife Service and California Invasive Plant Council. 2018. Land Manager's Guide to Developing an Invasive Plant Management Plan. Cal-IPC Publication 2018-01. National Wildlife Refuge System, Pacific Southwest Region, Inventory and Monitoring Initiative, Sacramento, CA. California Invasive Plant Council, Berkeley, CA. Available at www.cal-ipc.org and data.gov;
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Invasive Species Management Resources

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https://conservationtools-production.s3.amazonaws.com/library_item_files/379/444/NLT_controlling_invasive_plants.pdf?AWSAccessKeyId=AKIAIQFJLILYGVDR4AMQ&Expires=1633665598&Signature=CwHM4aSZOUjyvLvzzKm2HDQryCM%3D

Pennsylvania Invasive Species Resources

Governor's Invasive Species Council

The Commonwealth of PA convenes an advisory panel that includes seven state agencies and non-governmental organizations. The Council serves as a state-wide group with a purpose of identifying invasive species of concern that could threaten natural or agricultural resources within the state. They maintain the a statewide invasive management plan and list of resources.
Website:https://www.agriculture.pa.gov/Plants_Land_Water/PlantIndustry/GISC/Pages/default.aspx

Mid-Atlantic Invasive Plant Council

MAIPC is a regional non-profit group comprised of members from six mid-Atlantic states and the District of Columbia. The group provides regional leadership to effectively address the theat of

invasive plants to the native flora, fauna, and natural habitats. They maintain non-regulatory invasive species lists for member jurisdictions and resources on identifying and controlling common invasive plants in the region.
Website: http://www.maipc.org

Pennsylvania Department of Conservation and Natural Resources

The state agency with the most knowledge and expertise of invasive plant management in forested ecosystems. They maintain a non-regulatory list of common invasive plants in state natural areas and information on the identification and control of common invasive plant species.
Website: https://www.dcnr.pa.gov/Conservation/WildPlants/InvasivePlants/Pages/default.aspx

Penn State Extension Resources

Maintains an extensive set of fact sheets on identification and management of common invasive plants in Pennsylvania.
Website: https://extension.psu.edu/forests-and-wildlife/forest-management/invasive-and-competing-plants

Appendix: List of understory native Plants observed at White's Woods in May 2021

Actaea pachypoda
Actaea racemosa
Adiantum pedatum
Ageratina altissima
Antennaria sp.
Arisaema triphyllum
Botrychium virginianum
Carex pensilvanica
Carex sp.
Chimaphila maculata
Circaea lutetiana
Claytonia virginiana
Conopholis americana
Dennstaedtia punctilobula
Dioscorea villosa
Diphasiastrum digitatum
Dryopteris intermedia
Erigeron sp.
Eurybia divaricata
Eurybia macrophylla
Galium aparine
Galium circaezans
Galium odoratum
Geranium maculatum
Geum canadense
Goodyera pubescens
Hamamelis virginiana
Hydrastis canadensis
Impatiens sp.
Juncus sp.
Lycopodium sp.
Maianathemum canadense
Onoclea sensibilis
Osmorhiza claytonii
Osmunda claytoniana
Osmundastrum cinnamomeum
Parthenocissus quinquefolia
Persicaria virginana
Phegopteris hexagonaptera
Podophyllum peltatum
Polygonatum biflorum

Polystichum
acrostichoides
Potentilla
canadensis
Prenanthes
altissima Prosartes
languinosa
Prunella vulgaris
Pteridium
aquilinum
Ranunculus
abortivus
Sanicula sp.
Sassafras
albidum
Silene
virginica
Smilax
rotundifoli
aSolidago
caesia
Symplocarpus
foetidus Thalictrum
thalictroides
Thelypteris
noveboracensis
Urtica dioica
Vaccinium
pallidum
Viburnum
acerifolium
Viola
appalachien
sis Viola
blanda
Viola
pubesce
nsViola
rotundif
oliaViola
sororia
Viola
triloba

Appendix B
Consulting Forester Evaluation of White's Woods

Mike Wolf
Appalachian Forester Consultants

June 24, 2020
July 22, 2020

Appalachian Forest Consultants
146 Mya Drive
Johnstown, PA 15904

Over 50 Years of Forest Management
www.appalachianforestconsultants.com
(814) 659-1280

Friends of White's Woods, Inc. June 24, 2020
P.O. Box 1271
Indiana, PA 15701

Thank you for the tour of White's Woods last Tuesday, June 16th. As you know, we had great weather and were able to walk most of the property. According to my "track," we walked 4.77 miles in White's Woods and reviewed every segment of the forest. Along the way we encountered many hikers, bikers, and even a mama bear and her two cubs. The forest is unique in many ways and it is easy to see why the property attracts so many recreationists on a daily basis.

Your organization has asked me to review current and past documents related to White's Woods as well as to provide a general assessment/opinion of the forest resource and property. I have broken the assessment into the following categories: Overall Impression, Overstory, Understory, Sustainability, and Recommendations.

Overall Impression

White's Woods is a 245 acre beautiful forest with only minor intrusions from a powerline and some shallow gas production. The property has limited vehicle access, but has substantial access for hiking and biking. The property is mainly used for recreation and has many daily recreational users on its vast internal trail system. Signs are posted naming the property "White's Woods Recreation Area" and listing hours for the "Park." There are 12 named trails (totaling over 5 miles in length) listed on a welcome sign at the 12th Street trailhead. The trails are well-designed and provide excellent recreational access to the whole property.

White's Woods forest is as beautiful as any I've seen in my career. The aesthetic value of the property is very high. Hikers and bikers experience large, beautiful trees along every path. The site/soil is obviously very productive for growing quality trees and the growth of the trees (both height and diameter) is impressive. It is easy to see why so many users and residents have a high degree of passion for White's Woods.

Forest Overstory

The overstory is the highest layer of vegetation in a forest. At White's Woods, the overstory is made up of trees that have formed a vegetative canopy over all other vegetation layers. In any forest, there are overstory (tallest), and understory (ground-level) layers of vegetation. All trees that have been measured by previous foresters (1995, 2007, and 2019) for volume and value estimations are part of the overstory of White's Woods.

According to the 2007 Forest Stewardship and Management Plan, authored by professional forester David J. Babyak of Indiana, "Most of the forest has developed on units that are abandoned farmland or previously harvested woodland." Also, according to Richard S. Stephenson, naturalist and historian, in his 1980 *Human History of White's Woods*, "White's Woods has been logged at least twice since the early settlers. Some areas in the woods were logged as recently as the 1940's and early 1950's." In a recent interview with The Hawkeye, professional forester David J. Babyak said, "White's Woods is an even-aged forest, for the most part. It was clear-cut. Walter Schroth told me his father clear-cut the forest in the 1950's."

When a forester inspects a forest, it is always important to gain knowledge about the forest's past logging history and to determine an approximate age of the forest. I reviewed historic aerial photos of White's Woods from 1939, 1957, and 1967. In the photos, it is easy to see evidence of abandoned old field as well as timber harvesting across the bulk of the property. I agree with Mr. Babyak that we are dealing with an even-aged forest and for now, I am using an average age estimate of the forest at approximately 70-80 years. Typically, trees don't grow to the size of the trees in White's Woods in only 70 or 80 years, but this indicates a very productive soil and nutrient component. An agricultural analogy would be that corn grows much faster and taller on a good site than it would on a poor site.

Because White's Woods is considered an even-aged forest (either grew from an abandoned field or as the result of a heavy timber harvest in the past), the large trees are not older than the small trees. In fact, the large trees are a very similar age to the small trees. The small trees were out-competed by the larger trees and were, in many cases, just barely able to survive. Through fierce competition, the larger trees were able to fight for a place in the forest canopy and the smaller trees were forced to hang back, grow slower, and accept an inferior position of only collecting filtered light. In this way, White's Woods is not unlike over 90% of Pennsylvania's forests. Most of our PA forests were clearcut between 1880 and 1930 and grew back as even-aged forests.

White's Woods overstory is healthy. As previously stated, the site is very good for growing high quality trees. There have been plenty of previous listings of species, board foot volumes, and timber values for White's Woods overstory, so there is no need to present that information here. However, it should be stated that the overstory is in very good (way above average) condition in terms of health and that the overstory of White's Woods is NOT over mature. Just because the trees are big, does not mean they are over mature or that there is need to harvest timber in order to save the forest. I would whole-heartedly disagree with anyone who would state this. In fact, due to the great growing conditions and overall health of the overstory, I would suggest that White's Woods is actually a long way from being over mature or in need of a near-term harvest. 80 Year old timber is basically in its prime. Of course, someone who wants to profit from harvesting the trees would certainly lick their lips at an opportunity to harvest and sell 80 year old, high quality timber, but the reality is White's Woods overstory is in its prime.

Forest Understory

The ground level vegetation in White's Woods is in very poor shape. Even though thousands of large trees are annually producing millions of seeds, it is almost impossible to find tree seedlings in the understory. What we do see in the understory are non-native invasive plants such as Japanese barberry, Japanese stiltgrass, bush honeysuckle, autumn olive, multiflora rose, and garlic mustard. It is also easy to find native competing vegetation such as spicebush and hayscented fern. The bulk of the forest floor has evidence of invasive and competing plants. There are also some small sections where the forest floor appears bare. None of this is good.

If given enough experience, it is easy for a forest manager to determine the culprit and to put blame where it is needed. There is nothing wrong with the tree seeds and there is nothing wrong with the soil. The culprit is deer. Deer have taste preferences. They like to eat the type of vegetation we typically want to grow and they do not eat the invasive and competing plants. The average deer requires 5 pounds of desirable hardwood buds per day during all months outside the growing season. So, from October through April, every year, each deer spends its days meandering the forest looking for its 5 pounds of desirable hardwood buds. As previously stated, there are basically zero desirable tree seedlings in White's Woods. This makes easy pickings for any deer that spends time on the property to find each and every germinated bud (fall or spring) on the property. The seedlings are gone before they ever get a chance to grow. I know I will meet with skepticism on this from the general public. Of course, in PA, the deer impact on our forests has been a hot topic of debate for decades. However, my statements are provable. Give me a few years and allow me to build a small deer exclosure and the evidence will be indisputable in a short matter of time. There is nothing wrong with the millions of seeds and there is nothing wrong with the soil.

The understory of a forest plays a vital role in forest health. If there are any impacts to the forest overstory, such as harvesting, ice damage, wind damage, insects, or disease the health of the understory will determine future forest health. Ideally, in a healthy forest system, there should be ample tree seedlings produced from overstory seed production and germination. Contrary to popular belief, tree seeds do not need added light to germinate and tree seedlings do not need added light to begin growing. In fact, the best understory condition would be to have tens of thousands of seedlings of desirable species "at the ready" in case of and in preparation for an overstory impact of some kind. If the forest understory and the deer impacts were not out of balance, there would be enough seedlings to feed deer and to be in place to become the next forest, following an overstory impact. In addition to many healthy seedlings, a forest understory should also have a wide range of forbs, wildflowers, and shrubs that are native to the area. Seeing only undesirable invasive and competing plants, or no vegetation at all is definitely cause for alarm.

Sustainability and Management Challenges

There are many resources and academic studies that discuss sustainable forest management. In brief, they can be boiled down to a simple premise…the forest should be able to grow back a similar or improved variety of species to a similar or improved quality following an overstory impact.

Whether the overstory impact is planned, as in proper harvesting, or in the case of an unplanned event like wind, insect, or disease, a sustainable outcome is one where the forest grows back in at least as good if not better condition. Tragically, most timber harvests in PA can be labeled unsustainable. The reality is, a sustainable outcome is extremely difficult to achieve. There are many impediments along the way to a sustainable outcome, such as hungry deer, invasive plants, competing plants, improper harvesting, improper planning, improper use of added light, etc. The days of thinking "we just have to add light to get things growing in the understory" are gone. There are way too many challenges today. In fact, if you want to know exactly what will grow back after a timber harvest it is quite simple – just look at what is on the forest floor before the harvest and you can know for sure. If there are invasives, you will grow invasives. If there are competing plants, you will grow competing plants. If there is nothing, you will make the perfect environment for increased invasives. Even if you kill all the invasive and competing plants first, you should definitely not add any light until you have an abundance of desirable, protected seedlings in place. The reason is simple…the invasives will come back much faster than any desirable native plant that is a target for deer.

To truly practice sustainable forestry today, there is no simple one, two, or three step process. Also, a sustainable outcome requires a substantial investment of time and money. There are costs for experienced professional foresters, costs for managing deer impacts, costs for managing competing plants, and costs associated with harvests and harvest planning. Responsible landowners are aware of these facts. However, most landowners do not understand or value the investment of time. There would be no way to ensure sustainability in a proposed regeneration harvest that would all be accomplished in a 5 year period. In fact, a sustainable outcome actually takes 10-15 years at least. A sustainable outcome can be achieved, but the regular underestimation (of time and money) on the part of landowners and their managers has made sustainable outcomes rare.

Recommendations

The situation at White's Woods is interesting to say the least. After reviewing many relevant documents, it is obvious that there are many folks on both sides of the issues that care about the property and the forest. The property, its location, and its usage is quite unique and special. There is passion on both sides and there is obvious friction. The current proposal for a

regeneration harvest (shelterwood harvest), beginning with a 50 acre area in the center of the property, is probably the last thing that would resolve the friction. Any regeneration harvest on a property like White's Woods will be viewed as extreme. Also, with the proposed process, the outcome will not be a good one for the forest. Believing the forest is over mature, the forest floor is "stagnant" and a regeneration harvest is the only hope for a bright future for White's Woods, is completely misguided. The fact is, White's Woods is only 70-80 years old, in its prime, and has a very healthy overstory. Of course, as mentioned, the understory condition is appalling and much work can and should be done to improve it which will greatly improve the overall health of the whole forest system.

If I were managing this property, I would manage it as it is…like a park. Parks are not industrial forests. Parks can be and should be treated differently. Traditional forest management techniques should be tweaked to meet the needs of the landowner, improve the forest, and consider all the users as well. Often, situations like this require a great degree of creativity. I realize the landowner would benefit from adding timber sale income to their budget. I also realize doing this improperly, as proposed, would forever change the forest. I also realize that the majority of Indiana's residents and users of the park would prefer the landowner and a manager to consider values beyond just timber income. How will a substantial timber harvest affect aesthetic values, recreational values, and surrounding property values? I would take a creative approach and present the landowner with options that delay harvesting while still allowing for some revenue generation from the property. My "plan A" would be to attract an organization that would be interested in paying the landowner for use of the forest as a carbon sink. White's Woods is a high volume, high production forest that annually absorbs an abundance of carbon dioxide from the air, producing an abundance of oxygen in the process. Do you realize Indiana, PA is a healthier place to live because of White's Woods? Emission offsets and carbon sinks are in the headlines across the world and many large companies have shown great capacity to invest in these projects. There are conservation organizations currently involved in plans to bring together multiple small landowners for carbon projects that pay out. Ideally, the landowner could be paid for just growing trees and maintaining forest health. There are other ways to be creative as well. Would residents be willing to pay for timber rights over time? Would a conservation organization be willing to pay for a conservation easement? Many such easements still allow for forest management and can be very practical. Would the landowner allow a regeneration study to include erecting a small educational deer exclosure? This would go a long way to proving how the system really works and what to blame for the current issues.

Of course, my "plan A" as well as other creative ideas would take some time to develop. Fortunately, there is no need to rush with White's Woods. Afterall, we are dealing with a forest that is approximately 70-80 years old. Many state forest agencies, even if managing timber with industrial forest techniques, would not consider an 80 year old forest to be over mature or in

desperate need of management. The reality is White's Woods will outlive all of us, even if we take a do-nothing approach. Time is definitely on our side.

Thank you for the opportunity to share my thoughts on this great forest property. Feel free to call me (814) 659-1280 or email me mike.wolf.afc@gmail.com anytime to discuss this report.

Sincerely,

Michael T. Wolf
Forester

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Friends of White's Woods, Inc.
P.O. Box 1271
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July 2, 2020

Dear Andy and Christina,

Thank you for the opportunity to review the "White Township Stewardship Plan," recently submitted to the PA Bureau of Forestry for approval. My only goal in participating with this work is to provide advice that will make a better outcome for White's Woods (and other White Township properties, as appropriate). From my initial, on-site review of White Township properties, it is apparent that following Millstone's plan creates the biggest risk to White's Woods. Millstone's plan was written to apply to all of White Township properties, and therefore this review (below) can apply to all locations. However, White's Woods is obviously at greatest risk for catastrophic results.

REVIEW OF WHITE TOWNSHIP STEWARDSHIP PLAN (prepared by Millstone Land Mangement, LLC)

Landowner's Goals for Woodlot Management of White Township Properties, page 2 and 3:

The reality is, these are not forest stewardship goals, and maybe that is on purpose. The plan is titled a "Stewardship Plan" and not a Forest Stewardship Plan. Given this list of "goals," it would appear you not only need a qualified forester's review, but also that of a qualified Municipal Planner.

As a qualified forester, I can certainly comment on "goals" 1 and 2 because the general idea behind both are common to many forest landowners. The goal to (#1) Improve Forest Health and Sustainability is great! Generally, I can agree with most of the ideas presented in Goal #1, however, there is actually a second goal presented here – Safety. I don't think you can lump the goal of safety in with the goal to improve forest health and sustainability. So, it seems to me White Township's top goal is forest health and its second goal is safety.

Listed as goal #2 is to enhance recreational activities. I assume this should really be stated as enhance recreational opportunities. Most of the wording in goal #2 refers to White Township's commitment to recreation, as if maybe this is not really a goal to accomplish or aspire to, but rather a past success that just requires maintenance.

Overall, the basis of each of the goals presented are fine. It is quite normal for forest owners to want to improve forest health and sustainability, improve safety, and increase recreational opportunities. It is well known that the landowners' goals are the building blocks of any successful plan. While the basis of each is fine, I do not see a clean, crisp presentation of goals here. Since the plan is built upon the goals, they should be well thought out and presented. As presented in Millstone's document, they are quite scattered and unfocused. The better the foundation is laid, the stronger the plan will be.

Worse than this, the parting thoughts in goals #1 and #2 refer to a much too simplistic way forward – contract with Mike Lawer. Goals can only be achieved through great strategy. The strategy part of the plan is the meat of the plan. A solution of blind trust, in any consultant, presented in the landowner goals section of the plan is misplaced. Alternatively, trust that well-presented goals can be accomplished should be put in a logical, biologically sound strategy presented in the meat of the plan (typically the recommendations section).

Millstone Land Management Objective for White Township Properties page 4:

First, the Consultant's "objectives" for any property should simply be to employ a logical, biologically sound strategy that will help the landowner meet their stated goals. That's it. Beyond this however, I feel it's necessary to also comment on the content presented in this section…

None of the information presented represents objectives, as the title of the section implies. Additionally, there are some foreign concepts presented such as (forest) mulching and mowing, selective objective timber harvesting, and utilizing sustainable selective harvests. Obviously the plan author has presented new ideas. While new ideas are often welcome when attempting to solve tough issues, a public property is hardly a place for experimentation. First, experimentation was not stated in the landowner's goals. Second, there are time-tested, logical, biologically sound practices that are available and could be employed. Anytime a "forester," timber buyer, or logger uses the word "selective," to describe a harvest the landowner should pause and notice a red flag. The word selective has been used by many to promote an idea of professional choice related to harvest decisions. The term has been used to put landowners at ease, i.e. "we won't clearcut, but rather we will be selective". The term selective harvest has been discussed, by forest health advocates, as the polar opposite of proper, sustainable harvesting for decades. In a 2016 Penn State Extension article by Dr. James C. Finley, Professor Emeritus of PSU Forest Resources, titled "Forest Stewardship: Timber Harvesting: An Essential Management Tool," Dr. Finley writes, "This misleading term –selective cutting—refers to a practice that has no basis in scientific forestry." Proper harvesting can only fall into one of two categories – thinning or regeneration harvesting. The goal of a thinning is to create additional space and increased growth for overstory trees. The goal of a regeneration harvest (shelterwood, seedtree, or clearcut) is to start a new forest. Any harvest plan that does not include the proper terms of thinning or regeneration harvesting and instead used the term selective harvest should at least raise concern.

The idea of utilizing mulching and mowing is ok in an old-field setting or where coppice forestry (creating and maintaining an early-successional habitat) is the goal. However, in a mature forest setting, tilling the soil to a depth of 6 inches (as stated in multiple Millstone documents) should again raise a red flag. As I stated in my June 24th report, there is not a soil compaction problem in White's Woods. Soil compaction is the result of running heavy equipment like skidders, dozers, or even a skid-steer over the forest. These activities have been absent for many decades in White's Woods. Additionally, think of how many leaves fall to the forest floor every year in the Park. Every fall, dead leaves create a new richness for the forest soil. This has been happening

there for hundreds of years. Annually, freezing and thawing loosens the soil above the frostline. Also, contrary to popular belief, the top six inches of forest soil contains many tons of roots per acre. These roots, close to the surface, are an important asset for healthy trees. Damaging these roots through compaction and breakage through tilling could have devastating effects on the health and vigor of all the trees of the forest. Root damage results in top dieback, increased root rot, and unnecessary tree stress which invites problems from a host of dangerous pathogens.

In addition, some of the invasive plants, like Japanese stiltgrass and garlic mustard are excellent seeders. These invasive plants produce an abundance of small, hard seeds year after year. These seeds can lay dormant for a decade – waiting for best conditions to germinate and spread. Running equipment across the soil and disturbing the soil will greatly increase these troublesome competitive plants. The seeds are already present and are easily spread by the mechanized process to every disturbed area. Unfortunately, this will certainly create a very undesirable and worse forest understory condition across the property. Competitive native plants that spread aggressively by rhizomes, like hayscented fern, will also greatly increase from running equipment around. Hayscented fern, Japanese stiltgrass, and garlic mustard are all abundant on White Township properties.

The Properties Within the Landscape page 7:

The reason the PA Bureau of Forestry wants a section like this in a plan is because every landowner should have an understanding that their own property is not an island. Each forest ownership is surrounded by other forest ownership as well as non-forest ownerships. Additionally, each forest property plays an important role within a watershed. The purpose here should be to help the landowner understand how their decisions effect surrounding properties, surrounding resources, and surrounding people. It is good that the plan author has named each of White Township's properties as a park and used considerable descriptions of public use and recreational activities to prove the labels.

What Millstone's section lacks is a discussion of how proposed activities can and will impact many surrounding properties. If, for example, a misguided treatment strategy were to be employed that actually decreased forest health (through root damage) or increases invasive plants (through seed spread), there would be a negative impact on surrounding properties. On the flip side, a process that maintains or improves the natural resources on White Township properties can and will have a positive impact on the surrounding landscape. There should also be substantial discussion on the water resources within and outside the White Township lands.

Species of Special Concern page 8:

PNDI report actual results:

2. SEARCH RESULTS

Agency	Results	Response
PA Game Commission	**Conservation Measure**	**No Further Review Required, See Agency Comments**
PA Department of Conservation and Natural Resources	No Known Impact	No Further Review Required
PA Fish and Boat Commission	No Known Impact	No Further Review Required
U.S. Fish and Wildlife Service	**Conservation Measure**	**No Further Review Required, See Agency Comments**

U.S. Fish and Wildlife Service
RESPONSE:
Conservation Measure: Voluntary implementation of the following recommendation(s) will contribute to the conservation and recovery of endangered and threatened species. To conserve foraging and roosting habitat for endangered bats, while also carrying out the proposed conservation, restoration, or stewardship project/activity, conserve and protect forested areas. Emphasis should be placed on retaining (or restoring, if not already present) mature forests with at least 60% canopy closure. Also, retain all hickory trees, and large diameter (>12 inches d.b.h.) snags, dying, and injured trees to ensure a continuing supply of potential roost trees for bats. If agricultural lands are proposed for inclusion in the conservation project/activity, use Integrated Pest Management, with an emphasis on avoiding or minimizing the use of chemical pesticides, and review this project under the appropriate "Agriculture/Farming" project categories. If any timber harvesting or tree cutting is proposed, review this project under the category "Timber harvesting and Vegetation Management" -- "Timber sale/harvest."

The U.S. Fish and Wildlife Service (as well as the PA Game Commission) are recommending only forest management activities that retain greater than 60% canopy cover and other conservation practices. Notably, a regeneration harvest would surely open the canopy beyond the recommended level.

Management of Goals and Objectives for Two WT Properties page 14, 15, 16, 17:

White Township Recreational Complex page 14

This section amounts to a version of a harvest plan. A harvest plan can be a part of a forest management plan, but the most important parts of a forest management plan are landowner objectives and the professional forester's recommendations. The recommendations are written by a forester and lay out the strategy – how will the forest be managed and what are the necessary steps to accomplish the stated goals. A harvest plan is typically something of an addendum to a forest management plan. It is typically put together after a forest management plan has been approved and it is then utilized to accomplish a portion of the recommendation. As stated, a harvest plan can be stuck in a forest management plan, but it is not common.

Regarding the content, there's a good bit worthy of debate. In Phase 1, I don't see how a process of mowing/mulching followed by Conservation Mix seeding could result in any substantial long-term improvements. Mowing/mulching does not eliminate invasive seed, instead it will spread it. Seeding with an Ernst Conservation seed mix can produce a beautiful initial site with good germination, but these plants get eaten or out-competed within just a couple years. Think about the vast wildflower plantings PA DOT used to do on PA highway medians…beautiful year 1, about 50% as nice in year 2, gone by year 3. Also, I did not read anything about soil testing in the plan, but if soil tests were to be conducted, soil analysis would likely recommend lime applications at a rate of at least 2 tons/acre for improved results.

In Phase 2, there's the subject of a timber harvest. As I stated in my June 24th report, whatever you add light to is what you will grow… 'if you want to know exactly what will grow back after a timber harvest it is quite simple – just look at what is on the forest floor before the harvest and you can know for sure. If there are invasives, you will grow invasives. If there are competing plants, you will grow competing plants. If there is nothing, you will make the perfect environment for increased invasives. Even if you kill all the invasive and competing plants first, you should definitely not add any light until you have an abundance of desirable, protected seedlings in place. The reason is simple…the invasives will come back much faster than any desirable native plant that is a target for deer." And to add to this, if you plant wildflower seed and then add light, you will get both wildflowers (temporarily) and invasives resprouting or germinating. The invasives will dominate after a short term.

WT Recreation Complex Timber Assessment page 16, 17

"Total Standing Price" – assuming this is actually referring to what the industry calls "stumpage value." Stumpage value is the value of standing trees. Stumpage value is less than "log value" or "log price" because there is an expense involved in cutting, skidding, and hauling to a sawmill. The industry does not reduce stumpage value due to costs of cutting, skidding, and hauling. Stumpage value can be reduced due to quality/grade, additional site access expenses, terrain, etc. So, there seems to be at least a misnomer in the "total standing value" designation. In Millwork's projections, after cut/skid/haul costs, the stumpage value of the timber sale is estimated at $9,259.26. Of all the forest consultant fees I'm aware of, the highest cost for a forester to prepare a timber sale prospectus, create contracts, and oversee the harvest work is approximately $1,400 on a sale this size. While a "forester" can charge whatever he/she wants in an open market, it should raise a red flag for a landowner to be paying almost 80% instead of industry standard 10-15%. Of course, there may be undocumented costs/fees involved that are not listed in the projections.

Whites Woods Tract #1 page 18 - 22

Again, this is more like a harvest plan.

Regarding the content, again, there is much worthy of debate. Remember this as you read through the following sections…the primary objective (of Millstone's work in White's Woods) is to improve forest health, wildlife habitat, and recreational opportunities for the community.

My June 24th report describes, in detail, issues related to deer. Yes, they are a problem. Conservation mix seeding cannot begin to solve the problem. It is good that Millstone's wording includes "based on observation, other methods may be evaluated such as deer fencing or a controlled deer harvest". However, this is like considering the purchase of insurance after having a car wreck. Of course the "observation" will require new control methods – they will just be too late following increased light.

Phase 1 quick debate points…

1. If there is "zero desirable regeneration," DON'T add light until there is an abundance of desirable regeneration
2. The stand is not "over-stocked". This could be a term associated with a thinning, but cannot be a term associated with a regeneration harvest.
3. A high canopy does allow filtered light to the forest floor and our PA trees can and will germinate and begin to grow in the shade of a closed canopy because the shade is high (not low like that from hayscented fern which can prevent germination and growth) and there is filtered light.
4. Deer and now also competing plants that deer do not eat are the reasons there is zero desirable regeneration.
5. None of the proposed steps will meet the primary objectives

"Total Standing Price" – assuming this is actually referring to what the industry calls "stumpage value." Stumpage value is the value of standing trees. Stumpage value is less than "log value" or "log price" because there is an expense involved

in cutting, skidding, and hauling to a sawmill. The industry does not reduce stumpage value due to costs of cutting, skidding, and hauling. Stumpage value can be reduced due to quality/grade, additional site access expenses, terrain, etc. So, there seems to be at least a misnomer in the "total standing value" designation. In Millwork's projections, after cut/skid/haul costs, the stumpage value of the timber sale is estimated at $39,965.44. Of all the forest consultant fees I'm aware of, the highest cost for a forester to prepare a timber sale prospectus, create contracts, and oversee the harvest work is approximately $5,990 on a sale this size. While a "forester" can charge whatever he/she wants in an open market, it should raise a red flag for a landowner to be paying almost 38% instead of industry standard 10-15%. Of course, there may be undocumented costs/fees involved that are not listed in the projections.

Phase 3 quick debate points…

1. The proposed invasive treatment will not improve wildlife habitat
2. Additional trails are not necessary in White's Woods
3. The proposed methods will not establish a healthy, diverse ecosystem

Management Recommendations for all WT Properties page 23-26

Quick debate points…(that haven't already been presented)

1. Fascines are typically vigorous sprouters. Typically made up of bundles of willow-type species are placed in the ground and will create (for White's Woods) a very unnatural-looking, shaggy growth along stream banks. The majority of species making up the fascine bundles would be out of place on a property like White's Woods.

Recommended Schedule page 27, 28

Quick debate points…

1. In only the second year of the schedule (summer/fall 2021), regeneration harvesting on 50 acres of White's Woods will be begin. The added light will NOT be on desirable seedlings and saplings, but rather (maybe) some wildflowers and of course invasives.

2. Question – what does "evaluate timber" mean (fall 2022 and fall 2024)? Is this a code for timber harvesting? Page 23 (2a) recommends to "evaluate and select trees for a timber harvest." If all acres of White's Woods receive a combination of mechanical/chemical treatment as proposed, we can only assume "all acres" of White's Woods are to be harvested similarly to White's Woods Tract 1. Based on all above information in this review…this is a scary thought.

3. A sustainable forest regeneration plan for a property like White's Woods should take 10-15 years, not just 4 as proposed in this schedule. And, this is for each unit. To sustainably regenerate a forest of any size, or any portion of a forest of any size (as described in my June 24 report) takes at least 10-15 years. To sustainably regenerate White's Woods Tract 1…10-15 years; Tract 2…10-15 years, Tract 3…10-15 years, etc. Anything less is an impossibility with a forest in its current condition. It is very important to remember, there has to be desirable seedlings in place before any light is added. This takes time.

Appendix 3 – Millstone Land Management Sustainable Forestry Philosophy

Quick debate points…

Paragraph 1: Soil

I called Soil Scientist, Ron Andrasko (Andrasko and Associates, Inc.) to discuss Millwork's basis for soil aeration (to a depth of 6"). Millwork claims that the soil in White's Woods and other White Township properties are compacted and lays blame on soil compaction for lack of desirable regeneration. I described the White's Woods property to Ron, including past logging history. Ron's response was, "it is a ludicrous claim." Ron said, "it has nothing to do with compaction of soil." He added, "taking a machine into a forest area results in compaction. Only manipulation (of any kind) of forest soil results in compaction. Only time, through annual freeze/thaw and shrink/swell decreases compaction."

Paragraph 2:

Millstone's plan to reintroduce native plant species refers to overseeding with a customized Ernst Conservation Seed Mix. This is not the native species that will result in improved habitat and forest ecosystem health. Native hardwood seedlings, resulting from White's Woods overstory seed production, germination, and growth are the only solution. The seed mix prescribed by Millwork will not result in desirable natural regeneration of the types of trees currently found in White's Woods. However, skipping the soil aeration, skipping the overseeding, and simply erecting a deer exclusion fence and killing competing plants WILL provide the desired results.

Paragraph 3:

Light is the enemy to an unhealthy forest understory. In my June 24th report, I detail the health of the understory in White's Woods. It is obviously unhealthy. ALL of our native PA trees can germinate and begin to grow in a shaded understory – especially when the shade level (height) is high, like that created by the overstory tree canopy. A tight canopy is NOT the issue in White's Woods. I recommend to NEVER add light to a forest floor until after desirable seedlings are sufficiently present.

Appalachian Forest Consultants
146 Mya Drive
Johnstown, PA 15904

Over 50 Years of Forest Management
www.appalachianforestconsultants.com
(814) 659-1280

Again, I thank you for requesting my input. White Township has some tremendous lands that are an asset to all the residents of White Township and Indiana Borough. I am quite impressed with the properties and their community usage. Forest management, public park management, and municipal planning are very complex today. It is my hope that this review, as well as my June 24th report can be used to move White Township in the direction of a sustainable outcome. In my opinion, because the properties are so incredible, there is much to lose if a wrong direction is chosen. I honestly do not see ill-intent, just a lack of fundamental understanding of silviculture, sustainable forestry practices, and how forests grow and develop. The "Forest Stewardship Plan" you asked me to review is intensive and was obviously written with passion. When this type of passion is mixed with the right knowledge and strategy there is no doubt a positive outcome can be reached. However, as this review and my previous report point out, while the proposed strategy may be well-intentioned, for many reasons, it will not produce a positive outcome.

Feel free to follow up with me at your convenience.

Sincerely,

Michael T. Wolf
Forester

Appendix C
Friends of White's Woods
2020-2021 Public Webinars

Friends of White's Woods
2020-2021 Webinars*

All webinars are free and open to the public.
We would be very pleased if you could join us.
All webinars are from 4:00-5:00 p.m. on the dates indicated.

September 24, 2020 **Gavin Deming, Allegheny Goatscape**
Using Goats to Control Invasive Plant Species

October 22, 2020 **Mike Wolf, Appalachian Forest Consultants**
The Health of White's Woods

November 19, 2020 **Vincent Cotrone, Penn State Extension**
The Role of Trees & Forests in Controlling Stormwater

January 14, 2021 **Dr. Margaret Brittingham, Penn State**

Department of Ecosystem Science and Management
Community Forests: Benefits for Birds and People - Options and Challenges

February 11, 2021 **Dr. Bonnie McGill, Carnegie Natural History Museum**

Comfortable spaces for uncomfortable conversations:
The Climate and Rural Systems Partnership of Western Pennsylvania"

March 4, 2021 **Todd Sherbondy, Davey Resource Group**
i-Tree Analysis* for the White's Woods Nature Center

The Dollar Value of the White's Woods Nature Center for White Township and the Indiana Area: Air Quality, Stormwater Control, Carbon Sequestration, Property Value, and more.

March 5, 2021 **Kevin Yoder, The Nature Conservancy, Family Forest Carbon Project**

(FWW Co-sponsor: Presented at the Indiana County Sustainability Economic Development Task Force Annual Summit)

April 15, 2021 **Shari Edelson, Director of Operations,**
The Arboretum at Penn State

The Hartley Wood Restoration Project

May 20, 2021 **Dr. Sara Kuebbing, Director & Dr. Marion Holmes, University of Pittsburgh Invasive Plant Laboratory**

The Ecological Impact of Invasive Plants

Sept. 28, 2021 **Alyson Fearon, Senior Director of Community Conservation and Resilience, Allegheny Land Trust**

Carbon Offsets: Producing Income from Valuable Greenspace

Oct. 21, 2021 **Dr. Sara Kuebbing, Director & Dr. Marion Holmes, University of Pittsburgh Invasive Plant Laboratory**

Invasive Plant Inventory and Management Report for White's Woods Nature Center

Dec. 9, 2021 **Dr. Kevin Patrick, Indiana University of Pennsylvania, Geography and Regional Planning Department**

Swallowed by the Trees: The Unremembered History of White's Woods

***All FWW webinars have been/will be recorded and available on the FWW website: friendsofwhiteswoods.org**

Appendix D
Pennsylvania Wildlife Action Plan*
Species of Concern 2015-2025
Birds & Reptiles

*Complete plan available at:
https://www.fishandboat.com/Resource/StateWildlifeActionPlan/Pages/default.aspx

PENNSYLVANIA
WILDLIFE ACTION PLAN

2015–2025

Species of Greatest Conservation Need Species Accounts

Appendix 1.4-Birds

- *Bird Species of Greatest Conservation Need*
- *Maps: Physiographic Provinces and HUC Watersheds*
- *Species Accounts (Click species name below or bookmark to navigate to species account)*

BIRDS

Tundra Swan
American Black Duck
Blue-winged Teal
Green-winged Teal
Lesser Scaup
Long-tailed Duck
Ruffed Grouse
Pied-billed Grebe
Horned Grebe
Red-necked Grebe
American Bittern
Least Bittern
Great Egret
Black-crowned Night-Heron
Yellow-crowned Night-Heron
Osprey
Bald Eagle
Northern Harrier
Sharp-shinned Hawk
Northern Goshawk
Broad-winged Hawk
Golden Eagle
King Rail
Virginia Rail
Sora
Common Gallinule
American Coot
Piping Plover
Spotted Sandpiper
Upland Sandpiper
Red Knot
Wilson's Snipe
American Woodcock
Black Tern
Common Tern
Barn Owl
Long-eared Owl
Short-eared Owl
Northern Saw-whet Owl
Common Nighthawk
Eastern Whip-poor-will
Chimney Swift
Red-headed Woodpecker
American Kestrel
Peregrine Falcon
Olive-sided Flycatcher
Yellow-bellied Flycatcher
Willow Flycatcher
Loggerhead Shrike
Purple Martin
Bank Swallow
Brown Creeper
Winter Wren
Sedge Wren
Marsh Wren
Swainson's Thrush
Wood Thrush

BIRDS, CONTINUED

Gray Catbird	Blackburnian Warbler	Grasshopper Sparrow
Louisiana Waterthrush	Blackpoll Warbler	Henslow's Sparrow
Northern Waterthrush	Black-throated Blue Warbler	White-throated Sparrow
Golden-winged Warbler	Prairie Warbler	Summer Tanager
Blue-winged Warbler	Black-throated Green Warbler	Scarlet Tanager
Black-and-white Warbler	Canada Warbler	Dickcissel
Prothonotary Warbler	Yellow-breasted Chat	Bobolink
Nashville Warbler	Eastern Towhee	Eastern Meadowlark
Kentucky Warbler	Field Sparrow	Rusty Blackbird
Hooded Warbler	Vesper Sparrow	Red Crossbill
Cerulean Warbler	Savannah Sparrow	Pine Siskin

https://www.fishandboat.com/Resource/StateWildlifeActionPlan/Pages/default.aspx

PENNSYLVANIA
WILDLIFE ACTION PLAN

2015–2025

Species of Greatest Conservation Need Species Accounts

Appendix 1.4D-Reptiles

- *Reptile Species of Greatest Conservation Need*
- *Maps: Physiographic Provinces and HUC Watersheds*
- *Species Accounts (Click species name below or bookmark to navigate to species account)*

REPTILES

Eastern Mud Turtle
Spotted Turtle
Wood Turtle
Bog Turtle
Blanding's Turtle
Eastern Redbelly Turtle
Eastern Box Turtle
Eastern Fence Lizard
Northern Coal Skink
Broadhead Skink
Eastern Worm Snake
Kirtland's Snake
Eastern Hognose Snake
Rough Green Snake
Queen Snake
Eastern Ribbonsnake
Shorthead Garter Snake
Eastern Smooth Earth Snak
Mountain Earth Snake
Copperhead
Timber Rattlesnake
Eastern Massasauga

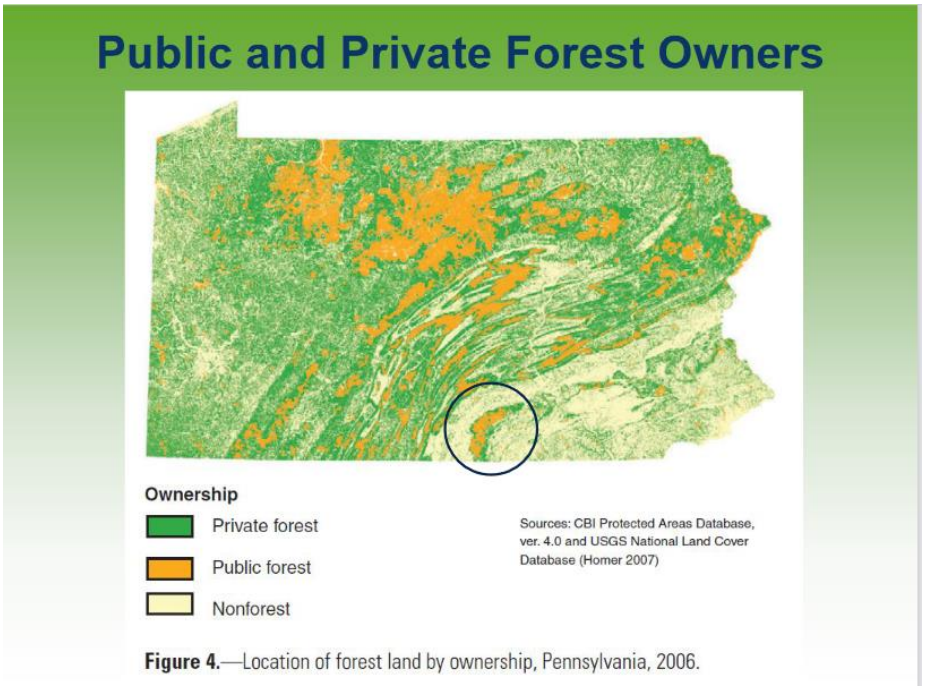
https://www.fishandboat.com/Resource/StateWildlifeActionPlan/Pages/default.aspx

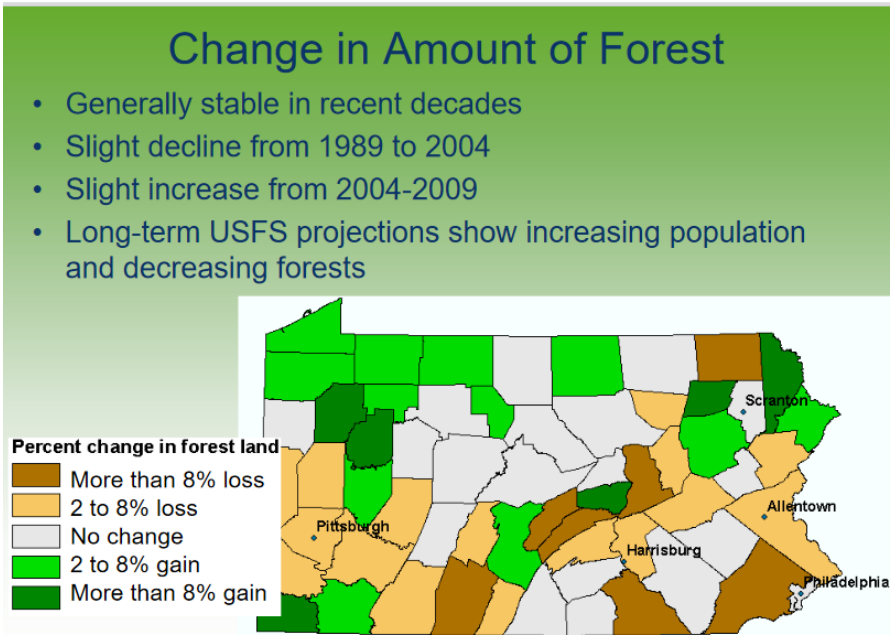
Appendix E
Recreational Opportunity Classification
and
Maps of Pennsylvania Public Forests

Figure 1.7. ROS classes and characteristics of those classes based on user experience.

DCNR Bureau of Forestry 2016 State Forest Resource Management Plan, p. 43.

Matthew J. Keefer, DCNR Bureau of Forestry. Current Conditions and Future Outlook of Penn's Woods, March 27, 2014. South Mountain Partnership Lecture Series, slides #13 & 16. http://www.paforestry.org/wp-content/uploads/2015/01/PFAsouthmountain-rothrockforumpresent-Keefer.pdf





Appendix F
2020 Survey of White's Woods Nature Center Recreational Use

White's Woods Use Survey: July 2020

The following survey was designed by Friends of White's Woods (FWW) to collect information from and about the users of WWNC. Questions are the result of multiple revisions, benefiting from input of ten+ FWW members. Our intent was to determine the respondents':

- reasons for using WWNC;
- opinions about quality of experience in WWNC;
- suggestions for improvements;
- opinions about park maintenance;
- willingness to participate in WWNC management;
- ideas and recommendations.

Results

The White's Woods Use survey was posted online through Survey Monkey June 3 – July16, 2020. Responses were solicited through Face Book, ads in the Indiana Gazette, email distribution, and QR codes posted in local businesses. Of the 229 respondents, 118 (52%) resided in White Township, 74(32%) in Indiana Borough, and 37 (16%) in other areas.

It is important to note that all respondents are regular users of WWNC. Fifty eight percent (58%) reported visiting WWNC twice or more per month (2-3 times/month; weekly; 3-4 times/week; daily); the remaining 42% visit the park monthly or less. The multiple uses of WWNC are impressive. Most frequent reasons for visiting were walking/hiking (97%), enjoying fresh air (82%), relaxing/relieving stress (79%), and spending time with family (53%). Additionally, significant numbers of respondents visit for walking their dog (38%), running (33%), bird watching (26%), photography (24%), teaching about nature (16%) , biking (14%), and cross country skiing (11%).

When asked what would enhance their WWNC experience, most frequent responses were better signage (directions -52%; vegetation -45%; historical -38%). More than one-quarter responded beautifying areas around gas wells (30%) and providing benches (28%).

Data showed that WWNC users want the park to be left in its natural state (98%). They state that WWNC affords a healthier life style (99.5%), is an important resource for the community (99.5%), and provides beauty and attracts wild-life to the area (98%). They believe it exists exclusively for recreation, conservation and historical preservation (98%), and that it should be managed by a park commission with citizen representation (97%) using a comprehensive, science-based management plan (94%).

Respondents are happy with the quality (92%) and quantity (93%) of the trails. They are split on whether the trails should be better maintained (59% / 41%) and rest room facilities should be added (61% / 39%); the majority opposes adding structures for gatherings (76%), but they would like better parking access (68%). Most believe that WWNC attracts visitors to Indiana (92%). Finally, respondents are willing to help with WWNC maintenance, by picking up litter (70%), clearing trails (51%), removing invasive species by hand (40%), and planting wild flowers

(43%). A substantial number were willing to make financial contributions (54%), even though WWNC is owned by the township and should be supported by their tax dollars.

Summary and Conclusions

It should be noted that approximately half of the respondents reside outside of White Township, either in the Borough, the surrounding areas, or beyond. Their value for WWNC and commitment to supporting it are equal to that of WT residents. FWW believes that their input is just as important as that of WT residents, because, although WT is technically the 'owner' of WWNC, the Project 70 funds which purchased it and continue to provide support came from Pennsylvania bond issues, intended for the use of all Pennsylvanians and visitors.

Comments from both this survey and the change.org petition show that former residents who return to visit Indiana head to WWNC, and many users regularly drive to Indiana from other parts of the state to hike in the woods. And when people come to the area to visit WWNC, they also patronize businesses in the Borough and the Township, spending their money and supporting local economy.

In conclusion, the overwhelming evidence from this survey of regular WWNC users is that **THEY LOVE THE PARK** and they want to keep it as a natural area with minimal intervention. They value WWNC for the enrichment it provides to them individually and to the community, to the point that they are willing to contribute ideas, labor, and money.

White's Woods Nature Center Use Survey

Results 7/16/20

All responses are shown as percentage (%) (N=229)

1. **Zip code**:_____

2. **Do you currently live in White Township?**
   52% (118) Township 32% (74)Borough 16%(37)Other

3. **How often do you use White's Woods Nature Center?**
   - 0% Have never been there
   - 15% 1-3X/Year
   - 15% 4-6 X/Year
   - 13% Monthly or less
   - 14% 2-3 X/month
   - 20% weekly
   - 17% 3-5 X/week
   - 7% Daily

4. **Why do you visit White's Woods Nature Center? (check all that apply)**
   - 97% Walking or hiking
   - 33% Running
   - 11% Bicycling, mountain biking
   - 14% Cross country skiing
   - 82% Enjoying fresh air and enjoying being outdoors
   - 79% Relaxing, relieving stress, mental health
   - 53% Spending time with family
   - 38% Walking dog
   - 26% Bird watching
   - 16% Teaching others about nature
   - 24% Photography
   - 10% Other: please explain

5. **What would enhance your experience in White's Woods? (check all that apply)**
   - 52% Provide better directional signage and trail maps
   - 45% Provide signage about vegetation and wild life
   - 38% Provide historical markers
   - 19% Remove obstacles in trails (roots, logs, small bushes)
   - 28% Provide benches for resting
   - 17% Provide picnic tables
   - 30% Beautify areas around gas wells with wild flowers and other plantings
   - 13% Reduce deer grazing

Please indicate your opinion of each of the following:

	Strongly Agree 4	Somewhat Agree 3	Somewhat Disagree 2	Strongly Disagree 1	Mean
White's Woods Nature Center should be left in a natural state.	**187**	38	3	1	3.8
White's Woods Nature Center should have pit toilet facilities at a convenient location.	25	**115**	**67**	22	2.6
White's Woods Nature Center needs pavilions or other structures for group gatherings.	9	47	**125**	48	2.1
Parking access near park entrances is sufficient.	42	**113**	64	10	2.8
The quality of the trails in White's Woods Nature Center is good.	**96**	**115**	18	0	3.3
The number of trails in White's Woods Nature Center is adequate.	**97**	**125**	7	0	3.4
White's Woods Nature Center exists exclusively for recreation, conservation, and historical preservation.	**169**	55	4	1	3.7
A park commission with citizen membership should be established to govern White's Woods Nature Center.	**142**	**80**	4	3	3.6
White's Woods Nature Center enriches Indiana by providing scenic beauty and as a home to diverse flora and fauna.	**210**	18	1	0	3.9
White's Woods Nature Center needs better trail maintenance, including litter removal.	22	**113**	**82**	12	2.6

	Strongly Agree 4	Somewhat Agree 3	Somewhat Disagree 2	Strongly Disagree 1	Mean
A comprehensive, science-based management plan should be established for White's Woods Nature Center	**130**	**85**	9	5	3.5
White's Woods Nature Center affords opportunity for a healthier life style	**203**	36	0	1	4.0
White's Woods Nature Center is an important resource for the community.	**216**	12	1	0	3.9
White's Woods Nature Center attracts visitors to Indiana, PA.	**111**	**98**	19	1	3.4

6. **How are you willing to help with park maintenance? Check all that apply.**
   51% Clear trails and clean surrounding areas
   40% Remove invasive species by hand
   70% Pick up litter
   43% Plant wild flowers
   14% Build benches and/or picnic tables
   54% Make financial contributions
   10% Other: Please explain_____

7. **Additional comments/suggestions**

8. **Contact (optional): Name, phone, email**

Selected Comments (24/77)

The citizens of White Township are incredibly lucky to have such a wonderful Nature Center. Most communities do NOT have the luxury and benefit of having such a refreshing place. I've seen the difference in communities without such a place, and how it affects the moral of the citizens in that place. Here, you have the opportunity to afford the benefit of teaching the

children (and adults) the value of stewardship of our natural world. The experiences and lessons learned here will help them to appreciate the world in a more meaningful way, and when they take their place in making decisions to help their community, they will have a rich background of appreciation of and value of nature to form their opinions from. They then will make decisions that will benefit as many people and as much of their community as they can, not just for a select few. It seems that the idea of selling off so much of White's Woods for timber, is a bad idea. Once those trees are gone, they won't be back in that size in your or my lifetime. In other words, you could not BUY them back for any amount of money. The money that would be received for them, would really only be a fraction of what they would really be worth to your children or mine. There are two different ways to look at this; one way sees only money for the short-term, the other sees the benefit of nature for a lifetime (many lifetimes!) Remember, Cook's Forest State Park was set aside to be enjoyed by all for generations - and Mr. Cook was a lumberjack and sawmill operator! He had the vision to save and protect the trees for the future. I share in that vision. Do you? Thank you.

I am willing to help organize a concert to raise awareness and potential revenue toward ensuring maintaining the woods as close to as natural state as possible. I have frequented the woods since 1975.

I'm so happy I learned about this place!!! I'm so disgusted firstly that anyone wants to destroy such a beautiful park for profit but also about all the secrecy behind the plans to destroy Whites Woods!

Please don’t do anything to the park. It’s perfect how it is and that’s why it’s been so successful with attracting people to hike and run. It’s my favorite place in Indiana. Don’t change it.

Let me be clear: I DO believe a science-based management plan COULD help enhance the health of White's Woods. IF the intentions are indeed for FOREST HEALTH. The 100-page proposed Millstone Land Management Plan that was sent to DCNR is NOT a science-based plan with goals of enhancing forest health. I did not see any environmental data (quadrat sampling? recent sediment analyses? avian studies? evidence to back up that "rototilling" enhances "soil health") that even suggested that this project has the best intensions for this COMMUNITY park. There is a Natural Heritage Site within White's Woods - this was never mentioned in the entire 100-page document submitted for DCNR review. It appears as if NO research on behalf of Millstone or the Supervisors was attempted during the development of the "plan". Not to mention the extremely aggressive proposed timeline and LACK of continued monitoring in future years (10+ years down the line). Additionally, based on what I saw in the Erosion and Sediment Control plan, Best Management Practices (BMPs) are not being implemented to prevent stormwater/sediment runoff into surrounding neighborhoods. In Summary: YIKES. I am not opposed to discussions about deer population control in White's Woods. I recreate in White's Woods year round, so hunting is not something I am a particular fan of. However, I understand this is a community park and that the deer population needs to be controlled. Would deer fencing around proposed management sites be more appropriate long-term? I imagine that even with hunting, deer will continue to come to White's Woods from neighboring woodlot lands (IUP CO-OP, etc). I do not think hard structures are necessary for restroom features. Rather, an ADA-compliant port-a-potty situation might be more easily managed/maintained and cost-effective? I

want to see the community - and more than one "expert" - involved in the development of a management plan for White's Woods - A park that was established with goals of preservation, conservation, and recreation in mind. I strongly support the suggestion of a committee, comprising of all stakeholders, being established to make management decisions for White's Woods. I believe White Township Supervisors should have organized this type of committee as soon as they began having the recent discussions about White's Woods (especially with their knowledge of controversy in the past). Thank you for the work that you are doing to make this project transparent.

The park is an incredible place that I have grown up running through during my high school career. I would absolutely say the park has great sentimental and practical value to me as a college athlete and as a local citizen, and I would be willing to offer my time and my voice to help preserve and maintain one of the most wonderful locations in the township.

Parking at the N12th st entrance is inadequate. I believe Indiana Borough would partner with the township to improve this situation. Knotweed should be eliminated by spraying with glyphosate. It seems that unless you burn the dug rhizomes it may spread elsewhere. The gas well owners should be held accountable for any introduction of invasive species. Make sure they are obligated to repopulate the site with native plants. I am a Borough resident. I wish you well.

I have been walking my dog daily for about 15 years in WWNC, and I am so fortunate that I live within walking distance! It’s a beautiful park, and we White Township residents are so lucky to have it right in our own backyard!

Living "downhill" from White's Woods, our property has been adversely affected by previous development, necessitating thousands of dollars of runoff mediation--and the amount of water that flows seems to increase every year. I shudder to think what the catastrophic removal of a majority of the mature canopy will bring to the basements of homes around White's Woods. This is a shameful plan--a blind money grab by greedy politicians and what seems like a greenwashed, self-interested contractor.

Although I'm not a White township resident, I live right on the township border and my home and yard back up to Whites Woods. I walk and photograph the woods several times a week in all seasons. We moved here in 2013 and we purchased our home (a modest structure built in the 1960s) because of the proximity to the lovely woods. Being part of nature brings mental, physical, and spiritual health to many including myself and my family.

A nature center is just that NATURE ! Sometimes just doing nothing is the best choice. Minor maintenance or cutting an opening in a felled tree or clearing the path is ALL that is needed. People who enjoy communing in nature are used to minor obstructions or stepping over a stone. It is what is...NATURE !!

My daughter is a professor at IUP and when we visit her we enjoy our time spent walking in White’s Woods and various Indiana Parks. It has been proven that enjoying nature walks/hikes

also boosts good mental health and brain function! Saving and maintaining Whites Woods is essential to the overall beauty and health of your community!

Whites Woods is frequently used by IUP faculty for field trips--my students LOVE it and are discovering the woods often for the first time. It also help me recruit grad students, most of whom are looking to live in a town that has natural areas and outdoor rec/activities.

Citizen involvement in the management of the park is a great idea. Above all, NO TIMBERING!!

I am hoping that we can finally create a conservation plan for the park guided by ecologists and conservation biologists, so that that forest biodiversity and health may be enhanced. That is the number one priority. We should be enhancing the woods's role in carbon sequestration, wildlife habitat and biodiversity preservation.

White's Woods is a gem. Part of its charm is that it is not overly curated. We do not want White Township's foresters in there constantly messing with things. Let the woods be the woods. Citizens will step up to form a task force for removal of litter, invasive species, etc. We do not want a "park." We want a woods. White Township needs to understand that their short-sighted financial interest does not outweigh the majority opinion - and physical and mental health- of their community.

The citizens of White Township are incredibly lucky to have such a wonderful Nature Center. Most communities do NOT have the luxury and benefit of having such a refreshing place. I've seen the difference in communities without such a place, and how it affects the moral of the citizens in that place. Here, you have the opportunity to afford the benefit of teaching the children (and adults) the value of stewardship of our natural world. The experiences and lessons learned here will help them to appreciate the world in a more meaningful way, and when they take their place in making decisions to help their community, they will have a rich background of appreciation of and value of nature to form their opinions from. They then will make decisions that will benefit as many people and as much of their community as they can, not just for a select few. It seems that the idea of selling off so much of White's Woods for timber, is a bad idea. Once those trees are gone, they won't be back in that size in your or my lifetime. In other words, you could not BUY them back for any amount of money. The money that would be received for them, would really only be a fraction of what they would really be worth to your children or mine. There are two different ways to look at this; one way sees only money for the short-term, they other sees the benefit of nature for a lifetime (many lifetimes!) Remember, Cook's Forest State Park was set aside to be enjoyed by all for generations - and Mr. Cook was a lumberjack and sawmill operator! He had the vision to save and protect the trees for the future. I share in that vision. Do you? Thank you.

I am willing to help organize a concert to raise awareness and potential revenue toward ensuring maintaining the woods as close to a natural state ss possible. I have frequented the woods since 1975.

I'm so happy I learned about this place!!! I'm so disgusted firstly that anyone wants to destroy such a beautiful park for profit but also about all the secrecy behind the plans to destroy Whites Woods!

Please don’t do anything to the park. It’s perfect how it is and that’s why it’s been so successful with attracting people to hike and run. It’s my favorite place in Indiana. Don’t change it.

I don't own a car at the present but would be willing to help there if I have a way to & home. I think it's very important to keep as many trees around as possible as well as remove dead trees that may hurt others as well as remove invasive plants from the area. I've been going to Whites Woods since 2009.

I strongly support your group’s mission and applaud you for slowing the clearing of Whites Woods. I also believe in civility in public discourse. I have been offended by some of the accusations that the group has made. I would urge you to be more diplomatic in your approach to the supervisors. It is important to have a civil relationship so that both sides can hopefully work together on a science-based conservation plan. Good luck!

Invasive species removal is very important to restore White’s Woods, which is suffering from years of deferred maintenance, but the plan proposed by the supervisors will destroy populations of native species and probably not remove the invasive barberry, multiflora rose, and garlic mustard. There are better strategies for doing that.

Let me be clear: I DO believe a science-based management plan COULD help enhance the health of White's Woods. IF the intentions are indeed for FOREST HEALTH. The 100-page proposed Millstone Land Management Plan that was sent to DCNR is NOT a science-based plan with goals of enhancing forest health. I did not see any environmental data (quadrat sampling? recent sediment analyses? avian studies? evidence to back up that "rototilling" enhances "soil health") that even suggested that this project has the best intensions for this COMMUNITY park. There is a Natural Heritage Site within White's Woods - this was never mentioned in the entire 100-page document submitted for DCNR review. It appears as if NO research on behalf of Millstone or the Supervisors was attempted during the development of the "plan". Not to mention the extremely aggressive proposed timeline and LACK of continued monitoring in future years (10+ years down the line). Additionally, based on what I saw in the Erosion and Sediment Control plan, Best Management Practices (BMPs) are not being implemented to prevent stormwater/sediment runoff into surrounding neighborhoods. In Summary: YIKES. I am not opposed to discussions about deer population control in White's Woods. I recreate in White's Woods year round, so hunting is not something I am a particular fan of. However, I understand this is a community park and that the deer population needs to be controlled. Would deer fencing around proposed management sites be more appropriate long-term? I imagine that even with hunting, deer will continue to come to White's Woods from neighboring woodlot lands (IUP CO-

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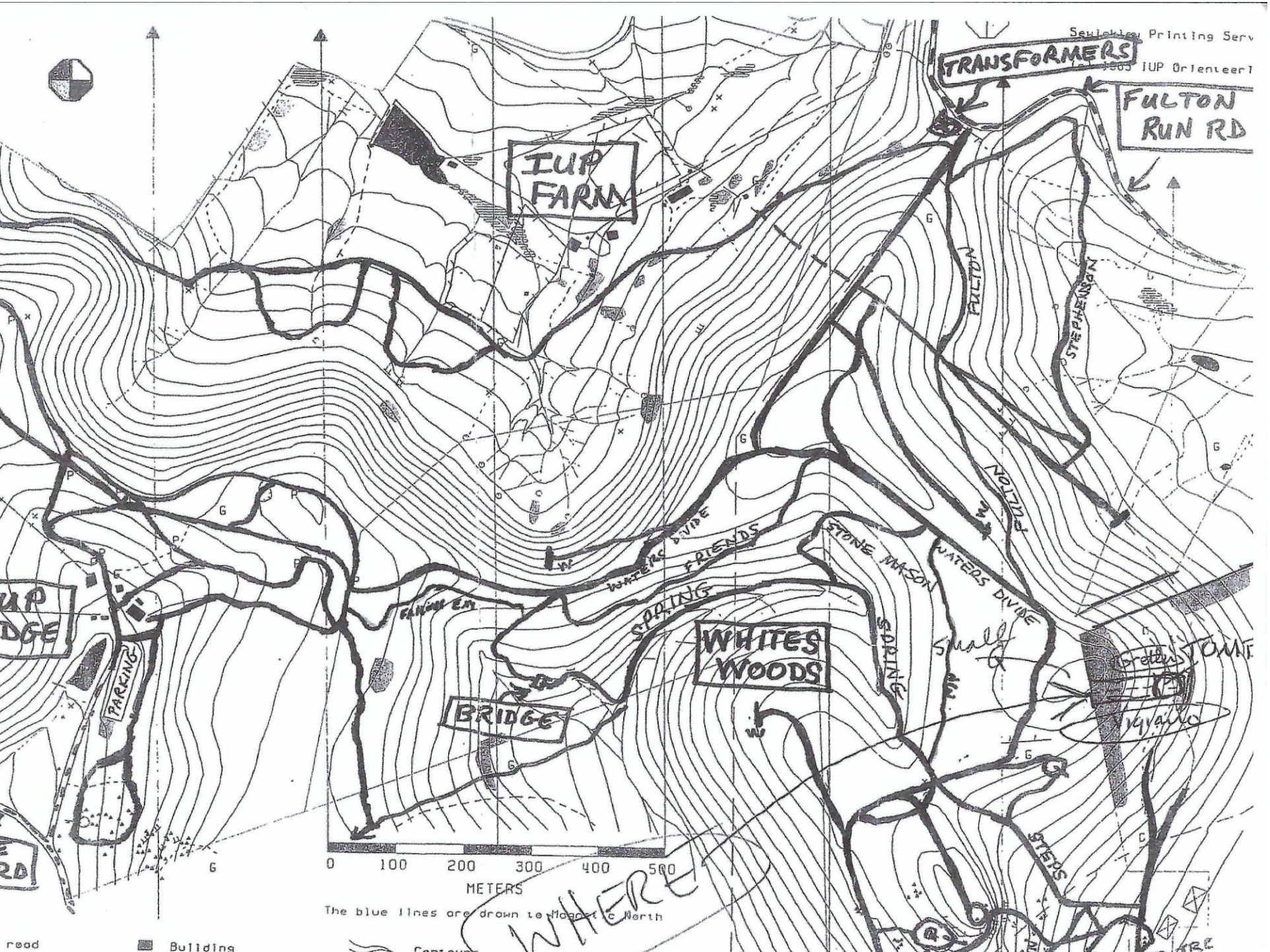
Appendix G
White's Woods Nature Center
Trail Map


TRANSFORMERS
FULTON RUN RD
IUP FARM
FULTON
STEPHENSON
WATERS DIVIDE
FRIENDS
SPRING
STONE MASON
WHITES WOODS
BRIDGE
PARKING
STEPS
0 100 200 300 400 500
METERS
The blue lines are drawn to Magnetic North
WHERE

Appendix H
Assembled List of FWW Specific Objectives for Management of the White's Woods Nature Center

WWNC CURRENT VALUE & FUTURE CARE
FWW Specific Objectives: Assembled List

I. Specific Objectives: Outdoor Recreation for All	a. Preserve the community forest park that we have!
	b. Preserve maximum canopy coverage so that the woods remain accessible in hotter weather.
	c. Schedule multiple, seasonal recreation and education activities to bring citizens of the Indiana region into the WWNC: • Develop a "big tree" tree-identification (type, size, age) loop walk. • Develop a native plant species loop walk (by season). • Host an annual Garlic Mustard Festival (which will help to get people in the woods and invasive plants out). • Host semi-annual educational medicinal plant and plant identification walks. • Host artist events in the woods: photography, painting (See FWW website). • Host annual nature-identification scavenger hunts for kids. • Encourage winter events by scheduling hiking and cross-county ski events to identify winter animal & avian species in the WWNC. • Develop a "history loop" to celebrate notable environmentalists, including Native American stewards and Indiana, PA native Edward Abbey. • Develop a network of bike trails to the WWNC 12th Street Entrance, providing access from each direction (including IUP) to help serve a broader population.

	• Provide bicycle parking at the 12th Street entrance parking lot. • Provide educational signage regarding at-risk and vulnerable species. • Host environmental education sessions (for children and adults). • Encourage reporting of plant, animal, and bird species through ***ebird*** and ***inaturalist***. • Update WWNC trail maps. • Support the creation of an Indiana-region greenways plan.
II. Specific Objectives: Support for DCNR Climate Mitigation and Adaptation Plan in the WWNC	a. Keep the 250-acre WWNC forest intact to maximize stormwater management and minimize flooding from increasingly heavy storms due to climate change.
	b. Keep the 250-acre WWNC forest intact to maximize temperature mitigation for surrounding communities in the context of increasing average and extreme temperatures that result from climate change.
	c. Keep the 250-acre WWNC forest intact to maximize carbon sequestration to help mitigate the deleterious effects of climate change.
	d. Monitor endangered, threatened, and "species of special concern" - mammals, birds, and plants--in the WWNC.
	e. Document arrival of migratory birds.
	f. Improve pedestrian, mass transit, and bicycle access to the WWNC.
	g. Work with DCNR on climate mitigation projects.

III. Specific Objectives: WWNC - A Steady Revenue Source By Leaving the Woods Intact.	Secure a carbon-offset (sequestration) contract for the 250-acre WWNC, providing estimated annual revenue of $25.00- $35.00 per ton: $211,000.00 in "up front" payment. NOTE 1: It may also be possible to secure revenue from the sale of valuable native plants currently found in the WWNC. (See attached report from Dr. Sara Kuebbing and Dr. Marion Holmes.)
	Note 2: DCNR grant funding is available to support management projects in the WWNC, including funding for the development of a comprehensive management plan for this Project 70 park.
IV. Specific Objectives: Preserving the WWNC for Future Generations	a. Listen to the public. Do not interfere with the recreational or aesthetic value of the WWNC. Seek public input at every stage of the management process.
	b. Rely on the best science, along with publicly-funded experts (DCNR and university-related) to preserve the WWNC community forest "largely in its natural state."
	c. Seek a DCNR Bureau of Recreation and Conservation Community Partnership Grant to support development of a vetted WWNC management plan.
	d. Complete an inventory and map of native plants in the WWNC. (Keubbing & Holmes, 2021).
	e. Complete an inventory and map of invasive plants (Keubbing & Holmes, 2021).
	f. Complete an inventory (on-the-ground-count) and map of the species type, size, and location of trees in the WWNC.

	g. Collect data regarding the diversity of people who use the WWNC.
	h. Collect data to determine the presence WWNC of avian, amphibian, and reptilian species that are now listed as "Species of Greatest Concern" by DCNR.
	i. Document date of arrival of migratory bird Species.
	j. Document animal species in the WWNC.
	k. Investigate conservation measures suggested by the U.S. Fish and Wildlife Service that will help the stability and recovery of both the Federally-endangered Indiana bat and Federally-threatened Northern long-eared bat.
	l. Inventory and map ecologically sensitive or unique areas in the WWNC.
	m. Locate and implement plans to preserve the three vulnerable plant species located in the WWNC, as identified in the Natural Heritage Program inventory.
	n. Implement a long-term, volunteer-based plan for the control of invasive species, including garlic mustard, multiflora rose, Japanese barberry and Autumn Olive.
	o. Implement this invasive plant removal plan by focusing on one section of the WWNC at a time.
	p. Implement bi-annual <u>preventative</u> invasive plant plan: survey entry points to WWNC for new invasive plant species.**.** q. Implement a long-term plan to promote native plant growth
	r. Conduct an assessment of the size of the WWNC deer population.

	s. Rely on natural succession and take advantage of "blow down" to plant seedlings to maintain WWNC regeneration status. t. Consider the use of goats to control especially dense invasive growth, to promote ecologically sound plant removal and to draw visitors into the woods.
	u. Seek partner funding to conduct a deer fencing or deer contraception pilot program.
	v. Create long-term management plans that factor in both (1) the forests surrounding the WWNC and (2) climate change. w. Promote forest songbird habit by planting and protecting both habit and food sources.
	x. Support the DCNR Bureau of Forestry's goal of increasing the percentage of Pennsylvania older-growth forests (80+ years old) by leaving the 80-year-old WWNC intact. Protect big trees.