



TRANSMISSION VEGETATION MANAGEMENT PLAN

FOR

The Highlands Region

Prepared by:

PSE&G, Delivery Projects and Construction

744 Broad Street, 13th Floor

Newark, New Jersey 07102-4194

(973) 430-7000

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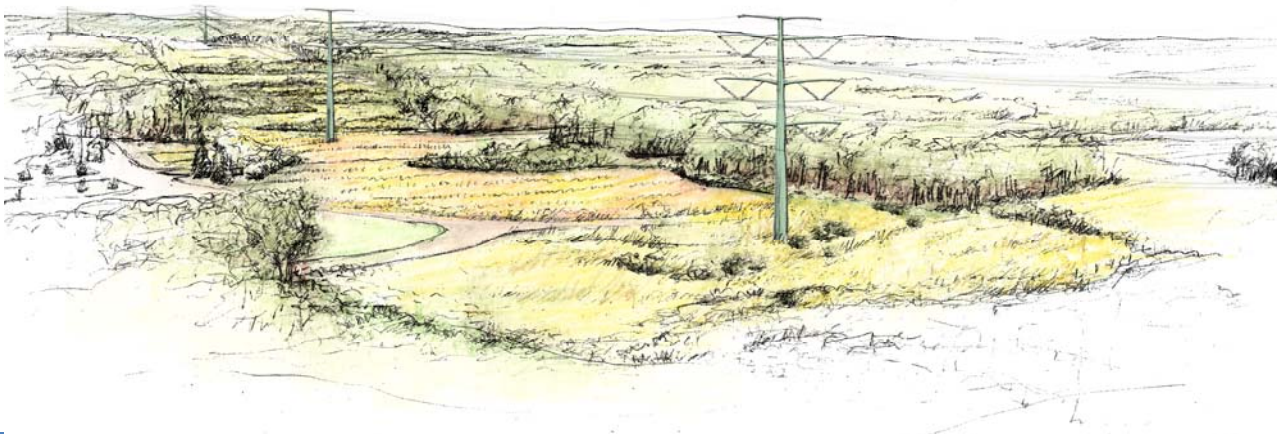
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Introduction

PSE&G has prepared this Transmission Vegetation Management Plan (VMP) specifically for the Highlands Region, which supplements existing company protocols and procedures for vegetation management. The Highlands diverse natural communities, including its extensive forests, wetlands, rivers, and streams, are of statewide importance and provide the water supply for over half of New Jersey's families and therefore require special consideration and management techniques.

However, it must also be recognized that according to the North American Electrical Reliability Corporation (NERC), "Conductor contact with trees has been an initiating trigger and a contributing factor in several major system disturbances since 1965, including the blackout of August 14, 2003. Tree contact caused the loss of multiple transmission circuits in several of the outages, causing multiple contingencies and further weakening of the system."

This Transmission ROW Vegetation Management Plan (VMP) provides standards and other regulatory requirements for the maintenance of the companies ROW within the Highlands Region. Throughout the United States, utility companies, like PSE&G, are required by existing state and Federal regulations to manage vegetation growing within ROW easements to ensure public safety, system reliability and emergency maintenance access and for routine inspection of the structures, switches, conductors, and communications equipment. In addition, PSE&G must maintain adequate clearance, as specified by the National Electrical Safety Code, between conductors and tall-growing vegetation and other objects. This requirement applies to vegetation within the ROW as well as to trees located off the ROW that could come into contact with the conductors.

This plan will enable the company to manage the vegetation on the ROW in accordance with all applicable rules and regulations. Integrative vegetation management within a transmission line ROW creates a framework that encourages opportunities for natural resource conservation and habitat enhancement, while helping to reduce costs. Vegetation management continues to be one of the largest recurring maintenance cost facing electrical companies.

The primary purpose of this work is to provide adequate clearance of the electrical conductors and structures from trees and other vegetation growing on the ROW to ensure the safety of employees, contractors and the general public and to promote transmission system reliability and security. Since the company recognizes the need for the preservation of natural resources and the environment, the company employs several different methods of vegetation maintenance. The following objectives should be kept in mind while carrying out all vegetation maintenance work:

- The safety of PSE&G employees, contractors and the general public is the company's highest priority therefore, all vegetation in the structure areas, along the access roadways and in the span lengths and widths, when not limited by easement and/or environmental restrictions, shall be removed and or managed to meet this objective.
- In environmentally sensitive areas (such as wetlands, wetland buffers, riparian buffers and/or threatened and endangered habitats) discriminatory type vegetation work, including specialized tree removal methods will be employed to preserve selected vegetation, particularly the low-growing tree varieties, shrubs and/or other ground cover.
- Throughout numerous spans, the plan supports vegetation removal efforts that will encourage future growth of low-growing more desirable grasses and other herbaceous species that were previously shaded or covered by invasive species or incompatible larger tree species.
- In certain locations, this plan also creates new wildlife habitat features including vernal pools, nest boxes, den and basking sites and supplemental beneficial planting within the ROW, which complements the regional need for various species, including some that are of special concern.

Wire-Border Zone Method

The NJBPU regulations, N.J.A.C. 14:5-9.6 (2008), establish vegetation management requirements, which follows the Wire-Border zone method that divides the ROW into two zones that are managed differently.

According to these regulations, the **wire zone** is defined as “the land located directly under the transmission line, plus a blow out area, which accounts for the swinging of the conductor as a result of wind. For a horizontal transmission line, the wire zone is bounded on each side by a location on the ground that is directly under the outermost transmission wire or the transmission tower, plus the blow out area whichever is wider.”

The **border zone** means the space from the edge of the transmission line wire zone, as defined herein, to the outer boundary of the right of way.

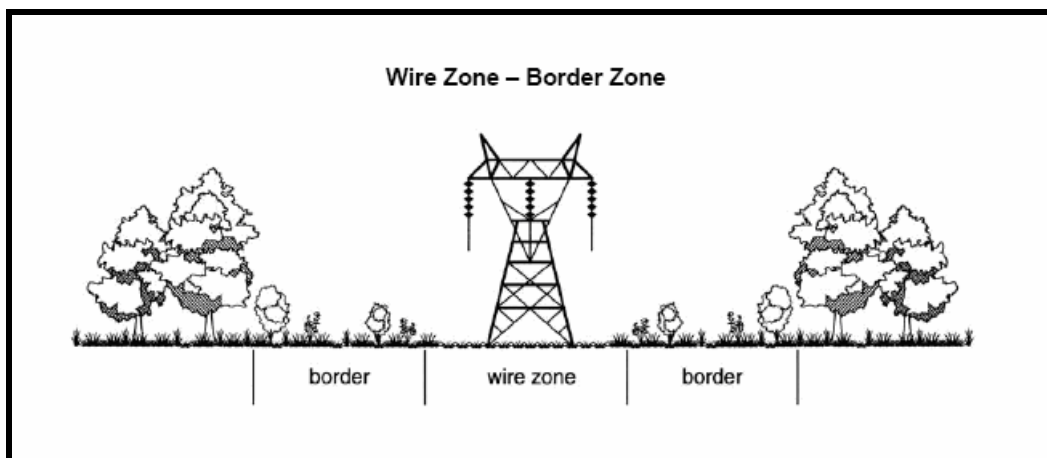
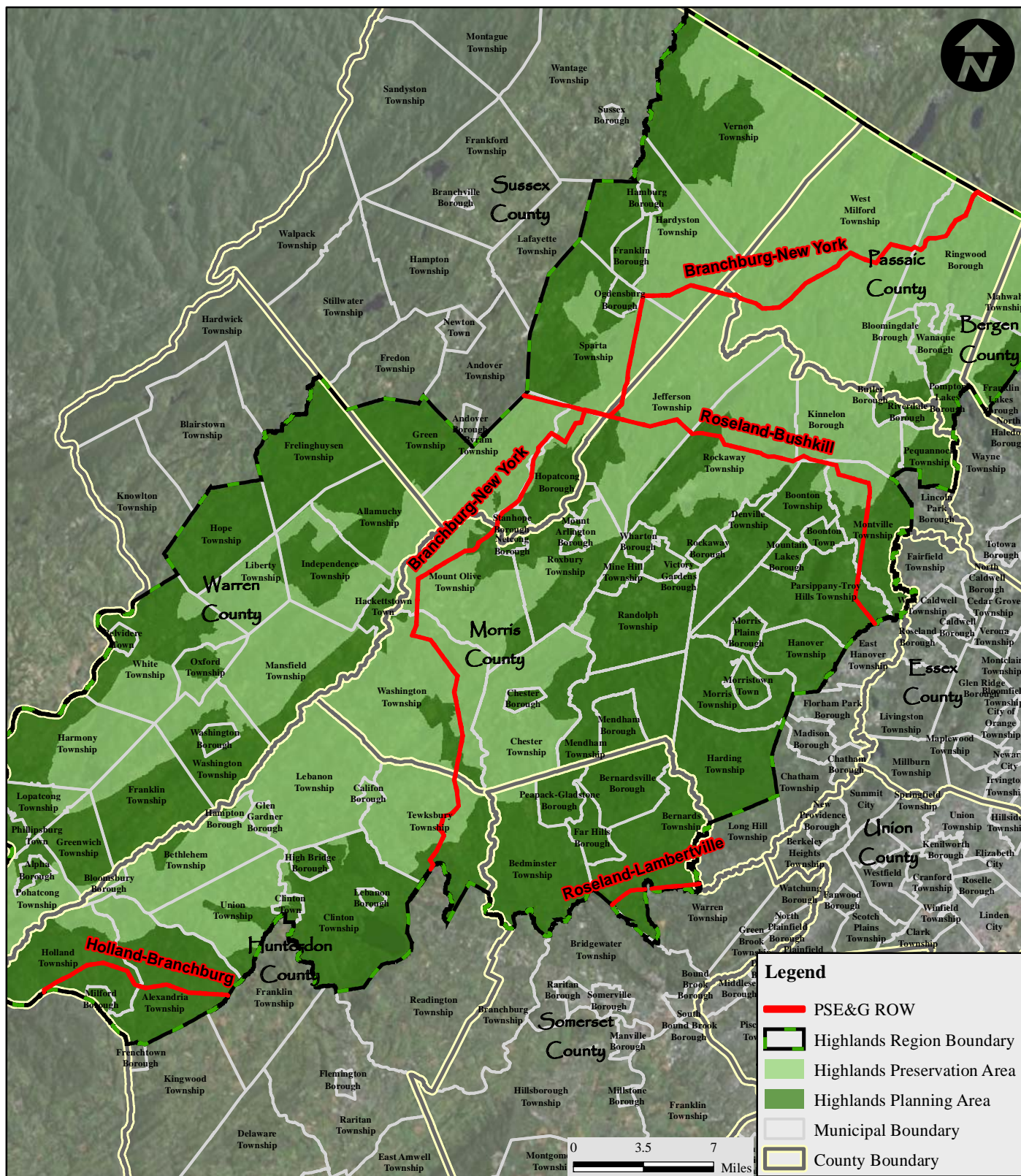


Figure 1 Illustration of the Wire-Border Zone by Yahner, et al 2000



SITE LOCATION MAP
PSE&G Highlands Region Right-of-Ways
Counties of Hunterdon, Morris, Passaic, Somerset, and Sussex
New Jersey



Source:
 Transmission line from PSE&G, 2009.
 Highlands Region Boundary, Preservation Area and
 Planning Area from NJ Highlands Council, 2006.
 County and Municipal Boundaries from NJDEP, 2008.
 Aerial Imagery from ArcGIS Online - Aerials
 Express, 2006.

Drawn By: JA

Scale: 1" = 7 miles

Project No. 01315.0071.030

Chk'd By: PD

Date: 8/22/2011

Figure No. 1

Path: P:\01315\071\Y\N\Maps\RoselandBushkill_Misc\Fig1_HighlandROW_082211_00.mxd

Regulatory and Management Context

Electric transmission corridor vegetative maintenance activity is regulated at the federal and state level. The Federal Energy Regulatory Commission (FERC) approves standards developed by NERC. NERC requires that a transmission owner such as PSE&G create a transmission vegetation management program (VMP) that is regularly updated and includes goals, management practices and procedures, and work specifications and minimum distances for vegetation clearances from electrical towers and conductors.

The NJBPU oversees transmission line siting and vegetation management for existing transmission lines in New Jersey. NJBPU sets forth rules related to the species and height of vegetation within the wire and border zones of ROWs, citing standards developed by the Institute of Electrical and Electronics Engineers, Inc. (IEEE) and disseminated through the National Electric Safety Code C2-2007. These rules found at N.J.A.C. 14:5-9.3-6 (See Appendix A of this plan) are summarized below:

1. Annual inspection of energized conductors is required to determine need for vegetation management.
2. Vegetation management must be performed at least once every 4 years to address vegetation that is close enough to pose a threat to transmission lines. If the company becomes aware at any time of any vegetation close enough to its energized conductor to affect reliability or safety prior to the next required vegetation management activity, the electric utility shall ensure that necessary vegetation management is promptly performed as required under [N.J.A.C. 14:5-9.5](#).
3. A schedule for vegetation management must be submitted each year.
4. No woody plants taller than 3 feet at maturity or non-woody agricultural crops taller than 12 feet at maturity are permitted in the wire zone.
5. No woody plants taller than 15 feet at maturity are permitted in the border zone.
6. Only grasses less than 18 inches tall are permitted to grow within 3 feet of any structure.
7. Tree and other woody vegetation may be left in an active ROW given:
 - i. The slope of the topography exceeds 30 degrees and the clearance between the electrical path to the ground (or vegetation) must be more than 150% the requirements set forth in the National Electric Safety Code.
 - ii. The maximum flash distance for a 500kV line is 14.7 feet (as determined in Miller 2007 from NERC Standard FAC-003-1 and referencing IEEE standard 516-2003); or
 - iii. The existence of a landowner agreement specifying such terms.
8. Species identified as invasive and non-indigenous should be eliminated to the greatest extent practicable from the ROW, especially if they pose a threat to maintenance or a hazard to transmission lines.

Goals and Objectives

The goal of this VMP is to establish a sustainable method of vegetation management within the ROW that (a) provides for the safety of the public, (b) ensures system reliability, (c) is protective of existing sensitive environmental resources, (d) promotes habitat diversity, and (e) reduces maintenance costs; all through an improved and integrated understanding of these complex relationships.

Figure 2: A mosaic of low growing grassland & shrubs

The primary objective of the VMP is to ensure the public safety and the reliability of transmission lines (N.J.A.C. 14:5-9.1) while complying with all pertinent environmental regulations and permits and the Federal requirements of FERC AND NERC. For major portions of the ROW, the preferred growth in a wire zone shall be grasses or a low-growing, compatible, scrub-shrub plant community to obtain a meadow effect where possible.



As part of this VMP, PSE&G has developed strategies that promote the establishment and viability of sensitive natural resources while meeting the requirements for vegetation height and clearing limits as defined by the New Jersey Board of Public Utilities (NJBPU) and the North American Electric Reliability Corporation (NERC).

The plan is designed to be protective of and encourage the sustainability of the following resources within the limitations imposed by NJBPU and NERC:

- The water quality of the Highlands region
- Threatened and endangered species habitat
- Avian habitat
- Wetlands, streams and riparian zones
- Grassland habitats
- Pollinator-friendly habitats for bees, butterflies and other invertebrates

Integrated Vegetation Management

In order to accomplish these goals, PSE&G implements a system of vegetation management decisions which nationwide are known as an **Integrated Vegetation Management** approach or **IVM**. This approach manages plant communities in which compatible and incompatible vegetation are identified, and then appropriate actions are considered and implemented to satisfy the goals of the plan.

“The goal of IVM is to use site-specific, ecosystem-specific, economically sensible and socially responsible treatments whose consequences lead to attainment of management objectives” (Nowak 2005). IVM recognizes the need to coordinate decisions about vegetation control methods based on safety, service reliability, environmental impact, effectiveness, site characteristics, security, and economics.

The IVM approach to vegetation management recognizes that establishing sustainable plant communities that integrate other compatible uses such as wildlife habitat makes economic sense. Ongoing research, including a multi-decade long study in Pennsylvania, has shown that “managing vegetation for the benefit of wildlife leads to a decrease in labor and chemical costs, as well as an increase in years between maintenance rotation cycles.” (Wildlife Habitat Council, 2006).



Typical control methods to be applied using IVM involve a combination of the following:

- Manual activities: Use of physical labor to control vegetation growth with chainsaws and smaller mower equipment.
- Mechanical tools: Use of large industrial mowers mounted on tractors, or excavators. Used when ROW become overgrown and dense with undesirable brush or significant woody vegetation.
- Chemical techniques: Includes the use of herbicides or tree-growth regulators, preferably those that selectively treat individual target plants. The commonly used procedures for herbicide application include basal (bark or stem), cut-surface and high-volume foliar (leaf) application.
- Cultural methods: Involves the introduction of desirable species on the ROW.
- Biological methods: Introduction of plants, pathogens, or microorganisms that will compete with undesirable vegetation.
- Invasive species control: Eradication of invasive plant species where they are found within the ROW.

Reporting and Notice Requirements

The public is required to be notified in advance of vegetation management activities that are occurring within the ROW. The basic notification requirements are as follows:

- Under N.J.A.C. 14:5-9.5, PSE&G is required to maintain vegetation management standards and guidelines which must be submitted to NJBPU within an Annual System Performance Report.
- PSE&G must inform, in writing, any affected municipality and public authority of planned vegetation maintenance activities at least 2 months in advance of physical activities.
- PSE&G must notify property owners at least one week, but not more than 45 days prior to maintenance activities and the notice must indicate if herbicides will be used.
- NJDEP and US Fish & Wildlife Service require a 45-day and 60-day notice respectively prior to work authorized under an existing vegetation maintenance permit from these agencies.

Permit Requirements

- New Jersey Department of Environmental Protection (NJDEP) regulates activities within sensitive areas of the ROW such as wetlands, wetlands transition areas (wetlands buffers), streams, and riparian zones (N.J.A.C. 7:7A and N.J.A.C. 7:13).
- Freshwater Wetland and Flood Hazard Area (FHA) Permits are required for work in these sensitive areas and carry restrictions on maintenance activities, including specific timing restrictions for the protection of trout streams and threatened and endangered species.
- These permits may also require a consultation with the US Fish and Wildlife Service regarding conditions and restriction for federally protected threatened and endangered species.



Current PSE&G Vegetation Management Practices

PSE&G maintain over 1,100 miles of transmission ROW. Each year, PSE&G assesses the conditions of the vegetation on and along its ROW. This is accomplished by aerial inspections, regular on the ground field inspections, aerial photography interpretation, and information from PSE&G personnel, property owners, and the general public. Important information gathered during these assessments includes the coverage by various vegetation types, the mix of plant species, the observed growth, the seasonal growing conditions, and the density of the existing vegetation within the ROW. The company also evaluates the proximity, height, and growth rate of trees adjacent to the ROW that may be a danger to the line or transmission structures.

Where feasible, PSE&G has selected management strategies that promote stable, low-growth terminal vegetative communities. In many locations, PSE&G also seeks to capitalize on opportunities to manage vegetation in support of habitat restoration and enhancement efforts within and adjacent to the ROW. While considering these objectives, this VMP provides efficient, practical and economically sound recommendations for vegetation maintenance and habitat enhancement which is consistent with current practices.

Some methodologies for assessing the current conditions of a span within the ROW are proprietary and are guarded by the company based on public safety concerns. PSE&G conducts site surveys to determine the management needs of a given span and vegetation management program is structured on a sequential process. The span evaluation involves a vegetation survey and environmental assessment conducted by in-house professionals in consultation with NJDEP and USFWS as needed based on the presence of threatened, endangered or species of concern using GIS technology or site assessments.

Once a site visit determines that vegetation maintenance is required, spans are then scheduled accordingly to comply with specific habitat timing restrictions for tree removal, brush mowing, and herbicide application as needed. The following year, spans are evaluated again based on established practices for monitoring a span for vegetation management.

Existing ROW Conditions

The PSE&G ROW through the Highlands Region comprises some very diverse eco-regions and habitat types. It extends up and across numerous mountain ranges, across lakes, marshland and other wetlands, across geologic outcrops, farmfields and through existing suburban neighborhoods. The only constant condition from span to span is the typical width of the existing ROW, which is generally measured between 150 to 200 feet depending on the ROW. Because of this diversity, there is no single set of standards that can or should be applied to the entire length of an existing ROW. However, the following photographs typify examples of the various types of vegetative conditions existing within the Highlands Region. These photographs were taken along the Roseland-Bushkill ROW, which is also known as the Susquehanna-Roseland (SR) ROW. And is a typical ROW displaying similar conditions as other ROW in the Highlands region.

The area of the ROW now occupied by suburban neighborhoods and other developed conditions is approximately 9%. In these locations, the ROW is managed to be compatible with the BPU regulations, while also being respectful of the vegetative conditions and the context of the ROW to the extent practicable.

Figure 2A: Suburban development on or near the ROW



Figure 3 Typical Agricultural (A) lands beneath existing Susquehanna-Roseland transmission line



Active agricultural lands typically require minimal maintenance by PSE&G transmission line staff, although PSE&G staff work closely with farmers to assure that crop management practices are consistent with vegetation maintenance requirements. In accordance with NJBPU rules, agricultural crops are typically below 12 feet in height and accordingly are permitted by PSE&G within the ROW. PSE&G transmission line personnel may periodically conduct maintenance on the line by the removal of sporadic woody vegetation within hedgerows along the ROW. Agricultural spans within the Highlands region compromise approximately 10% of the existing ROW.

Figure 4: *Forest dominated span (F) beneath existing Susquehanna-Roseland transmission line*



Forest dominated spans, as illustrated in the background of the photograph, are limited in their locations along the ROW. If left unchecked, they could pose significant issues for transmission lines since the potential for interference with existing conductors increases with the height of vegetation. NJBPU and NERC regulations are specifically designed to avoid these types of situations. However, the NJBPU regulations establish room for interpretation where “the slope of the topography exceeds 30 degrees and the clearance between the electrical path to the ground (or vegetation) must be more than 150% the requirements set forth in the National Electric Safety Code.” Under these limited conditions, the forests similar to what this photo demonstrates may be left. However, the discretion must rest with the company with respect to the prescribed safety considerations, requiring action such as topping, girdling or removing any danger trees. As this photo also demonstrates, the requirements for transmission line maintenance may also overlap or conflict with regulations protecting wetlands and riparian vegetation. Preserving the functioning of wetland and riparian areas is an important component of the vegetation management plan. Forest dominated spans within the Highlands region compromise approximately less than 1% of the existing ROW.

Figure 5 *Shrub and tree dominated span (S-T) beneath existing Susquehanna-Roseland transmission line*



A shrub and tree dominated span poses particular vegetation management difficulties. Certain species of woody vegetation that have been mowed or cut can produce “runners”, shown within the center section of this span, that develop from the base of a remnant tree. Unless treated with spot herbicides to control their growth, these “runners” grow very quickly and require additional costly management before they encroach into the safety zone of the conductors. A second vegetative management issue, illustrated in this example, is side growth from trees along the outer perimeter of the corridor. As vegetation seeks additional sunlight, side growth can intrude into the safety zone of the transmission line corridor. Accordingly, PSE&G routinely is required to “side trim” the edges of their corridors to preserve adequate safety margins between the vegetation on the edges of the transmission corridors and the conductors. Shrub and tree dominated spans within the Highlands region compromise approximately 10% of the existing ROW.

Figure 6 *Herbaceous vegetation with shrubs (H-S) beneath existing Susquehanna-Roseland transmission line*



A span dominated by herbaceous vegetation and shrubs is a preferred condition to that of a forested span. In some cases, as dictated by NJBPU regulations, this type of vegetative community may be an acceptable condition. However, depending upon the ultimate final growth height of shrubs and potential seedling growth, the need for maintenance will vary. Spans with this type of vegetation are typically not considered “red spans,” i.e., they do not need immediate maintenance. Side trimming of encroaching tree limbs and removal of isolated trees is a common maintenance practice within these types of spans. Herbaceous vegetation dominated by shrubs spans within the Highlands region compromise approximately 10% of the existing ROW.

Figure 7 *Tree sprout and herbaceous vegetation dominated with few to no shrubs (T-H)*



A span dominated by tree sprout and herbaceous vegetation dominated by few shrubs meets the vegetation criteria established by both NJBPU and NERC. Typically, this type of span would be subject to maintenance on a 3 to 5 year cycle depending upon the type of tree sprout present within the span. Spans dominated by herbaceous vegetation with tree sprout and few shrubs within the Highlands region compromise approximately 30% of the existing ROW.

Figure 8 *Scrub-shrub wetland dominated span with tree sprouts or topped trees (S-H)*



A span dominated by scrub-shrub wetland vegetation meets the vegetation criteria established by both NJBPU and NERC. The presence of topped trees is not a recommended practice from a natural resource perspective. Typically, topped trees result from requests from adjacent property owners or other interests to preserve trees. While the tree is preserved, the practice of topping trees at a height significantly below their original height is not healthy for the trees and is likely to lead to disease or eventual death of the tree. However, in some locations, topped trees may also be intentionally girdled and left standing as a wildlife snag to provide perches for raptors, food sources for woodpeckers, and sites for cavity nesting bird species. Spans with this type of vegetation are subject to maintenance on a 3 to 5 year cycle. Spans dominated by scrub-shrub wetland vegetation within the Highlands region compromise approximately 5-10% of the existing ROW.

Figure 9 *Herbaceous wetland dominated (PEM) beneath existing Susquehanna-Roseland transmission line*



A span dominated by herbaceous wetlands vegetation meets the vegetation criteria established by both NJBPU and NERC. Furthermore, from a transmission management perspective, a span dominated by herbaceous wetland vegetation is an ideal situation. It provides the ultimate operational safety from conflicts between the conductors and vegetation and it provides easy access to the corridor in the event of an emergency. It also allows for relatively cost effective and routine maintenance. Spans with this type of vegetation are subject to maintenance on a 3 to 5 year cycle. Spans dominated by herbaceous vegetation within the Highlands region compromise approximately 5-10% of the existing ROW.

Figure 10 *Rock outcrop or bare soil (R) beneath existing Susquehanna-Roseland transmission line*



A span dominated by rock outcrops interspersed with various types of vegetation may meet the vegetation criteria established by both NJBPU and NERC depending upon the height of the interspersed vegetation. These types of spans can pose challenges for mechanized maintenance because of the presence of the rock and the potential impact to mowing equipment. Spans with this type of vegetation are subject to maintenance on a variable cycle depending upon the type of interspersed vegetation within the span. Spans dominated by rock outcrops within the Highlands region compromise approximately 10% of the existing ROW.

Management Strategies

The following management strategies describe alternative philosophies that may be applied to specific ROW spans or series of contiguous spans. A number of combinations of treatments may be used to maintain ROWs under these strategies and all are subject to any restrictions imposed by applicable permits and the presence of sensitive species and habitats. Ultimately, the combination of strategy, treatments, and restrictions prescribed for an individual span should consider public health and safety concerns, maintenance crew safety, effectiveness, natural resource impacts, site condition, and cost. NJBPU describes the preferred terminal ROW vegetation as low-growing (compatible) scrub-shrub communities or grasses in order to meet clearance requirements for the transmission lines. This is accomplished based on several management strategies.

As-Needed Maintenance Approach

Description

PSE&G performs vegetative maintenance along spans on an as-needed basis that conforms to the NJBPU regulations. PSE&G conducts annual visual inspections of spans to determine, based on vegetation height and clearances between transmission lines and vegetation, whether maintenance is required. Vegetative maintenance must be performed every four years, at minimum (N.J.A.C. 14:5-9.4) to rectify clearances that are small enough to pose a threat to public health or the integrity of the transmission system. The current PSE&G vegetation management is similar to this approach.

Treatment Methods

Maintenance is conducted using the most efficient method given the terrain and typically involves large-scale non-selective cutting and/or mowing of vegetation combined with application of non-selective herbicides to the entire span. Treatments are subject to any applicable restrictions, but this strategy does not generally promote stable terminal communities or provide quality habitat.

Advantages, Disadvantages and Potential Impacts

This management approach is considered cost-effective in the short-term. However, it often leads to tree re-growth within the ROW, requiring similar or increasingly intensive treatments to maintain acceptable conditions during each maintenance cycle. Each maintenance cycle results in repeated disturbance to habitats, wildlife, and non-target plant species through habitat and ground disturbance and machinery noise. This strategy may require more frequent and intense management than others.

Specific Examples for this management strategy

- Spans overgrown by blackberry, raspberry, or multiflora rose which are inaccessible due to the dense thickets formed by these thorny shrubs. Often these thickets provide limited species diversity and grow out of control and spread into neighboring properties.

Slow Growing Spans

Description

Along portions of the ROW, several spans have reached an equilibrium that is dominated by slow growing shrubs, like mountain laurel, rhododendron, and low bush blueberry. These are often locations in higher elevations and on harsh weathered plateaus with rocky soil conditions. While some individual plants may technically exceed the three (3) foot rule in the wire zone, and would meet the border zone standards of 15 feet - many of these trees are very old and have reached a point where new growth each year can be measured in very small increments. Removing these trees on harsh rocky soils could lead to a soil erosion problem.

Treatment Methods

Vegetation maintenance in these communities is recommended to be evaluated and identified as a slow growing span, which can be documented by comparison of individual shrubs to a vegetation profile board as shown in Figure 11. This board will enable the field survey crews the ability to photograph individual trees or shrubs during successive years to show that the annual growth of slow growing species is not cause for a vegetative maintenance concern. Treatment methods should be to trim offending branches that are reaching skyward and to encourage a more lateral orientation of growing branches. Individual fast-growing trees within these spans can be removed manually with a chainsaw.

Advantages, Disadvantages and Potential Impacts

This management approach is considered very cost-effective since it requires little maintenance, except the evaluation process described above and maybe the occasional trimming plants on the transmission ROW.

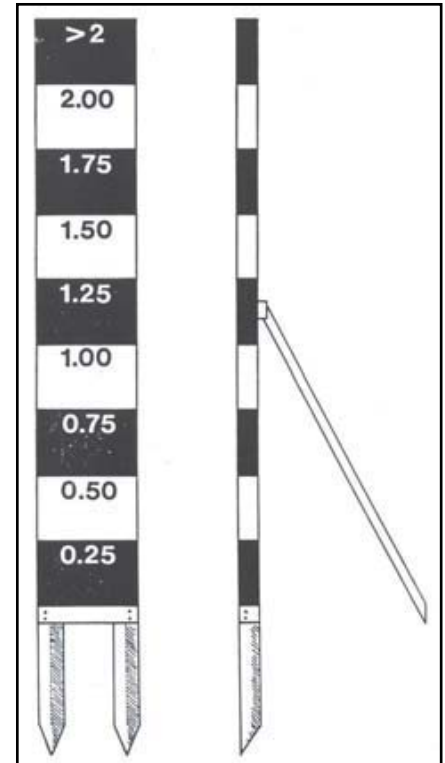


Figure 1:
Vegetation Profile Board

Directed Succession Grassland Approach

Description

This approach focuses on promotion of tree-resistant, low-height terminal plant communities (tall and short grasslands habitat) within the ROW that meet clearance requirements set forth in NJBPU regulations and standards set by NERC. The desired terminal community is created through cover-type conversions that use a combination of treatments (manual, mechanical, herbicide, and biological) to provide competitive advantage to plant species compatible with these regulations. Different communities of grass, shrub and herb species have different resistance to tree establishment (Bramble et al. 1990), and communities with tree-resistant characteristics should be favored. Two phases are typically required to achieve the conversion. Nonselective clearing within the ROW is followed by directed succession of re-growth using selective treatments (Miller 2007). A prominent example of this approach is the wire-border zone method (Bramble et al. 1992). Within the wire zone (the area directly beneath wires on either side), species with a height at maturity of less than 3 feet—namely grasses, forbs and small shrubs—are promoted. Within the border zone (the remaining area within the ROW), shrub dominated terminal communities are promoted. The wire-border zone method is considered a best management practice; however, it is not always appropriate or feasible in all locations of the ROW (Miller, 2007).

Treatment Methods

The initial establishment period requires intensive non-selective clearing, typically using mechanical methods and appropriate herbicide applications, followed by selective elimination of persistent tree sprouts and other inconsistent species to provide competitive advantage to preferred species. Initial establishment of desirable species occurs through the existing seed bank or by planting desired native grassland species, if necessary. Once the desired tree-resistant, low-height terminal plant community is established, subsequent maintenance would involve selective cutting and possible herbicide application.

Advantages, Disadvantages and Potential Impacts

Development of tree resistant cover types reduce tree densities and thus are expected to increase maintenance efficiency, decrease costs (Bramble et al. 1990), and provide a more stable and less frequently disturbed habitat for wildlife over the long term. The initial establishment period may be more time and cost intensive; however subsequent maintenance should require significantly less effort—fewer trees to cut during maintenance and sometimes a reduction in maintenance return intervals. This effort reduction also results in fewer disturbances to wildlife and habitat. Planting for initial establishment may become cost prohibitive and would be feasible only in select areas or when funded in cooperation with a wildlife partner, such as New Jersey Audubon or the Natural Resource Conservation Service (NRCS), Wildlife Habitat Incentive Program (WHIP).

Specific Seed selection for management strategy

Flat upland spans, which extend for long distances can be managed as short or tall species grasslands containing a mix of little bluestem, big bluestem, Virginia wild rye, and Indian grass. As the topography increases, then grassland species that are scenic and more suitable for stabilizing slopes should be used to include deer tongue, Virginia wild rye and various colorful wildflowers. Species selected for the region ERNST 01: Buena Vista Upland Seed Mix (Short); ERNST 02: Buena Vista Upland Seed Mix (Tall) and ERNST 03 Steep Slope Scenic Mixture. See Appendix 1 for the entire listing of restoration seed mixtures suitable for specific areas within the Highlands region prepared by Ernst Seed Company.

Rotational Management Approach

Description

This approach relies on the creation of a rotational treatment schedule for a series of contiguous spans with similar habitat potential. This approach would be implemented to create stable habitat suitable for a selected wildlife species. The series of similar spans would be managed such that within the home range of the selected species, appropriate habitat would be maintained at all times but would be located within different spans within the series to allow for required vegetation management. The number of spans, timing and types of treatments, and type of managed habitat would depend on the requirement of the particular species, terrain, existing site access, conditions and restrictions, and other environmental factors that might influence the growth rate of plants (e.g., rainfall).

Treatment Methods

Maintenance is conducted using the most efficient method given the terrain and typically involves large-scale non-selective cutting and/or mowing of vegetation combined with application of selective herbicides to the entire area. In certain species-dependent cases, treatments that are more selective or some aspects of a directed ecosystem approach may be appropriate. Treatments would be subject to any applicable restrictions—those related to breeding seasons and herbicides may be particularly important.

Advantages, Disadvantages and Potential Impacts

The Rotational Management strategy is an efficient and cost effective way to provide quality habitat to specific species through the purposeful scheduling of maintenance activities. It is similar to the As-Needed Management strategy in that it typically uses the most efficient non-selective or selective clearing methods most suitable for the terrain within a span. Similarly, this management approach is considered cost-effective in the short-term, but can lead to increasingly intensive treatments due to increases in tree sprout density. Additional mobilization costs may be incurred due to maintenance within contiguous spans being restricted. This strategy will provide undisturbed quality habitat for a specified species within a series of spans—although maintenance activities would result in disturbance to habitats, wildlife, and non-target plant species, quality habitat would be available within close proximity. This strategy may be especially effective for species that require communities of a mid-successional stage.

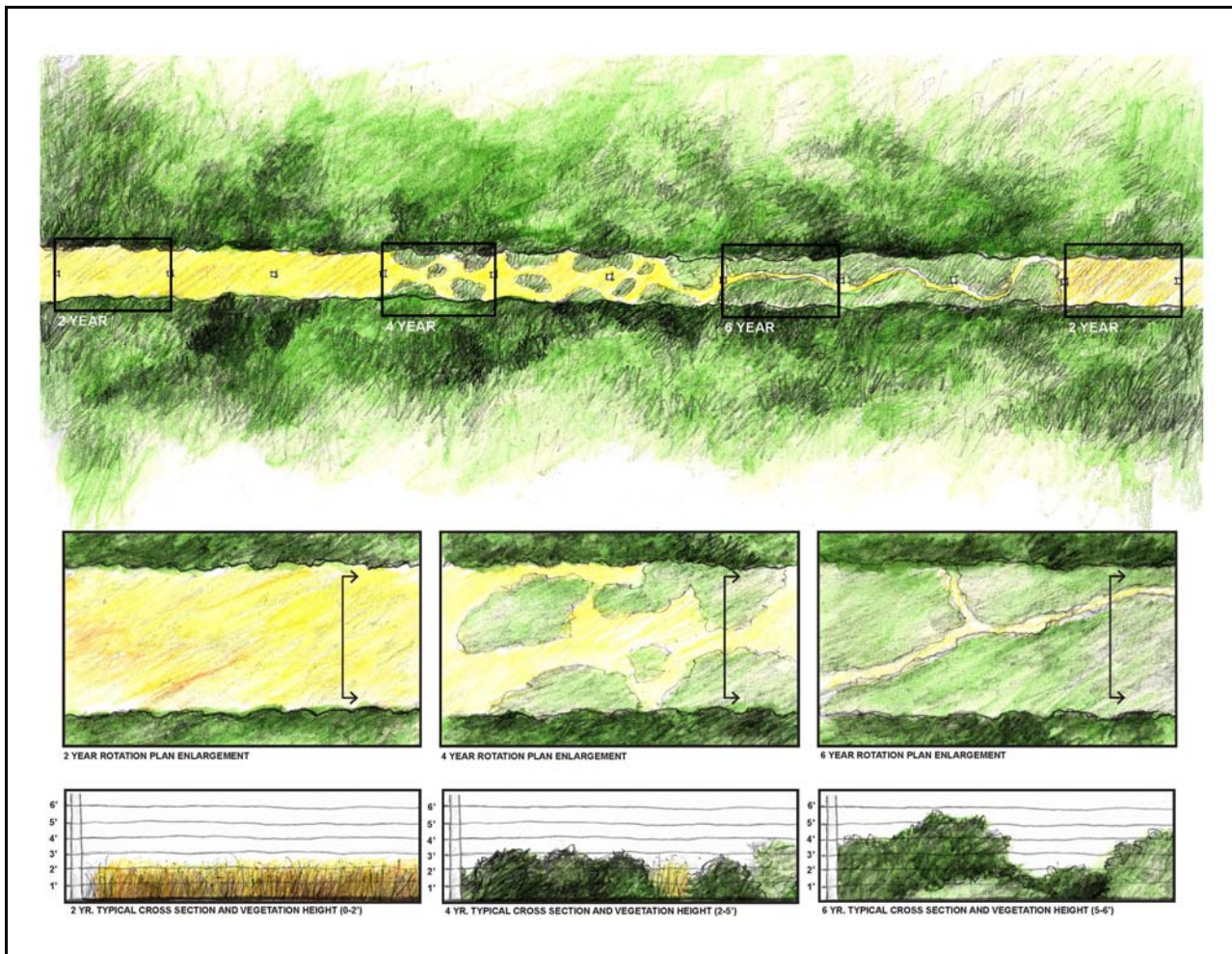
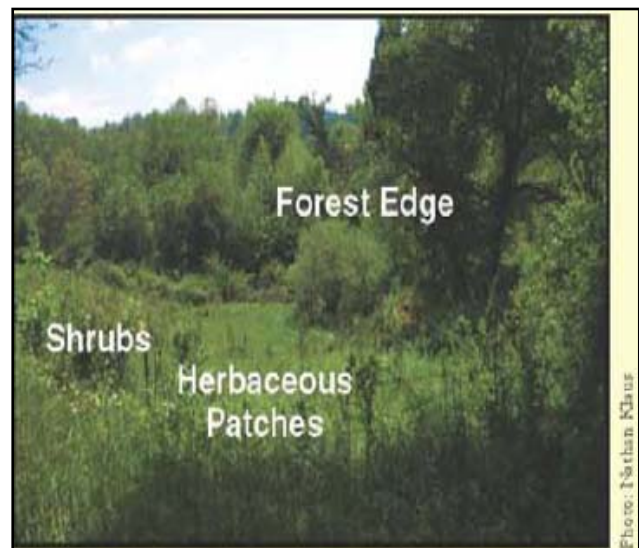


Figure 12: Case Study: The Golden-winged Warbler (*Vermivora chrysoptera*) is an early-successional species that requires a somewhat unique habitat of sparse trees and shrubs with an herbaceous understory of grasses and forbs in either upland or wetland settings. Rotational cutting of the ROW along a series of spans has been used to create needed habitat types for this species.



Special Areas

Special areas are those that either have special treatments required through permits or regulations or present an opportunity for less disruptive treatments. PSE&G would manage these areas with modified treatment prescriptions. Special areas are typically a subset of a span, and maintenance would be prescribed for these areas in addition to the basic span by span management.

Special Area Practices

Ravines / steep slopes

NJPBU permits trees to grow within the ROW to a height that is 150 percent of the required clearance between ground and wire, when located on a 30 degree or greater slope. This allowance provides an opportunity to protect stream and riparian habitats in some instances, even if topping of trees is required. Because little to no maintenance would be prescribed, maintenance costs should be substantially reduced, especially in areas where the transmission lines are sufficiently high to eliminate the need for topping.

Replanting rather than topping

Areas where tree topping has occurred or is planned (because of restrictions or access constraints), may provide an opportunity to replant with compatible shrub or tree species rather than topping trees which might kill or limit the habitat value of tree. Replacement of tree species may be especially useful when fast-growing, tall trees are the existing dominant species (e.g., sweet gum). The costs for replanting are expected to be high and should only be considered in extremely sensitive area.

Spans adjacent to preserves, parkland or State/National historic sites/districts

The transmission line ROW within the Highlands region does traverse adjacent to or within publicly and privately owned preserves and parkland and in some instances to State or National listed historic sites/districts. Habitat management is likely less restricted in these areas than within the ROW and partnerships may be formed to select a terminal vegetation community or a maintenance strategy that complement these adjacent lands. These landowners may also want to take advantage of habitat creation opportunities such as using cut vegetation to form snags or brush piles on parcels adjacent to the ROW. Companion management plans, such as for NJDEP wildlife management areas or Morris County parklands, may also provide suggestions for opportunities of this kind. Where feasible and cost-effective, PSE&G will incorporate such measures.

Pollinator Friendly Spans

The North American Pollinator Protection Campaign (NAPPC), in partnership with the Wildlife Habitat Council and the Xerces Society, has created a list of Pollinator Friendly Practices, which consider six different areas of land use management: foraging habitat, reproduction, shelter, invasive/exotic species control, chemical use, and monitoring. Habitat management practices vary depending on the type of native pollinator targeted. However, there are a number of habitat management practices that will benefit most, if not all, groups of native pollinators. These include planting appropriate vegetation, providing water, and using pesticides carefully. Where feasible and cost-effective, PSE&G will incorporate such measures. Appendix 6 contains a list of plant species that are most suitable for pollinators.

Treatment Methods

Maintaining the ROW with various treatment options requires an understanding of the existing regulatory limitations and the need to manage maintenance costs. At the same time, protecting the wildlife present and enhancing their habitats in an integrated manner has significant value from a regulatory and cost perspective. The following treatment options are intended to find this balance.

Ground line Maintenance

This practice shall be interpreted to mean that all trees and shrubs shall be cut to the ground level (1 inch above the soil) if possible, but no more than 3 inches (3") above soil line, except within environmentally sensitive areas. In wetland areas mower heads will be set at 6 inches above the soil line. In areas determined to support New Jersey threatened or endangered plant species, mowers will be set at 3 inches or greater (3 inches in upland habitat, 6 inches in wetland habitat). Ground line-type tree removal methods shall be employed along all access roadways, all structure sites and in all spans with no easement or environmental restrictions. If an area has been cleared, the area will be maintained in the same manner. This practice also recognizes adherence to the established timing restrictions and in-field oversight by environmental professionals when sites are particularly sensitive. Generally, the maintenance window for numerous spans occupied by threatened or endangered species is very narrow once timing restrictions are imposed. This reduces the likelihood that these species will be harmed by low cutting mowers. Timing restrictions play an integral part of the maintenance schedule, but then require intensive mobilization of manpower within a shorter window of time to accomplish the needed maintenance objectives for a particular span.

Cutting and Clearing Treatments

Manual Control

PSE&G currently employs manual control of vegetation using chainsaw and other hand tools to cut trees at the base when selective treatments are prescribed or when access for heavy equipment is limited or restricted. PSE&G will top trees (removing the upper portion of a tree) in cases of regulatory requirement or property owner request.

Treatment Options

- Physical removal of trunk /roots may be appropriate in limited upland situations (e.g., invasive species control)
- Girdling a tree by cutting a ring around the trunk so that the tree is killed, but remains standing may be appropriate in limited situations (e.g., the creation of snag habitat)
- Topping may be appropriate in limited situations (e.g., the creation of snag or perch habitat)

Advantages, Disadvantages and Potential Impacts

Manual cutting is relatively labor intensive and creates large amounts of debris. Its most appropriate use is in wetland and riparian corridors where the use of heavy equipment can potentially disrupt soils, create mosquito habitat from resulting ponded areas, and change the nature and function of the ecosystem. When used on certain forms of deciduous vegetation (e.g., sweet gum, red maple) manual cutting without associated use of herbicide or removal of the trunk/root system can result in re-growth at greater stem densities. The development of fast growing “runners” emanating from a cut tree is a continual maintenance issue from manual cut vegetation, particularly within wetland and riparian areas. Topping can also be used in sensitive areas such as wetlands or riparian zones where trees are compatible with regulations provided that they are maintained with sufficient clearance. Topped trees will continue to grow and must be maintained regularly to ensure they do not encroach on minimum clearance requirements. Impacts from manual cutting include temporary noise disturbance to wildlife from chainsaws and the presence of humans and from the possibility of oil from equipment entering water sources. Residual management is a particular problem with manual control. Access to fallen vegetation is limited and hand removal from wetland and riparian areas is labor intensive which subsequently increases the probability of safety related incidents.

Figure 12A: Examples of Rotational Cutting in early Fall and Spring



Mechanical Control

Mechanical Control of vegetation using machinery mounted on tractors or excavators (tires or tracks) is used widely by PSE&G for nonselective clearing of trees, shrubs and grasses.

Treatment Options

- Walking bush controllers have mechanisms (e.g., booms, dippers, etc.) to provide increased maneuverability and precision and to minimize soil disturbance while cutting.
- Shears are used to cut at the base, lift and stack entire trees. Examples include feller-bunchers and excavator-mounted mowers.
- Roller-chopper equipment use blades, chains and other devices to roll and chop vegetation.
- Blading equipment uses blades or forks to remove vegetation with pushing and lifting motions.
- Mechanized pruning equipment (e.g., boom-mounted circular saw) can be used to efficiently remove branches from a distance or at excessive heights.
- Aerial lifts can be used to provide access to tree tops for manual control treatments such as topping and pruning.

Advantages, Disadvantages and Potential Impacts

Mechanical cutting methods are considered cost effective and efficient, especially when a span has thick stands of incompatible vegetation. Machinery often creates and spreads mulch during the cutting process resulting in minimal large forms of debris from cutting activities. Additional stump removal efforts may be necessary after mechanical treatments. In most uses, mechanical control does not afford an opportunity to avoid non-target species. Machinery can also unintentionally spread undesirable seeds and does not kill the roots of plants making return treatments necessary. Mechanical control utilizes heavy machinery that has the potential to impact wildlife, habitat and water quality. Noise, exhaust, dust, and the presence of people can disturb wildlife. The machinery can disturb soils, disrupt soil horizons and compact soils (all of which can modify plant communities and make invasive plant growth more likely), and the possibility of petroleum product leaks from refueling and hydraulic processes is ever present.



Mowing

Mowing is accomplished by a variety of specific types of mechanical equipment. Equipment is selected based on the types of plant growth present within the ROW span. Figure 13 (Fecon Grinder) represents the types of larger equipment that can shear and shred shrubs and small trees growing within the ROW to a ground pulp chip. Figure 14 (Tractor-mounted Fecon) is also able to shred woody vegetation to a pulp, when mounted to the back of a tractor. A HydroAx (Figure 15) is also used to clear woody vegetation from ROW but does not grind stumps as well as the Fecon mowers, and so trees often re-sprout from the root system. From a cost perspective, the ability to manage the ROW with a Brush Hog (Figure 16) would be ideal. This mower is most effective on tall grasses and herbaceous plants but is less effective when larger woody vegetation takes over a ROW.

Vegetation managers select machinery based on the control that is required on the ROW. There is also a progression of equipment that can be selected over time. For example, initially a larger Fecon mower may be used, which has the capacity to shred modest size trees and most shrubs into a woody pulp. This is not a quiet machine, which has drawn some public attention. However to minimize the impact of this machine on neighboring properties, maintenance work within a ROW occurs during the week and during normal working hours. The secondary treatment could consist of the use of a smaller Fecon mower in combination with an herbicide application to kill back any sprouting woody vegetation. By the third treatment, the ROW can generally be cut with a brush hog and could then be maintained as a grassland meadow on a regular two to three year cycle. PSE&G has established various warm season grassland mixtures, which can also be planted within the ROW in select areas.

Mowing is considered cost effective and efficient for large-scale nonselective clearing operations, especially when a span has thick stands of tree sprouts or other incompatible vegetation. As with other mechanical control methods, avoidance of non-target plant species is difficult. However, it is not uncommon to combine mowing treatments with manual removal in patchy habitats. Also PSE&G has established windows of time, where most cutting occurs to be the least disruptive to wildlife within in the ROW.

Figure 13 : Fecon Grinder machine



Figure 3 HyroAx Mower



Figure 14: Tractor Mounted Fecon



Figure 4 Brush Hog mower



Chemical Control Agents (Herbicides)

Chemical control treatments involve the application of a chemical substance to vegetation to kill or control its growth. These substances must be used in accordance with label instructions and with applicable regulations and laws. The application of herbicides has numerous uses in vegetation management, ranging from primary treatment of dense vegetation to selective elimination of species. Herbicide treatments must specify an application method, type (active ingredient), concentration, and volume/rate. Different types of herbicides can be either general (nonselective such that they act on all or most plants) or selective (effectiveness limited to one or species or other limited group of plants). These details should be decided by the vegetation manager and should consider the range of options, minimizing impacts to non-target species whenever possible.

PSE&G will not employ broadcast spraying of herbicides from aircraft or from high-volume sprayers from trucks. Subsequent to the initial clearing of large woody vegetation and subsequent selective cutting and mowing operations, selected herbicides which control woody and broad-leaved vegetation will be applied. This will be accomplished through the use of an ultra low volume emulsified herbicide applied by an inverted low-level directional spray contained on the rear of a modified track-mounted ATV. The selected vertical directional application of emulsified herbicides applies the emulsification directly onto the vegetation and soils in a uniform pattern of droplets, which allows for control and maintenance of the undesirable vegetation during the growing season. The selected emulsified herbicide mixture falls directly onto the plants/soils and does not become airborne as the herbicide mixture is not in an aerosol state.

Herbicide treatments are commonly used to control re-sprout and to promote the establishment of compatible vegetation that is both sufficient for wildlife species and cost-effective to maintain.

Treatment Options

- Backpack sprayers are used to apply spot treatments.
- Tubular lances and hand held cutting devices, in combination with backpack or squirt bottle applicators, are used to cut and inject herbicides into the tree.
- Herbicides in pellet form are used in localized treatments and are dropped within the drip line of the target plant during sufficiently wet weather.
- Sprayguns, broadcast nozzles or booms mounted from tractors or ATVs are used for low volume applications.

Alternative Application Methods

Stump treatments are applied to individual cut stumps with backpack applicators or other hand carried devices. They are used to discourage tree re-sprout.

Basal treatments are used on individual stems or trunks at the base and are applied to the bark or injected with backpack applicators, tubular lances or other hand carried devices.

Low-volume foliar treatments are localized treatments used on individual plants or confined groups of plants during the growing season and typically applied using backpack or ATV mounted sprayers.

Advantages, Disadvantages and Potential Impacts

Compared to manual and mechanical cutting treatments, herbicide application minimizes soil disturbance and impacts from noise and exhaust. Improper application can result in contamination from volatilization, leaching, and drift. All required application protocols must be followed to avoid environmental consequences and application to unintended plant species.

Alternative Herbicides

Biological Controls

Although not currently in use by PSE&G, but biological controls may be appropriate, in limited areas, for directing succession and/or controlling invasive species. Biological control agents are typically plant-eating insect or pathogens (bacteria or fungus) that cause disease in the target species. Sometimes particular plant or animal species can be used to inhibit the growth of incompatible plants through chemical suppressors or consumption of seeds/plant matter, respectively. These control methods are limited in use, but may be appropriate in sensitive areas where herbicide use is restricted. Biological control methods may be practical when existing conditions promote biological control naturally, but can be costly and slow to take effect when planting or release is required. When considering non-native biological controls, only tested species with proven host specificity should be employed. In addition, biological control agents are not always available for the target species.

Cultural Controls

Cultural control methods use habitat modification to promote the growth of compatible species and typically incorporate other control methods (e.g., mechanical, manual, and chemical) to achieve a desired terminal vegetative community. Cultural controls are considered best management practices where they are applicable (Miller 2007).

Treatment Options

- Agricultural crops can replace incompatible vegetative cover.
- Meadow creation can replace incompatible vegetative cover.
- Cover-type conversions provide competitive advantage to tree resistant, native, low-growing communities (grass and forbs) by employing multiple control methods

Advantages, Disadvantages and Potential Impacts

Cultural control methods typically require an initial reclamation period where incompatible vegetation is cleared to allow the establishment, through planting (agricultural crops, or meadow creation) or sprouting from the existing seed bank. This initial period can be intensive and costly, but subsequent management requirements are typically reduced. Crop production and the creation of sustainable early successional communities are considered benefits of cultural controls. Impacts associated with treatments used during the initial reclamation period would also apply.

Residuals (woody debris) Management

Vegetative maintenance results in logs and branches (slash) that must be managed according to fire risk, landowner requests, terrain, vegetation establishment goals, and adjacent land use. Woody debris left unmanaged within the ROW after cutting can prevent desired herbaceous and shrub species from sprouting and may interfere with future maintenance activities. Dry woody debris (particularly debris within piles) within ROWs may pose a fire hazard that risks the reliability of the transmission lines. Mowing treatments usually do not require debris removal unless excessive quantities of debris would prevent sprouting of desired herbaceous and shrub species. Many mechanical treatments automatically chip wood as it is being cut.

Typically for upland areas, slash should be chipped and spread out thinly along the ROW and logs should be chipped and removed or lopped and scattered within the ROW. It is acceptable for debris to remain within the ROW provided that piles are not formed, unless specifically designed as habitat brush piles within identified locations only. Within wetlands and wetlands buffers, the area of debris allowed to remain in is limited to 2 percent of the wetland or wetlands buffer area and all slash and logs excess of this amount should be chipped and removed from the ROW. Chipping should occur on the access road to prevent filling the wetland with debris. No woody debris should be placed below the high water mark for surface waters unless specifically designed to be a habitat enhancement measure.

Treatment Options

Some alternative practices for maintenance residuals may be used in certain instances where access is limited, landowners have special requests, or habitat enhancement opportunities are possible. If an alternative method is planned, it should be approved by the ROW landowner and any applicable regulatory agency.

- Woody debris that has been chipped or lopped may be spread on the ROW and left to decompose as mulch.
- Logs may be recovered for firewood or wood products.
- Topped or girdled trees may be left as habitat (snags) either within the border zone or in properties adjacent to the ROW if land cover is appropriate and the opportunity to coordinate with landowners exists.
- In areas inaccessible to tractor-mounted equipment, felled trees should be limbed and logs lopped. Lopped logs and slash should be spread throughout the ROW, unless other specific measures are prescribed.
- Vegetative debris may remain within wetlands and wetlands buffers provided that the area covered by the debris be no more than 2 percent of the land area of the wetland or wetlands buffer area in question located within the ROW. This debris should be cut to 4 feet or less in length and 3 inches or less in diameter and should not disturb the ecological function of the wetland or wetlands buffer. All vegetative debris located in wetlands and wetlands buffers in excess of the 2 percent should be removed from the ROW. This is a similar standard now presently used in the Pinelands Transmission ROW Vegetation Management Plan.

Prescriptive Practices

In this section, generic prescriptions are prescribed for different existing cover types. Terrain, accessibility, the presence of sensitive areas or species, or other opportunities and constraints may require modifications to and restrictions on these guidelines.

- Agriculture dominated spans should utilize prescribed mechanical mowing, if necessary, and only after crop harvest.
- Shrub and tree dominated spans should utilize prescribed mechanical or manual clearing of trees, avoiding shrubs, and stump application of herbicides.
- Tree sprout and herbaceous vegetation dominated spans with shrubs should utilize prescribed mowing of tree sprout and grasses, avoiding shrubs, and stump application of herbicides.
- Tree sprout and herbaceous vegetation dominated spans with few to no shrubs should utilize prescribed mowing and broadcast ground application of a selective herbicide (that does not affect forbs and grasses).
- Scrub-shrub or herbaceous dominated spans with some tree sprouts or topped trees should utilize prescribed manual cutting and stump application of herbicides.
- Herbaceous dominated spans should use prescribed mowing.
- Rock outcrop / bare ground should utilize manual removal of any trees followed by stump application of herbicide, but otherwise no management is required.

Timing

Timing of vegetative control treatments, both in terms of return intervals and time of year, is an important component to VMP. Return intervals are influenced by the existing cover type, growth rate of plants, management strategy, and treatments being applied. In cases where a span is managed for a particular species (e.g. Rotational Management Approach), the species' life history and the number of spans being managed together affect the frequency of management. Seasonal timing is influenced by the existing cover type, presence of sensitive wildlife or habitat, and prescribed treatment type.

Timing restrictions can be used for the following reasons:

- Avoid disturbance of protected plant and wildlife species during critical life periods
- Avoid disturbance of sensitive areas such as wetlands during wet seasons
- Maximize effectiveness of herbicide applications
- Maximize effectiveness of cutting and mowing treatments
- Minimize risk to equipment and crew



Environmental Oversight

To provide quality control and oversight of vegetative maintenance activities, a trained professional will be present in the field at regular inspection intervals after initially delineating wetlands and other vegetation within a span as compatible (do not cut) or incompatible (cut) prior to arrival of the maintenance crew. This trained professional would also oversee maintenance crews to ensure adherence to the efforts to preserve non-target species and to protect new habitats under development, such as created vernal pools or recently seeded grassland meadows.

Emergency Situations

PSE&G must be permitted to clear vegetation as necessary to access ROW for situations such as fires, pole failures and downed transmission lines or other emergency situations at the discretion of the vegetation manager or other similar authority.

Maintenance Flexibility

It is important that vegetation managers and crews have the ability to adapt management in certain situations. The choice of appropriate machinery and herbicide for the prescription should be made by the vegetation manager, subject to concurrence with all environmental permit conditions.

Tree cutting when not prescribed

PSE&G must be able to remove trees that pose a threat to transmission lines either by directly falling into lines or by encroaching on minimum clearance requirements even when tree cutting was not prescribed for that span. Manual or mechanical means should be used in upland areas. In wetlands, only manual methods should be used.

Height Restrictions

One of the goals of the VMP is to promote self-sustaining low-growth plant communities that are comprised of shrubs, grasses and forbs. Although shrubs that are listed as acceptable typically do not grow above height restrictions, it is possible that individual plants will exceed allowable heights. In these cases, vegetation crews must be allowed to selectively prune, remove or apply growth inhibitors to bring plants into compliance.

Access Road Maintenance

Access roads within the ROW periodically require maintenance to ensure access for site visits, vegetation management, transmission line work, and emergencies. Proper maintenance of the road, including grading and filling, will minimize disturbance beyond the road edge. The construction of new access roads and structures (e.g., culverts, bridges, etc.) are not covered under this plan.

Roadways, Pathways and Boardwalks

Where required and as permitted by terrain, access roadways may be established within the ROW to facilitate passage of authorized vehicles and equipment, including tree and brush cutting equipment. Such roadways must remain accessible.

In mountainous or wooded terrain, authorized personnel shall establish pathways to facilitate traversing the ROW. The path shall be a minimum of four feet wide and free of plant growth. Steps shall be constructed where required to improve footing on steep banks and slopes. Field stones or cross arms may be cut and used for this purpose.

In wetlands and high water table areas, boardwalks must be constructed and existing boardwalks maintained unless another means of access is available. The structure shall be constructed of treated planks and piling. All appropriate permits must be obtained prior to construction of new boardwalks.

Invasive Species Control

Methods to prevent, detect and control invasive plants in the treatment areas are outlined below. Appendix 5 contains fact sheets about 29 specific non-indigenous plant species that are considered to be invasive. As part of the ROW maintenance practices, the Company will take appropriate steps to prevent, to detect and to control these plant species within the ROW, where reasonable and providing such efforts are within the context of our standard operation and maintenance protocols for the transmission system. However, the primary function is to maintain a safe and reliable transmission system consisting of over 1,100 miles and so resource allocation will also invariably be a major consideration relative to this issue.

Prevention - No topsoil or plant materials containing invasive plant propagules will be permitted to be imported into the treatment areas. Seeds, bare root plant materials and stock grown indoors in sterile conditions will be selected over plant material grown outdoors and/or in soil. Where practicable existing populations of invasive plants will be excluded or removed from the treatment area before initiating ROW treatment and maintenance activities.

Detection – If necessary, PSE&G will conduct baseline vegetation inventories to document existing conditions. Any extant populations of invasive plants will be documented and their status monitored throughout the treatment monitoring period. All treatment areas will be inspected at least once each season to determine the presence of any new invasive plant populations.

Control - Treatment measures will be developed to control any new or expanding invasive plant populations. Depending on the species and size of the population these measures may include hand pulling, covering with a light inhibiting barrier, cutting, mowing and/or the appropriate application of an herbicide or a combination of all of the above. Guidance about specific species control will be taken from the fact sheets within Appendix 5.

Table 1:

The following invasive species are the minimum that must be addressed if present.

See also the Central Jersey Invasive Species Strike Team recommendations at:

http://www.cjisst.org/pdf/CJISST_AllFactSheets.pdf

Common Name	Scientific Name	Plant type
Norway maple	<i>Acer platanoides</i>	<u>Tree</u>
Tree of Heaven	<i>Ailanthus altissima</i>	Tree
Winged spindle tree	<i>Euonymus alata</i>	Tree
Japanese barberry	<i>Berberis thunbergii</i>	Shrub
Oriental bittersweet	<i>Celastrus orbiculata</i>	Shrub
Autumn olive	<i>Elaeagnus umbellata</i> var. <i>parvifolia</i>	Shrub
Honeysuckle	<i>Lonicera</i> spp.	Shrub
Multiflora rose	<i>Rosa multiflora</i>	Shrub
Wineberry	<i>Rubus phoenicolasius</i>	Shrub
Common buckthorn	<i>Rhamnus cathartica</i>	Shrub
Garlic mustard	<i>Alliaria petiolata</i>	Herb
Japanese knotweed	<i>Polygonum cuspidatum</i>	Herb
Japanese stiltgrass	<i>Microstegium vimineum</i>	Herb
Porcelain berry	<i>Ampelopsis brevipedunculata</i>	Herb
Mile-a-minute weed	<i>Polygonum perfoliatum</i> L	Herb
Chinese and Japanese wisteria	<i>Wisteria sinensis</i> ; <i>Wisteria floribunda</i>	Herb
Lesser celandine	<i>Ranunculus ficaria</i>	Herb
Purple loosestrife	<i>Lythrum salicaria</i>	Herb
Giant hogweed	<i>Heracleum mantegassianum</i>	Herb
Common reed	<i>Phragmites australis</i>	Herb

Erosion control

To prevent soil erosion from beginning and to control erosion that has started, it may be necessary to use an herbaceous seed mixture. When erosion becomes a serious problem, a specific means of restoration will be determined by PSE&G such as diversion berms or contour terracing.

Precautionary Measures

Safety in the vicinity of electrical wires

Many contractors who do tree work are not familiar with the hazards of working in the vicinity of electrical wires, especially high voltage transmission lines. Special care shall be taken to ensure all persons working on the ROW comply with company safety requirements as shown on sheet a892 of the safety section of the tower handbook, the occupational safety and health act of 1970 and the American National Standards Institute, standard ansi-z133.1 latest issue, "safety requirements for tree pruning, trimming, repairing or removal". These contractors shall be qualified line clearance contractors.

In addition, extreme care shall be taken to ensure that any tree being felled cannot come within fifteen feet (15') of energized transmission conductor. If this clearance cannot be maintained, the circuit shall be cleared, tagged, short-circuited and grounded at the terminal ends and tested for potential in the vicinity of the work area under PSE&G work standards.

Fire hazards

The company shall guard against the hazard of brush fire, especially during the Spring and Fall seasons. The presence of spray oil, which may inadvertently be released if equipment is not properly maintained, in conjunction with dry leaves presents a highly flammable situation.

The presence of *Phragmites spp.* (common reed) and other meadow grasses on the ROW in high-water table areas presents a serious fire hazard. Except in special locations, such grasses are presently controlled by cutting or by chemical treatment on an annual basis. A radius of approximately fifty feet (50') from the structure foundation perimeter must be cut or treated to provide adequate protection. Care shall be taken when using chemical treatments in or adjacent to waterbodies and/or wetlands.

Poisonous plants

In areas near or used as pasture or grazing for livestock, special precautionary measures shall be taken. All poisonous trees, brush or other vegetation, such as poison Ivy, Poison sumac, common milkweed, dogbane, cut on pastures, grazing lands, along fence and tree rows or other areas accessible to livestock shall be identified and it may be necessary to remove these plants from the area depending on the scale of the operation.

Poisonous Snakes

The performance of work on the ROW requires that certain safety precautions be taken. The possibility of poisonous snakebite, especially in the northern section of the state, must be recognized. Poisonous species such as timber rattlesnakes and northern copperheads are prevalent. Personnel working in these regions must wear protective boots or work shoes with separate snakebite chaps or leather leggings to knee height. Snakebite kits shall be carried in work vehicles.

Toxicological information, chemical brush and weed control

The toxicological precautions to be taken when applying brush and weed control chemicals depend upon the carrier being used. Only EPA approved products shall be used and at the recommended dosage, manufacturer's recommendations for skin contact and cleanup shall be followed.

Under no circumstances shall arsenical weed killers be used for brush or weed control on the ROW. These compounds are poisonous and also require special precautions during mixing and application to prevent skin burns caused by splashing.

Since it is literally impossible to wash all herbicidal materials out of spray equipment, this equipment shall not be used for any other type of spray application such as insecticides.

In keeping with applicable ordinances, no herbicidal materials shall be used on transmission ROW without permission of the property owner and only following appropriate public notification procedures, if applicable. Manufacturer's recommendations for skin contact and cleanup shall be followed.

Natural Resource Specific Practices

In New Jersey, regulations require that all vegetation within a ROW be less than 15 feet at maturity and that all woody vegetation within the wire zone be less than 3 feet at maturity. See N.J.A.C. 14:5-9.6 (2008). These constraints allow for the presence of few woody plant species within the transmission corridor (see Table 2 Shrubs to Preserve within ROW) and limit the types of natural communities that may be maintained within the ROW. However, these limitations do not preclude the protection and enhancement of sensitive natural resources. The specific practices outlined herein are designed to meet the regulations imposed by NJBPU and NERC while maximizing to the extent possible, the protection and enhancement of sensitive natural resources.

Vegetation Management in Uplands Areas

- Upon completion of the initial cutting and construction, an annual follow-up inspection shall be established to determine the need for maintenance. Authorized personnel thoroughly instructed in the vegetation management program shall conduct the inspections.
- Upland areas identified as requiring maintenance will be maintained utilizing the ground line maintenance method described in the treatment methods above, unless restricted or identified as environmentally sensitive areas.
- Certain easements on the transmission ROW provide definite restrictions regarding the cutting of trees. These restrictions shall have precedence over normal tree maintenance practices. Restricted areas will be maintained, as stipulated by the easement, utilizing the selective removal methods as described in part 1. Regardless of method utilized, thirty feet (30') of clearance between the tree line and the conductor at its maximum operating temperature must be maintained.
- Existing ROWs, which were originally cleared to ground line, shall be allowed to sustain natural regrowth of low growing shrubs, herbaceous plants and grasses. Low growing vegetation will limit the growth of less desirable tree species.

Freshwater Wetlands

In New Jersey, freshwater wetlands are regulated by the NJDEP under the Freshwater Wetlands Protection Act Rules at N.J.A.C. 7:7A-1.1 et seq. Most construction related activities, including the disturbance of the soils and existing vegetation, are considered to be regulated activities for which a permit is required from NJDEP. Along portions of the ROW within the Highlands region, the limits of wetlands and their transition areas (wetlands buffers) have been established within the ROW by a field delineation and a State verification. The long-term maintenance of the ROW will require some level of interaction with wetlands to assure that the transmission line remains safe and reliable. A number of treatment modifications can be made to minimize impacts to freshwater wetlands and wetlands buffers within the transmission line ROWs. The following general standards shall apply in addition to those conditions established in the field for a particular wetland:

- To the greatest extent feasible, removed trees should be replaced with woody shrub species selected from the desirable shrub vegetation list, unless it is apparent that the wetland already contains sufficient shrub or herbaceous plant understory that would readily reseed into the area formerly occupied by the tree which has been removed.
- If the prescribed treatment includes cutting of wetland forests, work should be adjusted depending on other seasonal restrictions based on the potential for the presence of threatened or endangered species. Where wetlands soils could be compacted or highly disturbed by heavy equipment, incursions shall be limited or marsh mats should be used to avoid long-term or permanent soil damage.
- Vegetative debris may remain within wetlands and wetlands buffers provided that the area covered by the debris is no more than 2 percent of the land area of the wetland or wetlands buffer area in question located within the ROW and should not disturb the ecological function of the wetland or wetlands buffer. All vegetative debris located in wetlands and wetlands buffers in excess of the 2 percent should be removed from the ROW.
- Mowing in State endangered, threatened or rare flora habitat will be conducted using small machinery or by hand and must be maintained at a height of a minimum of 3 inches.
- Herbicide applications within riparian buffers will be painted or snip & dripped directly onto the stump or cut end of the species requiring removal.
- Avoid wetland crossing with mechanical equipment, if possible.
- Marsh mats must be used within wetland area if heavy equipment is used as part of any operation.
- Use low pressure ground equipment.
- Manual woody stem cutting only within wetlands, unless it has been determined in the field that mechanical cutting will not significantly affect the wetland.
- Herbicides shall not be utilized in areas identified as containing threatened or endangered plant species. In other locations, the application of herbicides within environmentally sensitive areas (wetlands, transition areas, riparian zones) may be permitted on a case by case basis, for example to target the eradication of an invasive plant species which would then promote a more compatible native wetland plant community.

- There will be limited application of herbicides within wetlands or the riparian zones of streams. However, in those cases, herbicide use within wetlands and wetlands buffers will be limited to the types of aquatic herbicides that are intended for this purpose, such as rodeo™ or other similar products.
- All herbicide use shall be in accordance with all safety laws and regulations established for such purpose and shall be applied by a licensed applicator.
- Upon completion of the initial cutting and construction, an annual follow-up inspection shall be established to determine the need for maintenance. Personnel thoroughly instructed in the vegetation management program will conduct the inspection.
- All wood chips from cutting of trees will be removed from the wetlands, wetlands buffers or waterbody riparian buffer areas and stored in upland areas.
- Certain easements on transmission ROWs provide definite restrictions regarding the cutting of trees. These restrictions shall have precedence over normal tree removal practices. Restricted areas will be maintained, as stipulated by the easement, utilizing the selective methods as described in part 1. Regardless of method utilized, thirty feet (30') of clearance between the tree line and the conductor at its maximum operating temperature must be maintained.
- Existing ROW which was originally cleared to ground line shall be allowed to sustain natural regrowth of low growing shrubs, herbaceous plants and grasses. Low growing vegetation will limit the growth of less desirable tree species.
- ROW that has been maintained by mowing shall continue to be mowed.
- Mower heights will be set at a minimum of 6 inches within all wetlands, wetland buffers and established riparian buffers
- To insure stream bank stability, woody vegetation within 25 feet of top of bank shall be managed to ensure a “no-net loss” of root mat. No vegetation maintenance will occur within a wetland area without obtaining all wetland permits.

Riparian Zones

In New Jersey, streams and their adjoining riparian zones (which could extend for up to 300 feet from the top of the bank of the stream) are regulated by the NJ Flood Hazard Area Control Act Rules at N.J.A.C. 7:13-1.1 et seq. In addition to the standards detailed above under WETLANDS, there are several recommended management techniques and additional standards that are specifically applicable to Riparian Zones:

- When steep slopes (at least 30 degrees) surround a stream, trees that are more than 150 percent of the required clearance between line and ground may be left standing or topped to meet minimum clearance requirements.
- Herbicide use shall be limited to the types of herbicides that are intended for this purpose, such as Rodeo™ or other similar products and which are applied in accordance with all safety laws and regulations for such purpose.
- When trees are to be removed from riparian zones, stumps or roots shall not be removed in order to maintain a stable stream bank. However, these stumps and roots may be treated with an appropriate herbicide to prevent new tree runners from resprouting from the tree root.
- Riparian areas shall be maintained to allow shrubs native to riparian zones as a means of stabilizing embankments.
- Bioengineering techniques shall be utilized to stabilize stream banks as appropriate and to provide shade to stream banks from the summer sun. Pools and riffles shall be maintained within streams. New pools and riffles may be created where appropriate. ROWs that have been maintained by mowing shall continue to be mowed. Adjacent to streams, PSE&G will maintain a 25 foot riparian buffer which will not be mowed. Trees in these areas will be hand cut. Shrubs and herbaceous vegetation will be maintained adjacent to the stream to provide shading for the stream.
- Stream crossings with mechanical equipment shall be minimized. No fill shall be added to stream channels or riparian areas to facilitate crossings. However, pads or other temporary bridging material shall be used where feasible and needed to avoid soil disruption from such equipment.
- All debris associated with vegetation maintenance shall be removed from the riparian zones.
- All work within riparian areas will be conducted to reduce impacts to trout production waters and waters that support general game fish.

Critical Habitat Areas

Timing Restrictions

- Timing restrictions have been established for the maintenance activities within the ROW through use of the landscape project and other sources including NJDEP Endangered and Non-game species program and the US Fish and Wildlife Service (USFWS).
- These timing restrictions are established to avoid disturbance of a specific wildlife species or its habitat during mating, nesting, fledging, or other critical life seasons. During these periods, there are often restrictions on the use of mechanical cutting in order to avoid non-selective clearing and/or soil and noise disturbance.
- For protected plant species, restrictions can limit activities to after the growth, flowering, and seed set periods and the restriction on herbicide use for species that are susceptible to such chemicals.

Opportunities for Habitat Protection and Enhancement

The long term maintenance and/or the reconstruction activities of any transmission ROW is a complex process that requires a significant coordinated effort by many internal and external contractors, engineers and environmental professionals. These efforts are also subject to the oversight by regulatory agencies, whose approvals are tied to compliance with sometimes conflicting regulatory purposes.

The purpose of the VMP is to reduce and minimize the environmental impact of ROW maintenance to the extent practicable and to facilitate the restoration of the immediate impacts and to some degree to promote the enhancement of the environmental resources within the ROW, while recognizing the legal, practical, and logistical approaches to the same.

No single recommendation within the VMP stands on its own and is therefore part of the deliberative and iterative VMP process as the understanding of ROW management activities continues to evolve. Below are some of the proposed habitat enhancement techniques that should be considered along specific spans that are maintained by the company. This is not an exhaustive list. Nor are they requirements by themselves, but they represent numerous best management practices that could be followed for improving conditions within a ROW for wildlife.

- Planting specific spans with the recommended seed mixtures within Appendix 1 based on the characteristics of the span. This will establish the desired native low-meadow warm season grass species requiring only limited brush cutting.
- Planting herbaceous or shrub species preferred by specific wildlife to enhance food availability or habitat (e.g., food plots).
- Taking an aggressive posture towards invasive species within the ROW with goal of eradication of the same and the reestablishment of native species.
- Establishment of pollinator friendly spans which would support native honeybees and butterflies and other invertebrates. The Pollinator Conservation Resource Center is an excellent source of guidance on plants needed for pollinator conservation projects. <http://www.xerces.org/>. Ongoing research has been conducted by Rutgers University on this topic and PSE&G could benefit from a collaborative agreement with RU to further this effort, especially in terms of graduate students.
- The creation of vernal pools within the ROW as per established details within research journals about the value of these resources. Specific locations could be determined in the field along specific ROW, such as those that traverse public lands. This would typically be considered during reconstruction activities.
- The establishment of pools and riffles and other bioengineering techniques within high-quality streams known to support trout or significant benthic macro invertebrate populations. Specific stream locations could be identified as part of the maintenance activities in the ROW.
- The identification for the suitable placement of habitat brushpiles and basking rock piles for various wildlife species. The precise location of these features could be determined in the field but none of them would be placed where concerns for fire or ROW maintenance would be an issue. The precise locations would be documented using GPS. This would typically be considered during reconstruction activities.

- The creation of wood turtle nest locations in various stream sections.
- Placement of perches or nesting boxes to enhance avian habitat as identified working with partners such as NJ Audubon. Precise locations in the field would be determined using GPS. The company could seek local sponsors to maintain these nest boxes, such as the Boy Scouts of America.
- The creation of dead snag trees in the border zone through girdling and the identification of and maintenance of suitable den trees (for cavity nesting birds) and roost trees (for roosting bats) in the border zone following the assessment of the same for safety and reliability concerns. Such border trees would be appropriately marked and the location identified through GPS.
- Management of specific spans or series of contiguous spans to create, preserve or maintain habitat for a particular species (i.e. the Golden Winged Warbler). Span specific management over a series of spans with similar vegetation types can be completed in such a manner as to always maintain a certain habitat type within a regional context.
- Coordination with landowners of parcels adjacent to ROW, (i.e. NJDEP, Morris County Park Commission) particularly parkland or preservations, to create or enhance habitat.

APPENDIX 1: ERNST SEED COMPANY SEED MIXTURES FOR ROW MAINTENANCE



PSEG Select Native Seed Mixes **Prepared Specifically for** **the New Jersey Highlands Region**

**In support of Right of Way
Restoration Planning and Design**

**By ERNST Conservation Seeds of
Meadville, PA**

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TRANSMISSION RIGHT OF WAY SPECIFICATIONS

PSEG/ERNST 01: Buena Vista Upland Seed Mix (Short)

% of Mix	Latin Name	Common Name
40	<i>Elymus virginicus</i>	Virginia Wild Rye
15	<i>Schizachyrium scoparium</i>	Little Bluestem
4	<i>Asclepias syriaca</i>	Common Milkweed
1	<i>Asclepias tuberosa</i>	Butterfly Milkweed
3	<i>Aster laevis</i>	Smooth Aster
7	<i>Chamaecrista fasciculata</i>	Partridge Pea
4	<i>Coreopsis lanceolata</i>	Lanceleaf Coreopsis
8	<i>Echinacea purpurea</i>	Purple Coneflower
3	<i>Liatris spicata</i>	Spiked Gayfeather
2	<i>Monarda fistulosa</i>	Wild Bergamot
5	<i>Penstemon digitalis</i>	Tall White Beardtongue
1	<i>Penstemon hirsutus</i>	Hairy Beardtongue
3	<i>Rudbeckia hirta</i>	Black Eyed Susan
2	<i>Rudbeckia triloba</i>	Brown Eyed Susan
2	<i>Solidago juncea</i>	Early Goldenrod
100	Total	
Seeding rates: 15 bulk lbs/acre with grain oats or grain rye at 30 lbs/acre		

PSEG/ERNST 02: Buena Vista Upland Seed Mix (Tall)

**PSE&G SELECT NATIVE SEED MIXES PREPARED BY ERNST SEED COMPANY
FOR THE SR RESTORATION PLANNING AND DESIGN ©ALL RIGHTS RESERVED**

% of Mix	Latin Name	Common Name
5	Andropogon gerardii	Big Bluestem
10	Elymus virginicus	Virginia Wild Rye
20	Schizachyrium scoparium	Little Bluestem
15	Sorghastrum nutans	Indiangrass
5	Tridens flavus	Purple Top
4	Asclepias syriaca	Common Milkweed
1	Asclepias tuberosa	Butterfly Milkweed
3	Aster laevis	Smooth Aster
7	Chamaecrista fasciculata	Partridge Pea
4	Coreopsis lanceolata	Lanceleaf Coreopsis
8	Echinacea purpurea	Purple Coneflower
3	Liatris spicata	Spiked Gayfeather
2	Monarda fistulosa	Wild Bergamot
5	Penstemon digitalis	Tall White Beardtongue
1	Penstemon hirsutus	Hairy Beardtongue
3	Rudbeckia hirta	Black Eyed Susan
2	Rudbeckia triloba	Brown Eyed Susan
2	Solidago juncea	Early Goldenrod
100	Total	
Seeding rates: 15 bulk lbs/acre with grain oats or grain rye at 30 lbs/acre		

PSEG/ERNST 03 Steep Slope Scenic Mixture

% of Mix	Latin Name	Common Name
1	Agrostis perennans	Autumn Bentgrass
5	Andropogon gerardii	Big Bluestem
20	Elymus virginicus	Virginia Wild Rye
20	Panicum clandestinum	Deertongue
15	Schizachyrium scoparium	Little Bluestem
15	Sorghastrum nutans	Indiangrass
5	Tridens flavus	Purple Top
1	Asclepias syriaca	Common Milkweed
1	Asclepias tuberosa	Butterfly Milkweed
1	Aster laevis	Smooth Aster
1	Chamaecrista fasciculata	Partridge Pea
1	Coreopsis lanceolata	Lanceleaf Coreopsis
1	Desmodium canadense	Showy Tick Trefoil
3	Echinacea purpurea	Purple Coneflower
1	Liatris spicata	Spiked Gayfeather
1	Monarda fistulosa	Wild Bergamot
2	Penstemon digitalis	Tall White Beardtongue
1	Penstemon hirsutus	Hairy Beardtongue
2	Rudbeckia hirta	Black Eyed Susan
2	Rudbeckia triloba	Brown Eyed Susan
1	Solidago juncea	Early Goldenrod
100	Total	
Seeding rates: 25 bulk lbs/acre with grain oats or grain rye at 30 lbs/acre		

PSEG/ERNST 04 Riparian Restoration Mixture

% of Mix	Latin Name	Common Name
2	<i>Agrostis perennans</i>	Autumn Bentgrass
8	<i>Andropogon gerardii</i>	Big Bluestem
4	<i>Carex squarrosa</i>	Squarrose Sedge
5	<i>Carex vulpinoidea</i>	Fox Sedge
20	<i>Elymus virginicus</i>	Virginia Wild Rye
15	<i>Panicum clandestinum</i>	Deertongue
15	<i>Sorghastrum nutans</i>	Indiangrass
3	<i>Asclepias incarnata</i>	Swamp Milkweed
3	<i>Desmodium canadense</i>	Showy Tick Trefoil
3	<i>Eupatorium fistulosum</i>	Joe Pye Weed
3	<i>Eupatorium perfoliatum</i>	Boneset
3	<i>Euthamia graminifolia</i>	Grass Leaf Goldenrod
1	<i>Lobelia siphilitica</i>	Blue Lobelia
2	<i>Monarda fistulosa</i>	Wild Bergamot
5	<i>Verbena hastata</i>	Blue Vervain
3	<i>Vernonia noveboracensis</i>	New York Ironweed
5	<i>Zizia aurea</i>	Golden Alexanders
100	Total	
Seeding rates: 15 bulk lbs/acre with grain oats or grain rye at 30 lbs/acre		

PSEG/ERNST 05 Facultative Wetlands Restoration Mixture

% of Mix	Latin Name	Common Name
3	<i>Asclepias incarnata</i>	Swamp Milkweed
3	<i>Aster puniceus</i>	Purple Stemmed Aster
5	<i>Carex comosa</i>	Cosmos Sedge
5	<i>Carex crinita</i>	Nodding Sedge
10	<i>Carex squarrosa</i>	Squarrose Sedge
20	<i>Carex vulpinoidea</i>	Fox Sedge
20	<i>Elymus virginicus</i>	Virginia Wild Rye
3	<i>Eupatorium fistulosum</i>	Joe Pye Weed
3	<i>Eupatorium perfoliatum</i>	Boneset
3	<i>Euthamia graminifolia</i>	Grass Leaf Goldenrod
1	<i>Lobelia siphilitica</i>	Blue Lobelia
3	<i>Mimulus ringens</i>	Monkeyflower
8	<i>Scirpus atrovirens</i>	Green Bulrush
6	<i>Verbena hastata</i>	Blue Vervain
3	<i>Vernonia noveboracensis</i>	New York Ironweed
4	<i>Zizia aurea</i>	Golden Alexanders
100	Total	
Seeding rates: 15 bulk lbs/acre		

PSEG/ERNST 06 Obligate Wetlands Restoration Mixture

% of Mix	Latin Name	Common Name
2	<i>Asclepias incarnata</i>	Swamp Milkweed
3	<i>Aster puniceus</i>	Purple Stemmed Aster
5	<i>Carex comosa</i>	Cosmos Sedge
5	<i>Carex crinita</i>	Nodding Sedge
8	<i>Carex lurida</i>	Lurid Sedge
8	<i>Carex squarrosa</i>	Squarrose Sedge
27	<i>Carex vulpinoidea</i>	Fox Sedge
2	<i>Dulichium arundinaceum</i>	Three Way Sedge
3	<i>Eupatorium fistulosum</i>	Joe Pye Weed
3	<i>Eupatorium perfoliatum</i>	Boneset
3	<i>Iris versicolor</i>	Blue Flag
1	<i>Lobelia siphilitica</i>	Blue Lobelia
3	<i>Mimulus ringens</i>	Monkeyflower
8	<i>Scirpus atrovirens</i>	Green Bulrush
2	<i>Solidago patula</i>	Rough Leaved Goldenrod
10	<i>Sparganium eurycarpum</i>	Giant Burreed
7	<i>Verbena hastata</i>	Blue Vervain
100	Total	
Seeding rates: 15 bulk lbs/acre		

FOREST ROAD RESTORATION SEEDING SPECIFICATIONS

PSEG/ERNST 07 Herbaceous Upland Mix For Partial Shade

% of Mix	Latin Name	Common Name
2	<i>Agrostis perennans</i>	Autumn Bentgrass
31	<i>Elymus virginicus</i>	Virginia Wild Rye
2	<i>Juncus tenuis</i>	Path Rush
65	<i>Panicum clandestinum</i>	Deertongue
100	Total	
Seed at 15 bulk lbs per acre. Add 30 lbs grain rye/acre as cover crop.		

PSEG/ERNST 08 Herbaceous FACW Mix for Partial Shade

% of Mix	Latin Name	Common Name
15	<i>Carex scoparia</i>	Blunt Broom Sedge
5	<i>Carex squarrosa</i>	Squarrose Sedge
40	<i>Carex vulpinoidea</i>	Fox Sedge
38	<i>Elymus virginicus</i>	Virginia Wild Rye
2	<i>Juncus tenuis</i>	Path Rush
100	Total	
Seed at 15 bulk lbs/acre.		

PSEG/ERNST 09 Herbaceous/Woody Upland Mix

% of Mix	Latin Name	Common Name
2	Agrostis perennans	Autumn Bentgrass
5	Aronia melanocarpa	Black Chokeberry
25	Cornus florida	Flowering Dogwood
31	Elymus virginicus	Virginia Wild Rye
2	Juncus tenuis	Path Rush
65	Panicum clandestinum	Deertongue
100	Total	
Seed at 20 bulk lbs per acre. Add 30 lbs grain rye/acre as cover crop.		

PSEG/ERNST 10 Herbaceous/Woody FACW Mix Shade

% of Mix	Latin Name	Common Name
10	Carex scoparia	Blunt Broom Sedge
5	Carex squarrosa	Squarrose Sedge
26	Carex vulpinoidea	Fox Sedge
5	Cepthanthus occidentalis	Buttonbush
10	Cornus amomum	Silky Dogwood
10	Cornus racemosa	Gray Dogwood
25	Elymus virginicus	Virginia Wild Rye
2	Ilex verticillata	Winterberry
2	Juncus tenuis	Path Rush
5	Lindera benzoin	Spicebush
100	Total	
Seed at 20 bulk lbs/acre		

For any plantings be very meticulous on the following:

- a. Control all existing weeds at the site.
 1. Do not till the site.
- b. If seed is broadcast applied, be certain to firm the seed into the soil. For small plots a lawn roller or your feet can be used.
- c. Mow the site to 8" whenever vegetation reaches 18 inches the first growing season. Failure to do so will enable weeds to smother natives and produce more weed seeds.
- d. Caution: Mowing below a height of 4 inches can kill warm season grass seedlings.
- e. Emphasize to all parties observing the test meadows that native meadows take time to mature. They often will look rather nice by growing season three, but may not show their full diversity until year 5 to 7.
- f. See Planting Specifications on the attached sheets.

Following are some general parameters for germination of native species created by Ernst Conservation Seeds' crop specialists. These parameters are applicable to restoration seedings.

A definite protocol of germination could be carried out for the fastest germination of each species, which would involve as much as one year's pre-treatment prior to planting. It is the opinion of Ernst Conservation Seeds that the application of the seed to the site and the natural conditioning of the seeds for germination (which occurs when conditions are right) are appropriate for restoration.

This description of germination of several species in a mix is an aid in understanding these principles.

EXPECTATIONS OF YOUR NATIVE SPECIES

Germination and Growth (all of these assume adequate light, appropriate moisture, and good seed-to-soil contact):

As a generalization, annual species have less dormancy than biennials, and biennials have less than perennials. This dormancy is nature's hedge against unfavorable conditions during the life cycle of a plant. Unfavorable conditions could be, but are not limited to, late spring frost or drought. Dormant seeds are in reserve to germinate when nature calls them "off the bench."

- **Annuals -**
Most species will germinate, flower, and set seed by the end of the first full growing season. Germination of an individual species is likely to be high.
- **Biennials -**
Most species will germinate, with some plants within a species population flowering and setting seed in the first full growing season. The bulk of the plants will flower and set seed in the second growing season. Germination of an individual species is likely to be lower than for annuals due to presence of seed dormancy.
- **Perennials -**
 1. **Warm Season Grasses:** Germination will occur in spring when moisture conditions are appropriate and soil temperatures at a 3" depth exceed 55° F (12° C). Best germination occurs when soil temperatures are much higher.

Most of these species do not need cold/wet stratification to produce an adequate stand. Two exceptions are *Tripsacum dactyloides* (Eastern Gamagrass), which needs 14-60 days of stratification, and *Chasmanthium latifolium* (River Oats), which needs 60 days of stratification for northern genotypes.

While cold/wet stratification is not necessary in most cases to produce an adequate stand, 20%-50% of the seed may be dormant. The vast majority of seedlings that emerge will be growing by the end of the second full growing season.

Greatest growth of these species occurs when air temperatures are 75° F-95° F. A very few (<5%) plants within a species may flower and set seed in the first growing season. The majority of growth is put into root development the first season. Maximum plant development may take five to seven years.

2. **Cool Season Grasses:** Some species will germinate when temperatures are a little higher than 40° F. Others will require warmer temperatures. They may germinate in fall or spring. Adequate stands of most species will not require stratification; however, 50% of the seed may remain dormant without stratification. The vast majority of seedlings that emerge will be growing by the end of the second full growing season.

Greatest growth occurs when temperatures are 65° F-85° F. With adequate moisture and nutrients, some flowering and seed set may occur in the first growing season.

3. **Some sedges** (*Carex alata*, *annectans*, *scoparia*, *tribuloides*, *vulpinoidea*), **rushes** (*Juncus canadensis*, *effusus*, *marginatus*, *tenuis*, *torreyi*), and **bulrushes** (*Scirpus atrovirens*, *cyperinus*, *expansus*, *polyphyllus*) have a very high seed count per pound of seed. If planted in the spring, a substantial number of seedlings may be produced by these species in their first growing season. These seedlings may represent 5% or fewer

of the total seeds present. Flowering and seed production will occur one to two growing seasons after an individual seedling has germinated. Maximum germination will take at least one year due to seed dormancy. Sedges and bulrushes will be recognizable by the arrangement of any three successive leaves in a pattern resembling the spokes in the Mercedes™ symbol. *Juncus spp* will have round stems that originate at a common point near or on top of the soil.

4. Some sedges (*Carex baileyi*, *buxbaumii*, *comosa*, *conoidea*, *crinita*, *folliculata*, *frankii*, *gynandra*, *intumescens*, *lacustris*, *lupulina*, *lurida*, *squarrosa*, *stipata*, *stricta*, *vesicaria*) and bulrushes (*Scirpus acutus*, *americanus*, *fluvialis*, *maritimus*, *pungens*, *tabernaemontani*) have a high level of seed dormancy and are unlikely to have any consequential germination without stratification. A majority of seedlings will emerge in the first and second growing seasons after they have been stratified (artificially or naturally). Plants will flower and set seed one to three years after they germinate. *Carex spp* in this group may be recognized as described above. *Scirpus spp* have round or triangular stems that arise from a point that is often below the soil surface. Stems are typically larger than those of *Juncus spp*.
5. Broadleaves: Some germination (typically inconsequential) may occur in the first year for most broadleaf species without stratification (artificial or natural). A high percentage of the species and seeds within the species are likely to germinate in the first growing season following the first winter *in situ* (on-site). A majority of the seeds that will germinate will have done so by the end of the growing season following stratification. Following germination, blooms may occur in the first growing season (*Heliopsis helianthoides*); the second (*Monarda spp*, *Rudbeckia triloba*); after three to five growing seasons (*Liatris spp*); or, not until the seventh growing season (*Baptisia tinctoria*).
6. Seed dormancy in perennial species is affected by latitude of origination for the ecotype. In green house studies, we have found that northern ecotypes (PA, OH, NY, NJ) typically require more weeks of cold/wet stratification than southern ecotypes (FL, GA, NC, SC) of the same species.

Life Span Of A Mix

The majority of our native seed mixes are composed of perennial species. Mixes dominated by perennial species have the potential to persist for more than a decade if properly maintained. For all mixes, the site must be maintained to keep them free from invasive species or aggressive weeds. Mixes of herbaceous species that have no tree or shrub components in their formula must be kept free from encroachment by woody species by controlled burning or mowing.

Appearance Of A Mix

The natural communities we create with native seed mixes are dynamic. Annuals, biennials, and short-lived perennials may be widely present in the landscape in the first one to three growing seasons, but non-existent or present in small pockets by the fifth growing season. Colonies of some long-lived perennials will grow larger in diameter. Species composition will change in response to annual variations of drought or heavy rainfall.

UPLAND & MEADOW SITES

UPLAND SITES are characterized as being dry the majority of the year. Soils at these sites often consist of sandy clay and shale, very little topsoil, and are subject to drought.

Examples of UPLAND SITES:

- Naturally rocky soil that has been subject to erosion or steep road cuts
- Abandoned building sites and industrial sites

Examples of MEADOW SITES:

- Abandoned farm fields
- Previous lawns
- Vacant land
- Roadsides

SITE PREPARATION

If your site was previously a lawn or crop field to which herbicides were applied, it is important that you allow the appropriate interval for the residues of those herbicides to break down prior to planting your meadow. Competition from invasive or undesirable vegetation is the most limiting factor in upland meadow preparation. Black plastic may be used to smother weeds in small areas before planting. Eradicate existing vegetation by having a licensed spray technician apply an approved herbicide; i.e., glyphosate (Roundup®), or tilling the weeds into the soil. Good pre-seeding weed control may require repeated tilling or spraying two applications of glyphosate (at least two weeks apart). Close mowing two weeks prior to spraying is recommended to stimulate weed growth. Glyphosate must be applied to vegetative growth in order to kill undesirable plants and their roots. The second application is needed only if the first application is insufficient. If excess dead plant material remains on the surface, burning or tilling may be necessary to achieve good seed-to-soil contact and sunlight penetration.

Habitat: Upland and meadow sites are generally in full sun for at least half of the day and have good air circulation.

Fertility: Natural fertility on these sites is generally adequate. No fertilizer or lime is needed. Check your soil pH and select species adapted to that pH.

Seeding Method: Hand seed, broadcast, hydroseed, or drill seed.

GENERAL MAINTENANCE

Grassy weeds or persistent perennials can re-establish in this soil type. Monitoring and controlling weeds is essential in the first and second years. Burning (by experienced professionals) about every three years in early spring can prevent shrub invasion.

FIRST YEAR MAINTENANCE

Observation of the desired species' growth and weed competition is essential when making maintenance decisions. When undesirable vegetation reaches 12"-18" tall, mow to no less than 6" high (with a mower or weed eater) to prevent the weeds from developing seed. Generally, native plants will grow more extensive root systems than tops in the first year; therefore, mowing to 6"-8" high will not cause harm. This practice allows sunlight to reach desired species. DO NOT MOW WITH A LAWN MOWER, as mowing too close encourages weedy grass species.

SECOND YEAR MAINTENANCE

Mow once, close to the ground, in early spring. This allows young native plants to emerge and rapid warming of the soil. If you postpone mowing until early spring, birds and other wildlife can enjoy your native site during the winter.

DISTURBED SITES & STEEP SLOPES

DISTURBED SITES & STEEP SLOPES have variable soil types and conditions.

Examples of DISTURBED SITES:

- Landfills
- Surface mines
- Road cuts
- Construction sites

SITE PREPARATION

Eradicate existing vegetation by having a licensed spray technician apply an approved herbicide. Whenever possible, regrade the site to reduce slope which will, in turn, reduce erosion and minimize seed loss.

Habitat: Soil consists of various clay, sand, and rock outcropping without topsoil.

Fertility: These sites are generally low in fertility; therefore, adding topsoil or organic matter (compost) can be very beneficial. Check your soil pH and select species adapted to that pH. Add lime and fertilizer as recommended by soil analysis. Incorporate any amendments into the soil. All incorporating activities should be done in a manner that will leave the soil rough, which will minimize soil erosion and rapid run-off.

Seeding Method: Hand seed, broadcast, hydroseed, or drill seed. Once the seed has been broadcast, dragging with a light harrow to cover the seed (approx. 1/4"-1/2" deep), tracking, or mulching with straw, hydromulch, or straw/coconut fiber mats is recommended to protect the seed from drying out or washing away. With adequate temperature and moisture, the seed should begin to germinate within approximately three weeks.

FIRST YEAR MAINTENANCE

Observation of the desired species' growth and weed competition is essential when making maintenance decisions. Minimum mowing (4"-6" high) to top off aggressive weeds is recommended to give desirable plants an opportunity to develop roots. Most of the competition the first year will be annual weeds. Mowing too close encourages weedy grass species.

SECOND YEAR MAINTENANCE

Monitor and control undesirable vegetation with spot spraying or mowing. Mowing the entire area (4"-6" high) during the dormant season can enhance the appearance without jeopardizing wildlife habitat and erosion protection.

SPECIAL CONSIDERATIONS

Vegetation allowed to grow without mowing provides more protection for wildlife and aids in erosion control.

RIPARIAN SITES

RIPARIAN SITES are usually adjacent to rivers and waterways. Soils often contain clay, high amounts of organic matter, and/or saturated sand.

Examples of RIPARIAN SITES:

- River and stream banks
- Damp flood plains of rivers and streams

SITE PREPARATION

Eradicate existing vegetation by having a licensed spray technician apply an approved herbicide, such as glyphosate (Rodeo®) or a similar aquatic herbicide formulation, to control undesirable vegetation. CAUTION: Some persistent species, such as purple loosestrife, phragmites, or reed canary grass, may need multiple applications of glyphosate. Before seeding, excess dead vegetation should be burned or turned under if conditions permit. Newly constructed riparian sites should be seeded as soon after construction as possible.

Habitat: Riparian sites generally vary from partial shade to full sun. These areas are often subject to flooding.

Fertility: Due to the potential for water contamination, the use of lime or fertilizer in riparian areas is not recommended. We do recommend the addition of organic materials when topsoil has been depleted or removed. Check your soil pH and select species adapted to that pH.

Seeding Method: Hand seed, broadcast, or hydroseed.

GENERAL MAINTENANCE

Grassy weeds or persistent perennials can re-establish in this type of soil. Monitoring weeds and mowing is essential in the first and second years. Burning (by experienced professionals) about every three years in early spring can prevent shrub invasions.

WET MEADOW & WETLAND SITES

WET MEADOW & WETLAND SITES have soils made up of clay and high organic matter, with high water tables or impervious layers that prevent drainage. They are wet most of the time.

Examples of WET MEADOW SITES:

- Roadside ditches
- Retention basins that catch run-off water
- Pond areas
- Wetland edges

Examples of WETLAND SITES:

- Newly created wetlands and wetland restoration sites
- Retention basins with wetland functions
- Flood plains, pond edges, and open water
- Wet bioremediation sites

SITE PREPARATION

Eradicate existing vegetation by having a licensed spray technician apply an approved herbicide, such as glyphosate (Rodeo®) or other aquatic herbicide formulation, to control undesirable vegetation. CAUTION: Some persistent species, such as purple loosestrife, phragmites, or reed canary grass, may need multiple applications of glyphosate. The soil is often too wet to till. Newly constructed wetlands, retention basins, and wet construction sites should be seeded as soon after construction as possible. Leaving the surface rough by creating mounds and kettles for an undulating microtopography can be very beneficial in obligate wetlands.

Habitat: Wetland sites, by necessity, must have wet soil or saturated soil to standing water, a high water table, and vary from partial shade to full sun.

Fertility: Due to the potential for water contamination, the use of lime or fertilizer in wetlands is not recommended. We do recommend the addition of organic materials when topsoil has been depleted or removed. Check your soil pH and select species adapted to that pH.

Seeding Method: Hand seed, broadcast, hydroseed, or drill seed when the water table is drawn down. It is not practical to seed any wetland where the water is more than 2" deep or where severe flooding is likely to occur before germination. The same caution applies to mulching. Often, natural seed banks (seeds in wetland soil) will establish part of the vegetation cover.

GENERAL MAINTENANCE

Very little can be done the first year. Spot treat invasives with appropriate herbicides. Burning (by experienced professionals) is an alternative to mowing every third year. NOTE: Wetland plants can often tolerate drier conditions than their indicator status.

**APPENDIX 1A: NORTHERN
NEW JERSEY POLLINATOR MIX**

Species	Percent of mix (%)	Pounds of seed per acre	Bloom Period	Max. height	Soil Moisture Requirements	Flower Color
Little Bluestem (<i>Schizachyrium scoparium</i>)	10.0%	0.98	July - Oct	2-3'	low	purplish seed heads
Lance Leaved Coreopsis (<i>Coreopsis lanceolata</i>)	10.0%	0.89	May - July	8"-3'	moderate-high	yellow
Yellow Wild Indigo (<i>Baptisia tinctoria</i>)	1.0%	0.07	April - June	2.5'	low	yellow
Wild Lupine (<i>Lupinus perennis</i>)	1.0%	1.03	May - June	1-2'	low	blue, pink, or white
Ohio Spiderwort (<i>Tradescantia ohiensis</i>)	1.0%	0.12	May - July	2-4'	moderate	purple
Common Milkweed (<i>Asclepias syriaca</i>)	3.0%	0.84	June - Aug	5'	moderate	pale purple
Lavender Hyssop (<i>Agastache foeniculum</i>)	10.0%	0.13	June - Sept	2-4'	low	blue-violet
Purple Coneflower (<i>Echinacea purpurea</i>)	8.0%	1.35	June - Sept	5'	moderate-high	purple
Wild Bergamot (<i>Monarda fistulosa</i>)	10.0%	0.15	April - June	5'	moderate-high	lavender
Boneset (<i>Eupatorium perfoliatum</i>)	10.0%	0.07	July - Aug	5'	moderate-high	white
Virginia Mountain Mint (<i>Pycnanthemum virginianum</i>)	10.0%	0.05	July - Sept	1-3'	low	white (sometimes with purple dots)
Partridge Pea (<i>Chamaecrista fasciculata</i>)	7.0%	2.11	July - Sept	3'	moderate	yellow
New England Aster (<i>Symphyotrichum novae-angliae</i>)	10.0%	0.18	July - Sept	2-6'	low-moderate	purple
Marsh Blazing Star (<i>Liatris spicata</i>)	2.0%	0.39	July - Sept	1-5'	moderate	purple
Giant Sunflower (<i>Helianthus giganteus</i>)	1.0%	0.12	July - Oct	3-10'	moderate-high	yellow
Mistflower (<i>Eupatorium coelestinum</i>)	5.0%	0.07	July - Oct	1.5-2'	moderate-high	purple
Showy Goldenrod (<i>Solidago speciosa</i>)	1.0%	0.49	Sept - Oct	4'	moderate-high	yellow

TOTALS: 100.00% 9.04

APPENDIX 2: SUBCHAPTER 9. VEGETATION MANAGEMENT N.J.A.C. 14:5-9.6 (2008)

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TITLE 14. BOARD OF PUBLIC UTILITIES
CHAPTER 5. ELECTRIC SERVICE
SUBCHAPTER 9. VEGETATION MANAGEMENT

N.J.A.C. 14:5-9.1 (2008)

§ 14:5-9.1 Purpose and scope

This subchapter sets forth requirements that EDCs shall follow in managing vegetation in proximity to an energized conductor in order to ensure public safety and the efficient and reliable supply of electric power.

HISTORY:

Recodified from N.J.A.C. 14:5-8.1 and amended by R.2008 d.57, effective March 17, 2008.

See: 39 N.J.R. 3716(a), 40 N.J.R. 1684(a).

Substituted "EDCs" for "electric public utilities".

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CHAPTER 5. ELECTRIC SERVICE

SUBCHAPTER 9. VEGETATION MANAGEMENT

N.J.A.C. 14:5-9.2 (2008)

§ 14:5-9.2 Definitions

The following words and terms, when used in this subchapter, shall have the following meaning unless the context clearly indicates otherwise. Additional definitions that apply to this chapter can be found at N.J.A.C. 14:3-1.1:

"Arboriculture" means the cultivation of trees, shrubs and other woody plants.

"Agricultural crop" means a non-woody cash crop, which can be used as a food and is sold for money.

"Border zone" means the space from the edge of the transmission line wire zone, as defined herein, to the outer boundary of the right of way.

"Contractor" means a person or entity, other than the Board, with which a utility contracts to perform work, furnish information and/or material. This term includes all subcontractors engaged by a contractor to perform any of the obligations required by a contract.

"Distribution line" means a primary electric voltage line, wire or cable including supporting structures and appurtenant facilities, which delivers electricity from transformation points on the transmission system to points of connection at a customer's premises, that would not be considered a transmission line as set forth in this section.

"Electric utility arborist" means a person that has been certified as a Utility Specialist by the International Society of Arboriculture and, in addition, meets the following:

1. The person is certified as a Tree Expert by the New Jersey Department of Environmental Protection's Board of Tree Experts; and
2. The person is certified as a Certified Arborist by the International Society of Arboriculture.

"Energized conductor" means an electric circuit or piece of equipment through which electricity is flowing or usually flows. This term includes both distribution and transmission circuits and equipment.

"Grass" means a type of plant with jointed stems, slender flat leaves and spike like flowers.

"Inactive transmission line corridor" means that unused part of the right of way that does not have transmission towers or transmission lines overhead.

"Major event" has the same meaning as is ascribed to this term in N.J.A.C. 14:5-1.2.

"Right of way" means less than fee interest in property, which gives a public utility a limited right to use land owned by another person or entity for the purpose of transmitting or distributing electricity. This right is typically memorialized in an easement. This term also includes the parcel of land for which a public utility holds a right of way or easement.

"Transmission line" means an electrical line, wire or cable, (including the supporting structures) and appurtenant facilities which transmits electricity from a generating plant to electric distribution lines. An electric transmission line usually has a rating exceeding 69 kilovolts.

"Tree" means a tall perennial woody plant with a main trunk and branches forming a distinct elevated crown.

"Vegetation" means trees and other plants.

"Vegetation management" means the removal of vegetation or the prevention of vegetative growth, to maintain safe conditions around energized conductor(s) and ensure reliable electric service. Vegetation management consists of biological, chemical, cultural, manual and mechanical methods to control vegetation in order to prevent hazards caused by the encroachment of vegetation on energized conductor(s), and to provide utility access to the conductor.

"Vegetation manager" or "VM" means an electric utility arborist, who is employed by an EDC to supervise and ensure the EDC's compliance with this subchapter.

"Wire zone" means the land located directly under the widest portion of a transmission line. For a horizontal transmission line, the wire zone is bounded on each side by a location on the ground that is directly under the outermost transmission wire or the transmission tower, whichever is wider. For a vertical transmission array, the wire zone shall be the minimum safe distance specified in the 2007 National Electric Safety Code, § 232 to § 235, which is incorporated herein by reference and available at <http://standards.ieee.org/nesc/>, that will allow maintenance on the wires.

"Woody plant" means any vascular plant that has a perennial woody stem and supports continued vegetative growth above ground from year to year and includes trees.

HISTORY:

Recodified from N.J.A.C. 14:5-8.2 and amended by R.2008 d.57, effective March 17, 2008.

See: 39 N.J.R. 3716(a), 40 N.J.R. 1684(a).

In definition "Agricultural crop", inserted "non-woody" and "can be used as a food and" and inserted a comma following "crop"; in definition "Distribution line", inserted a comma following "facilities", and substituted "this section" for "N.J.A.C. 14:5-8.2"; deleted definition "Electric public utility"; in the introductory paragraph of definition "Electric utility arborist", deleted "one or more of" following "meets"; in 1 of definition "Electric utility arborist", substituted "and" for "or"; in definition "Energized conductor", inserted the last sentence; added definitions "Inactive transmission line corridor" and "Vegetation manager"; rewrote definitions "Major event" and "Wire zone"; and reorganized definition "Tree" alphabetically.

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N.J.A.C. 14:5-9.3 (2008)

§ 14:5-9.3 General provisions

(a) An EDC shall ensure that vegetation management is conducted in accordance with this subchapter on any energized conductors of 600 volts and higher, whether for distribution or transmission, that the electric public utility owns, in whole or in part.

(b) Each EDC shall obtain, and shall ensure that its contractors obtain, all required permits and licenses prior to commencement of vegetation management.

(c) An EDC that utilizes chemical or biological agents in vegetation management shall comply with any laws or regulations governing the use of those biological and chemical agents.

(d) Each EDC shall employ a vegetation manager, who is an electric utility arborist, as defined at N.J.A.C. 14:5-9.2. The VM shall be a utility employee, not a contractor. The electric public utility shall provide the VM with the authority and the resources to administer all aspects of the utility's vegetation management program, and the VM shall ensure that the electric public utility complies with this subchapter. The VM's name and contact information shall be posted on the electric utility's web site and shall be included on all notifications provided pursuant to the notice requirements of N.J.A.C. 14:5-9.8.

(e) Each EDC shall ensure that all contractors hired to perform vegetation management inform their workers of all applicable Federal and State laws, rules or regulations that apply to the work performed under this subchapter. The EDC shall also ensure that all contractors comply with each applicable requirement of this subchapter and all other applicable law.

(f) An EDC that performs vegetation management at the request of a municipality or government agency, other than vegetation management required under this subchapter, may require the requesting party to pay any incremental cost above the EDC's cost to perform the vegetation management required by this subchapter. An EDC shall not perform such additional vegetation management if the additional vegetation management would decrease the reliability or safety of an energized conductor.

(g) Upon a written request from a municipality, an EDC may, but is not required to, temporarily suspend compliance with one or more of the vegetation management requirements of this subchapter, within the following limits:

1. The suspension of compliance shall apply only to the distribution system, and shall not apply to transmission line vegetation management required under N.J.A.C. 14:5-9.6;

2. The suspension of compliance shall apply only to those portions of a distribution system that are located within the municipality, and that do not affect service to any adjacent municipality;

3. The EDC shall not suspend compliance with any requirement if the suspension would result in danger to the public; and

4. If the suspension results in additional costs to the EDC due to lack of tree trimming or other vegetation management, the municipality shall reimburse the electric public utility for these costs.

(h) An EDC may petition the Board for recovery of the distribution and transmission portion of vegetation management program costs required under this subchapter in future base rate proceedings.

(i) Each EDC shall perform vegetation management on a pro rata basis over the four-year cycle identified in N.J.A.C. 14:5-9.4(b) to achieve full compliance by December 18, 2010.

HISTORY:

Recodified from N.J.A.C. 14:5-8.3 and amended by R.2008 d.57, effective March 17, 2008.

See: 39 N.J.R. 3716(a), 40 N.J.R. 1684(a).

Substituted "EDC" for "electric public utility" throughout; in (d), deleted "(VM)" following "vegetation manager" and updated the N.J.A.C. references; in (e), substituted "and State" for ", State; county, and municipal" and substituted the second occurrence of "EDC" for "electric utility"; in (f), inserted "incremental" and substituted "EDC's" for "electric public utility's"; in (g)1, inserted "transmission line" and "required", and substituted "N.J.A.C. 14:5-9.6" for "transmission lines"; in (g)4, inserted "or other vegetation management"; and rewrote (i).

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TITLE 14. BOARD OF PUBLIC UTILITIES CHAPTER 5. ELECTRIC SERVICE SUBCHAPTER 9. VEGETATION MANAGEMENT

N.J.A.C. 14:5-9.4 (2008)

§ 14:5-9.4 Maintenance cycle

(a) An EDC shall perform an annual visual inspection of all energized conductors that are associated with a transmission line, to determine whether vegetation management is needed. The visual inspection may be performed from the ground except in cases where the conductor is not visible from the ground. The EDC shall take into account the height of the vegetation and the distance of the vegetation from the energized conductor, in determining whether vegetation management is needed.

(b) An EDC shall perform vegetation management on vegetation that is close enough to pose a threat to its energized conductors at least once every four years.

(c) In addition to the maintenance required in (b) above, if an EDC becomes aware at any time of any vegetation close enough to its energized conductor to affect reliability or safety prior to the next required vegetation management activity, the electric utility shall ensure that necessary vegetation management is promptly performed as required under N.J.A.C. 14:5-9.5.

(d) If the EDC determines that vegetation described under (c) above poses an immediate safety hazard, the EDC shall not be subject to the notice requirements at N.J.A.C. 14:5-9.8. However, the EDC shall, to the extent practicable, make a reasonable effort to notify the customers and property owners described at N.J.A.C. 14:5-9.8(b)1 and 2 prior to performing the vegetation management.

HISTORY:

Recodified from N.J.A.C. 14:5-8.4 and amended by R.2008 d.57, effective March 17, 2008.

See: 39 N.J.R. 3716(a), 40 N.J.R. 1684(a).

Substituted "EDC" for "electric public utility" throughout; in (a), inserted "that are associated with a transmission line"; rewrote (c); and added (d).

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N.J.A.C. 14:5-9.5 (2008)

§ 14:5-9.5 Technical standards for vegetation management

(a) Each EDC shall ensure that vegetation management conducted on its energized conductors is performed in accordance with the standards and accepted procedures set forth in the following publications, which are incorporated herein by reference including amendments and supplements thereto:

1. Pruning Trees Near Electric Utility Lines, by Dr. Alex L. Shigo. This publication may be obtained from Shigo and Tree Associates, P.O. Box 769, Durham, New Hampshire 03824;

2. Part 1 of the document entitled Tree, Shrub, and Other Woody Plant Maintenance-Standard Practices. This document, also known as ANSI A300, is published by the American National Standards Institute, and may be obtained at [www.ansi.org](http://www ansi.org);

3. Best Management Practices, Utility Pruning of Trees, 2004. This title is published by the International Society of Arboriculture and may be obtained at <http://secure.isa-arbor.com/store/Best-Management-Practices-pUtility-Pruning-of-Trees-P23060.aspx>;

4. Environmental Stewardship Strategy for Electric Utility Rights-of-Way, (2002). This title is published by the Edison Electric Institute Vegetation Management Task Force, which may be obtained at www.eei.org;

5. Pruning, Trimming, Repairing, Maintaining, and Removing Trees, and Cutting Brush -- Safety Requirements, 1994. This document, also known as ANSI Z133.1, is published by the American National Standards Institute, and may be obtained at www.ansi.org;

6. Native Trees, Shrubs And Vines For Urban And Rural America: A Planting Design Manual for Environmental Designers, by Hightshoe, G.L., 1987, is published by John Wiley and Sons and may be obtained at <http://www.wiley.com/WileyCDA/WileyTitle/productCd-0471288799.html>;

7. Manual of woody landscape plants 5th Ed., by Michael A. Dirr. Stipes Publishing, LLC; 5th edition (August, 1998), and may be obtained at <http://www.amazon.com/exec/obidos/tg/detail/-/0875637957/103-3217696-1920611?v=glance>;

8. Hortus Third: A concise dictionary of plants cultivated in the United States and Canada, by L.H. Bailey Hortorium, 1976, and may be obtained at <http://www.wiley.com/WileyCDA/WileyTitle/productCd-0025054708.html>; and

9. National Electric Safety Code C2-2007. ISBN: Z2-RES69-07 is published by the Institute of Electrical and Electronics Engineers, Inc and may be purchased at www.ieee.org.

(b) Where multiple standards listed at (a) above would apply or conflict, the VM or his or her designee shall select the most appropriate method.

(c) Each EDC shall develop its own vegetation management standards and guidelines, which shall be consistent with this subchapter. In developing these standards and guidelines, a utility shall prioritize work based upon:

1. The extent of the potential for vegetation to interfere with the energized conductor;

2. The voltage of the affected energized conductor; and
3. The relative importance of the affected energized conductor in maintaining safety and reliability.

(d) Each EDC shall provide a copy of its vegetation management standards and guidelines to the Board as a chapter in the Annual System Performance Report. If an EDC makes a change in its vegetation management standards and guidelines, the utility shall provide Board staff with a copy of the change no later than 30 days prior to implementing the change.

(e) Each EDC's vegetation management standards and guidelines shall cover, at a minimum, all of the following activities:

1. Tree pruning and removal;
2. Vegetation control around poles, substations and other energized conductors;
3. Manual, mechanical, or chemical control of vegetation along rights of way;
4. Inspection of vegetation management both before and after the work is performed;
5. Research and development of improved vegetation management activities and practices; and
6. Public education.

(f) Among the factors the EDC shall consider in determining the extent of vegetation management to be performed at a particular site are:

1. The rate at which each species of vegetation is likely to grow back;
2. The voltage of the energized conductor, with higher voltages requiring larger clearances;
3. The potential movement of the energized conductor during various weather conditions;
4. The potential movement of trees or other vegetation during various weather conditions; and
5. The utility's legal rights to access the area.

(g) The EDC shall remove all trimmings and cut vegetation resulting from vegetation management activities that are part of the utility's regular maintenance cycle, within five business days after the vegetation was cut, except if the EDC obtains consent to leave the trimmings or cut vegetation, from the owner of the property upon which the trimmings or cut vegetation are located.

HISTORY:

Recodified from N.J.A.C. 14:5-8.5 and amended by R.2008 d.57, effective March 17, 2008.

See: 39 N.J.R. 3716(a), 40 N.J.R. 1684(a).

Substituted "EDC" for "electric public utility" throughout; in (a)9, substituted "C2-2007" for "C2-2002" and "07" for "02"; in (d), substituted "its" for "their" following "provide a copy of" and "as a chapter in the Annual System Performance Report" for "by January 17, 2007"; in (f), substituted "EDC" for "electric utility"; and rewrote (g).

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N.J.A.C. 14:5-9.6 (2008)

§ 14:5-9.6 Transmission line vegetation management

(a) In addition to the other requirements of this subchapter, transmission lines, as defined at N.J.A.C. 14:5-9.2, are subject to the requirements in this section.

(b) An EDC shall meet the requirements of the National Electric Safety Code (C2-2007) for minimum clearances between any transmission line and the closest vegetation beneath it.

(c) If a transmission line is upgraded or newly constructed after December 18, 2006, the width of the clearing under the transmission line shall meet the minimum requirements of the National Electrical Safety Code (C2-2007).

(d) An EDC may request an exemption from (b) and (c) above based upon exigent circumstances.

(e) In addition to meeting the other requirements in this section, each EDC shall ensure that the following requirements for transmission lines are met, except for those instances set forth in (f) below:

1. Clearing under transmission lines shall be wide enough within the EDC's right of way so that no vegetation or parts of vegetation will grow or fall into the transmission lines;

2. An EDC shall not allow any vegetation taller than 15 feet at maturity to grow anywhere within a transmission line right of way;

3. The preferred growth in a wire zone shall be grasses or a low-growing, compatible, scrub-shrub plant community to obtain a meadow effect where possible. An EDC shall not allow woody plants that naturally mature above three feet tall to grow in the wire zone;

4. The EDC shall not allow any woody plant species that naturally matures above 15 feet to grow in the border zone. Mature height may be determined from a reliable text authorities either

listed in, or equivalent to those listed in N.J.A.C. 14:5-9.5(a). Utilities shall provide this information on their web site or in a publication upon request by a ratepayer;

5. Non-woody agricultural crops, not exceeding 12 feet in height at maturity, may be grown anywhere in the right of way;

6. Only grass vegetation not exceeding a height of 18 inches shall be permitted to grow within three feet of any structure;

7. Where an EDC has cleared a right of way of vegetation and bare soil is exposed, the EDC shall comply with the soil erosion requirements of the applicable soil conservation district in order to prevent soil erosion. A list of the soil conservation districts in New Jersey may be found at www.state.nj.us/agriculture/divisions/anr/nrc/conservdistricts.html;

8. To the extent that any plant species identified as invasive and non-indigenous to New Jersey poses a threat to the maintenance of the right of way or a hazard to electrical transmission conductors, the EDC shall make reasonable efforts to actively eliminate from the entire right of way the species identified as invasive and non-indigenous, see Snyder, David and Sylvan R. Kaufman, 2004. An overview of non-indigenous plant species in New Jersey. New Jersey Department of Environmental Protection, Division of Parks and Forestry, Office of Natural Lands Management, Natural Heritage Program, Trenton, NJ (available at <http://www.nj.gov/dep/parksandforests/natural/heritage/InvasiveReport.pdf>, and incorporated by reference herein, including any supplements and amendments thereto). To do so, the EDC shall use the best integrated vegetation management practices available and practical; and

9. Each year in the March billing cycle, or two months prior to the commencement of vegetation management work on a particular property, whichever is earlier, each EDC shall advise customers of the requirements in this subsection, through a direct notification.

(f) Notwithstanding (e) above, an EDC may leave trees and other woody vegetation within the transmission right of way under any of the following conditions:

1. The right-of-way document, easement, indenture, deed or other written land rights, executed before Jan 1, 2007, expressly permit vegetation to be located within the transmission right of way;

2. The slope of the topography exceeds 30 degrees and the transmission right of way is such that the tree or other vegetation at mature height will allow a space of more than 150 percent of the clearance requirements for an electrical path to ground, as set forth in the National Electric Safety Code, § 232 to § 235; or

3. Trees are located within an inactive transmission corridor and at mature height will allow a space of more than 150 percent of the clearance requirements for an electrical path to ground set forth in the National Electric Safety Code, § 232 to § 235.

(g) For the purposes of this section, the mature height of woody and non-woody agricultural crops shall be determined in accordance with the publications listed in N.J.A.C. 14:5-9.5(a), or equivalent publications.

(h) Each year, before June 1, the EDC shall develop a schedule for transmission line vegetation management, which shall be included in the EDC's annual system performance report as required by N.J.A.C. 14:5-8. The schedule shall:

1. List the transmission lines planned for vegetation management for the next four years in advance (one of the four-year cycles required at N.J.A.C. 14:5-9.4(b));
2. Ensure that vegetation management on transmission lines is performed prior to vegetation becoming a threat to safety or service reliability; and
3. Be distributed to affected municipalities by the EDC.

HISTORY:

Recodified from N.J.A.C. 14:5-8.6 and amended by R.2008 d.57, effective March 17, 2008.

See: 39 N.J.R. 3716(a), 40 N.J.R. 1684(a).

Substituted "EDC" for "electric public utility" throughout; in (a), updated the N.J.A.C. reference; in (b) and (c), substituted "(C2-2007)" for "(C-2 2002)"; in the introductory paragraph of (e), inserted ", except for those instances set forth in (f) below"; in (e)1, inserted "within the EDC's right of way"; in (e)2, deleted "that grows" following "vegetation"; rewrote (e)3; in (e)4, updated the N.J.A.C. reference and inserted the last sentence; in (e)7, substituted the second occurrence of "EDC" for "utility" and updated the URL; in (e)8, rewrote the first sentence; in (e)9, substituted "advise customers" for "owners of land upon which the utility holds a right of way" and "direct notification" for "separate direct mailing"; added new (f); recodified the second (e) as (g); recodified former (f) as (h); and in (g), the introductory paragraph of (h) and (h)1, updated the N.J.A.C. references.

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*** NEW JERSEY REGISTER, VOL. 40, NO. 12, JUNE 16, 2008 ***

TITLE 14. BOARD OF PUBLIC UTILITIES
CHAPTER 5. ELECTRIC SERVICE
SUBCHAPTER 9. VEGETATION MANAGEMENT

N.J.A.C. 14:5-9.7 (2008)

§ 14:5-9.7 Training, recordkeeping and reporting

(a) Each EDC shall ensure that:

1. Qualified OSHA and ANSI Z133 line clearance employees or contractors perform vegetation management for the EDC;

2. All such employees or contractors are trained in the proper care of trees and other woody plants in order to provide safe, reliable electric service; and

3. All such employees or contractors are knowledgeable regarding safety practices and line clearance techniques.

(b) Each EDC shall ensure that records are kept of all persons used by a contractor or the EDC to perform vegetation management on behalf of the EDC, including the dates and types of training that each such person has received.

(c) The EDC shall monitor and document all vegetation management and related activities. Documentation shall be retained for five years and shall include, but shall not be limited to:

1. The municipality in which the work was performed;

2. Identification of the circuit and substation where vegetation management activities were performed;

3. The type of vegetation management performed including removal, trimming and spraying and methods used;

4. The crew size and supervisor's name;

5. The date of activity;

6. Any safety hazards encountered;

7. Any unexpected occurrence or accident resulting in death, life-threatening or serious injury to a person assigned to perform vegetation management activities or the public; and

8. Vegetation management activities planned for the following year.

(d) Each EDC shall include a summary of the information required in (c) above about its vegetation management work during the past year, and planned activities for the following year in the Annual System Performance Report to be filed with the Board by May 31 of each year. This information shall include, at a minimum, the name of each municipality in which the EDC conducted vegetation management during the preceding year, and all circuits affected.

HISTORY:

Recodified from N.J.A.C. 14:5-8.7 and amended by R.2008 d.57, effective March 17, 2008.

See: 39 N.J.R. 3716(a), 40 N.J.R. 1684(a).

Substituted "EDC" for "electric public utility" throughout; rewrote (a) and (b); in (c), inserted "be retained for five years and shall"; and in (d), substituted "the Annual System Performance Report" for "an annual report" and "May 31 of" for "May 31st".

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N.J.A.C. 14:5-9.8 (2008)

§ 14:5-9.8 Public notice of planned vegetation management activity

(a) Unless specifically stated elsewhere in this subchapter, each EDC shall make a diligent attempt to notify all municipal governments, customers, and property owners that may be affected by planned vegetation management activity on the EDC's distribution or transmission system. This requirement will be satisfied if the EDC provides written notice to customers and property owners in accordance with (b) and (c) below at least seven days, but not more than 45 days, prior to performing any vegetation management activity; and provides notice to municipal governments in accordance with (f) and (g) below.

(b) For distribution circuits, notice shall be provided to the following customers and property owners by separate direct mailing, door hanger, or any other Board-approved method:

1. All customers upon whose property runs any portion of the right of way or easement that will be maintained; and

2. Any owner of a property that meets both of the following:

i. The property is not served by the EDC, that is, there is no customer located on the property; and

ii. The property includes a portion of the right of way or easement that will be maintained.

(c) For transmission circuits, notice shall be provided through both of the following:

1. The EDC shall notify the persons described at (b)1 and 2 above through a direct mailing by certified mail, return receipt requested, or by another Board-approved method; and

2. The EDC shall publish a notice in two newspapers that serve the area, within the timeframe set forth in (a) above.

(d) For the purposes of (c)1 above, the United States Post Office (USPS) receipt of mailing (usually printed on white paper), which the USPS provides upon the mailing of an item certified mail return receipt requested, shall constitute proof of compliance.

(e) Each EDC shall maintain a record of the dates, locations and activities contained in the notices, which were provided to the municipal government under this section, for a period of five years after notices are sent.

(f) For municipal governments, each EDC shall provide written notice of any pending vegetation management activities to a primary contact. For a municipality, the mayor, town clerk or other person or position mutually agreed upon shall be the primary contact. For other government entities and for public authorities, the primary contact shall be selected by mutual agreement between the EDC and the entity or authority.

(g) An EDC shall notify all municipalities and public authorities that may be affected by vegetation management activities. The notice shall be made in writing to the primary contact designated under (f) above, at least two months in advance of the planned vegetation management. This notice shall include the planned dates and locations of the vegetation management. In addition, the notice of vegetation management shall be in a manner sufficient to explain each EDC's procedures and easement rights. The EDC shall provide a telephone number of the vegetation manager to enable questions to be answered.

(h) If any notice required under this section is provided by the EDC through a contractor or agent, the notice shall bear the name and logo of the EDC only, and not of the contractor or agent.

HISTORY:

Recodified from N.J.A.C. 14:5-8.8 and amended by R.2008 d.57, effective March 17, 2008.

See: 39 N.J.R. 3716(a), 40 N.J.R. 1684(a).

Section was "Public notice of planned vegetation management". Substituted "EDC" for "electric public utility" throughout; rewrote (a), added (b) through (d); recodified former (b) through (d) as (e) through (g); rewrote (e); in (f), substituted "For municipal governments, each EDC" for "Each electric public utility or its contractor" and substituted the second occurrence of "EDC" for "electric utility"; in (g), substituted "(f)" for "(c)", "manner sufficient to explain" for "form appropriate to" and "EDC's" for "electric public utility's", and inserted the last sentence; and added (h).

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N.J.A.C. 14:5-9.9 (2008)

§ 14:5-9.9 Outreach programs

(a) Each EDC shall conduct an annual public education program to inform its customers, as well as the municipalities and public agencies in the EDC's service territory, of the importance of vegetation management, and of the EDC's role and responsibility in managing vegetation near electric lines.

(b) The public education program required under this section shall be implemented by direct mail or another method approved by the Board.

(c) Each EDC shall post its public education materials on its website.

(d) As part of its education program under this section, the EDC shall provide on its website illustrations of typical configurations of transmission lines and easements, as necessary to comply with the requirement in (a) above to inform the public regarding the EDC's responsibilities in performing vegetation management under this subchapter.

HISTORY:

Recodified from N.J.A.C. 14:5-8.9 and amended by R.2008 d.57, effective March 17, 2008.

See: 39 N.J.R. 3716(a), 40 N.J.R. 1684(a).

In (a) and (c), substituted "EDC" for "electric public utility"; in (a), substituted "EDC's" for "electric public utility" twice; and added (d).

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CHAPTER 5. ELECTRIC SERVICE

SUBCHAPTER 9. VEGETATION MANAGEMENT

N.J.A.C. 14:5-9.10 (2008)

§ 14:5-9.10 Penalties

(a) Failure to comply with any provision of this subchapter shall subject the violator to penalties in accordance with the Board's regulatory and statutory authority.

(b) An EDC that violates this subchapter may be subject to penalties of up to \$ 100.00 per day per violation, for each day the violation occurs. The Board shall notify the EDC of the violation(s) in writing. Upon receipt of the written notice of violation, the EDC shall have five business days to correct the violation(s). Any failure to correct the violation shall subject the EDC to penalties of \$ 100.00 per day for each violation, calculated from the day such written notice was received by the EDC.

(c) Penalties imposed under this subchapter are in addition to, not a replacement for, other fines and/or penalties that apply under Federal and State laws and regulations.

(d) In determining the appropriate sanction for a violation of this subchapter, the Board shall consider the following criteria, and any other factors deemed appropriate and material to the electric public utility's failure to comply:

1. The good faith efforts, if any, of the entity charged in attempting to achieve compliance;
2. The gravity of the violation or the failure to comply;
3. The number of past violations by the entity charged, including violations of this subchapter as well as of other standards adopted by the Board;
4. The appropriateness of the penalty to the size of the company charged;
5. Events judged to be beyond the violator's control; and
6. Good faith efforts on the part of the EDC to resolve any violations of the requirements contained in this subchapter.

HISTORY:

Recodified from N.J.A.C. 14:5-8.10 and amended by R.2008 d.57, effective March 17, 2008.

See: 39 N.J.R. 3716(a), 40 N.J.R. 1684(a).

In (a), deleted the last sentence; in (b), substituted the first and fifth occurrences of "EDC" for "electric public utility", substituted the second, third and fourth occurrences of "EDC" for "utility", and substituted "penalties" for "fines" twice; deleted former (c); recodified former (d) and (e) as (c) and (d); in (c), substituted "Penalties" for "Fines and costs"; in (d)4, substituted "penalty" for "sanction or fine" and deleted "and" from the end; in (d)5, substituted "; and" for a period at the end; and added (d)6.

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APPENDIX 3: Shrub Species to Preserve within ROW

Mountain laurel (*Kalmia latifolia* L.)

Lowbush blueberry (*Vaccinium angustifolium* Aiton)

Highbush blueberry (*Vaccinium corybosum* L.)

Rhododendron *Rhododendron* spp.

Spicebush *Lindera benzoin* (L.) Blume

Red buckeye *Aesculus pavia*

Fringe tree *Chionanthus virginicus*

Winterberry *Ilex verticillata* (L.) A

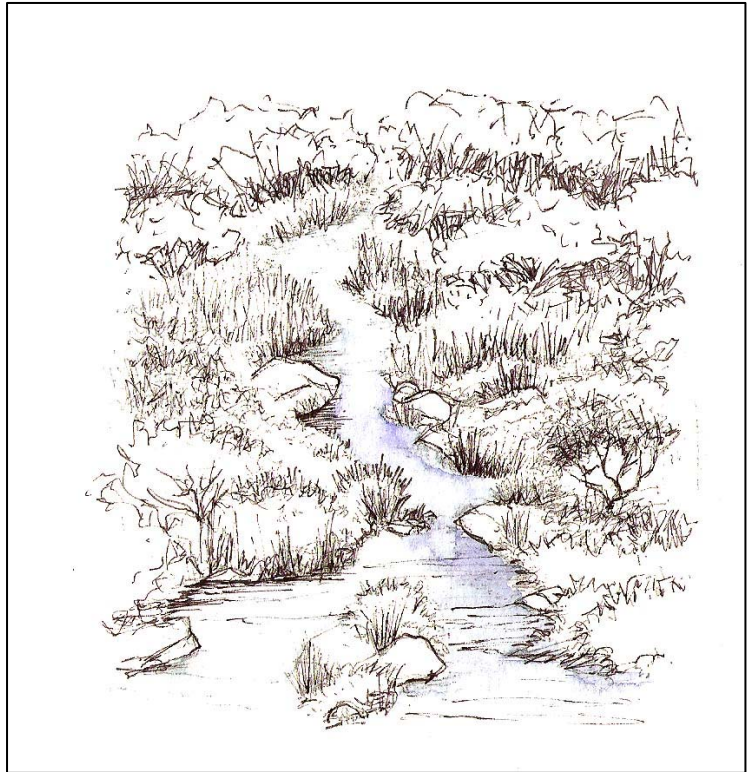
Any Viburnums *Viburnum* L.

Buttonbush *Cephalanthus occidentalis*

Silky Dogwood *Cornus amomum* Mill.

Alder

Witch Hazel



APPENDIX 4 Summary of Vegetation Management Prescriptions

Table 3		
Existing Landcover	Prescription	Debris Management
Agricultural (A)	Mow, if necessary, after crop harvest	Chip and remove
Forest dominated span (F) There are limited spans within the SR line that are forested – special treatment of these areas is required – however vegetation manager maintains discretion regarding trees within these areas.	Evaluate topography and relationship of conductor height. Manual or mechanical removal, cutting, girdling, topping of danger trees.	Chip and remove or lop and scatter
Shrub and tree dominated span (S-T)	Manual cutting of trees only and stump application of herbicides	Chip and remove or lop and scatter
Tree and herbaceous vegetation dominated with shrubs (T-H-S)	Mow trees and grass (manual removal of trees if necessary), avoid shrubs and stump application of herbicides	Mowing automatically mulches
Tree sprout and herbaceous vegetation dominated with few to no shrubs (T-H)	Mow and broadcast ground application of herbicides	Mowing automatically mulches
Scrub-shrub or herbaceous dominated span with tree sprouts or topped trees (S-H)	Mowing or Manual cutting of trees and stump application of herbicides	Chip and remove or lop and scatter
Herbaceous dominated (H)	Mowing	Mowing automatically mulches
Rock outcrop or bare soil (R)	Manual cutting of trees and stump application of herbicides, if necessary	Chip and remove or lop and scatter
Wetlands and Wetlands Buffers	Manual cutting only preferred; avoid crossing; mats required for equipment use and crossings; Maintenance activities MUST MEET TIMING RESTRICTIONS	Chip and remove or for debris equiv. to 2 percent of wetland area, lop to 4 feet length, 3 inch diameter max and spread
Riparian Zones	Manual cutting only; when slope 30 degrees or greater top trees to clearance standard; avoid crossing stream.	Chip and remove or lop and scatter above high water mark
Critical Habitat for T&E Species	Maintenance activities MUST MEET TIMING RESTRICTIONS	Chip and remove or lop and scatter

INFORMATION ONLY



An Overview

of Nonindigenous Plant Species in New Jersey

INFORMATION ONLY



State of New Jersey
Department of Environmental Protection

James E. McGreevey, Governor
Bradley M. Campbell, Commissioner

Appendix 2. Invasive Nonindigenous Plant Species Fact Sheets

Twenty-seven fact sheets have been prepared for 29 nonindigenous plant species that aggressively invade natural plant communities in New Jersey. These are invasive plant species that have many invasive biological traits, are generally widespread in New Jersey and are known to invade natural plant species. Most of these plant species are considered to be invasive throughout much of their range in the United States and all are considered to be invasive in two or more adjacent states (i.e., CT, NY, PA, DE, MD, VA).

The information presented in these fact sheets was primarily compiled from literature review, consultation with botanists from the network of state natural heritage programs, and an examination of herbarium specimens. Herbarium specimens cited are those contained in the collection of the Philadelphia Academy of Natural Sciences (abbreviated PH). Specimens contained in the Chrysler Herbarium, Rutgers University were unavailable for study due to the temporary closing of the collection. A study of herbarium specimens provides data on when and where a plant species was first collected in the state, the type of habitat it grows in, and its relative abundance throughout the state. This information is most useful for the years prior to 1960; after this date, the number of botanical collectors active in New Jersey decline significantly. As a result, many of the most widespread nonindigenous plant species occurring in New Jersey are underrepresented in herbaria.

Although no field surveys were conducted specifically for this project, information on habitat, distribution, and threats was augmented by data collected by the principal investigator over the course of 30 years of fieldwork in New Jersey. The county distributions presented in these fact sheets are by no means comprehensive. A thorough understanding of the distribution, abundance, habitats, and the ecological and economic threats caused by nonindigenous plant species will require many years of additional field surveys and data collection.

The State of New Jersey does not officially recognize the species described in these fact sheets as invasive nonindigenous plant species. No legislation currently exists mandating the creation of an official list of invasive nonindigenous plant species. In addition to enabling legislation, the creation on an official list of invasive nonindigenous plant species will require additional research, more documentation, and a thorough review by the public and governmental agencies.

Acer platanoides L. (Norway maple)

Description

Norway maple is a deciduous tree that averages 90 feet tall. The leaves have five sharply pointed lobes, similar to sugar maple leaves (Univ. of DE 1998). Norway maple can be distinguished from all native species of maples occurring in New Jersey by the milky sap present when the leaf petiole is broken off from a branch. The leaves are 4-7 inches long and are arranged opposite along the stem. The tree produces small greenish yellow flowers in April, and the seeds are held in wind-dispersed samaras that are 1½ - 2 inches long (Univ. of DE 1998). Leaves turn yellow in late autumn (Webb 1996).

Habitat

Norway maple readily establishes on disturbed sites, such as road and railroad embankments, vacant lots, and fallow fields. It also invades and establishes in natural plant communities. It is particularly successful on alluvial soils in floodplain forests and along riverbanks (see specimen records cited). It also occurs in woodlands and forests where it invades through cleared edges or blow-downs within the interior. Tolerant of air pollution, drought and salt spray, it is commonly used as a street tree in cities and coastal communities (Nowak and Rowntree 1990).

Distribution

Indigenous to Europe and western Asia, Norway maple currently occurs from eastern Canada south to North Carolina, and west to Nebraska (USDA 1998). Scattered occurrences are reported from Idaho, Montana, Washington, and British Columbia (Kartesz 1999). Delaware, Maryland, Massachusetts, New York, Pennsylvania, Vermont, and Virginia list Norway maple as invasive. In New Jersey, the collected range (based on specimens at PH) of Norway maple is Burlington, Camden, Cape May, Cumberland, Gloucester, Hunterdon, Mercer, Middlesex, Monmouth, Ocean, and Warren counties. Clemants and Glenn (1999) map more than 150 occurrences for the northern part of the State (i.e., Monmouth County north to Sussex County). It occurs in all physiogeographic provinces, but most collections are from the Piedmont and Inner Coastal Plain.

Threats

Norway maple is an aggressive colonizer able to survive under a range of habitat conditions. The dense shade produced by the canopy decreases understory plant diversity, but does not affect establishment of its own seedlings (Wyckoff and Webb 1996).

Control

Norway maple can be controlled mechanically or with herbicides. In some situations, the use of herbicides could harm native plants. Seedlings and saplings can be hand-pulled or dug out. They will resprout if all the roots are not removed (Webb 1996).

Literature Cited and Other Sources of Information

Clemants, S.E. and S.D. Glenn. 1999. New York Metropolitan Flora Woody Plant Work Book. Brooklyn Botanic Garden, Inc., Brooklyn.

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Representative New Jersey Specimens Examined

Burlington Co.: Rich wooded slope, fork of Black's Creek, 1.5 mi NW of Jacobstown, 2 October 1949, *B. Long* 70229, PH; Moist wooded alluvial bank along Delaware River, Delanco, 29 April 1915, *B. Long* 11607, PH. **Camden Co.:** Road embankment, Hay's Mill Bridge, Atco, 19 July 1923, *G.W. Bassett s.n.*, PH. **Cape May Co.:** Dump near Crooked Creek, 11 September 1938, *B. Long* 53077, PH. **Cumberland Co.:** Wooded bank along Union Lake, W of Millville, 2 May 1937, *B. Long* 49742, PH; Dump, old dam on mill pond, Cohansey Creek, Seeley, 29 September 1935, *B. Long* 47769, PH. **Gloucester Co.:** Rubbish dump in old sand pit, N of Clayton, 18 October 1902, *B. Long* 70402, PH; Border of woods near old farm, Mullica Hill, 21 April 1935, *B. Long* 45693, PH. **Hunterdon Co.:** Wooded slope along Delaware River, 1.5 mi S of Lambertville, 23 June 1940, *B. Long* 54549, PH; Alluvial bank of Delaware River, below Stockton, 20 April 1950, *B. Long* 70993, PH. **Mercer Co.:** Fills and rubbish dumps, 1 mi SW of Mercerville, 30 October 1947, *B. Long* 66732, PH. **Middlesex Co.:** Alluvial woods along Raritan River, 2 mi NW of Fieldville, 3 June 1951, *B. Long* 73256, PH. **Monmouth Co.:**

Alluvium, 3/8 mi S of Allentown, 29 July 1945, *S.D. Wickoff* 542, PH. **Ocean Co.:** Roadside ditch bordering woods, Manahawkin, 23 July 1923, *B. Long* 27989, PH. **Warren Co.:** Alluvium, 1 mi SE of Columbia, 16 July 1948, *R.L. Schaeffer, Jr.* 28502, PH; Alluvium, 1.5 mi E of Belvidere, 7 August 1950, *R.L. Schaeffer, Jr.* 33806, PH.

***Ailanthus altissima* (P. Mill.) Swingle (tree-of-heaven)**

Description

Tree-of-heaven is a deciduous tree that can reach 90 feet tall (Hunter 1996). The bark is gray and relatively smooth. Leaves are alternate and compound with 11-30 lance-shaped leaflets (Hunter 1996; Virginia NHP1998). Most leaflets have 1-3 coarse teeth at the base of the leaflet (Virginia NHP1998). Leaves can be distinguished from sumac (*Rhus hirta*) by 1-4 small round glands on the leaflet's underside (Hunter 1996). When the leaves are crushed, they give off a distinctive ill scent of burnt peanut butter. Trees bloom in late spring, forming small green flowers at the ends of new shoots (Hoshovsky 1998; Hunter 1996). Flowers develop into clusters of samaras, papery winged fruits with a flattened seed in the center. The seeds are wind-dispersed (Virginia NHP 1998). While seedlings are highly shade intolerant, saplings appear to be more tolerant of varying light conditions (Knapp and Canham 2000). Tree-of-heaven can also reproduce asexually by sprouting from stumps or roots (Hoshovsky 1998).

Habitat

Tree-of-heaven readily establishes on disturbed sites including vacant lots, roadsides, and railroad embankments (Virginia NHP1998). It can tolerate poor soils, drought and rocky conditions (TN EPPC 1998). Early New Jersey collections largely have been made from roadsides, thickets along creeks, and old house sites (see specimens cited). It can establish in old growth forests when disturbances caused by storms or insect outbreaks create gaps in the canopy (Knapp and Canham 2000). In New Jersey, it is frequent in floodplain forests and in woods occurring on trap rock or diabase, especially on the northeastern portions of the Watchung Mountains and the Palisades.

Distribution

Tree-of-heaven is indigenous to central China. It reached the East Coast in the late 1700s as an ornamental plant (Hoshovsky 1998), and was widely planted in urban areas because of its tolerance to pollution and drought. It is now present throughout the United States, with the exception of the northernmost midwestern states (USDA 1998). It is reported for British Columbia and Ontario, Canada (Kartesz 1999). It is considered invasive in at least eight other eastern states. The collected range (based on specimens at PH) in New Jersey is Atlantic, Burlington, Camden, Cape May, Cumberland, Gloucester, Hudson, Hunterdon, Mercer, Monmouth, Ocean, and Warren counties. It occurs throughout New Jersey's physiographic provinces. Clemants and Glenn (1999) map it as common throughout northern New Jersey.

Threats

Tree-of-heaven can disperse rapidly due to its prolific seed production. A single tree can produce 325,000 seeds in a year (Hoshovsky 1998). It can outcompete indigenous plants for underground resources with its long taproot. Trees keep native vegetation from establishing by

producing a toxin that accumulates in the soil. Because of its rapid growth (Knapp and Canham 2000), it quickly and significantly alters plant community structure and disrupts the process of natural plant succession.

Control

Seedlings can be hand-pulled before the taproot becomes established (Hoshovsky 1998). Once trees are established, they are very difficult to remove. Cutting trees repeatedly over several years will stress the trees and prevent seed production. Herbicides are especially effective when applied late in the growing season because the herbicide is then taken into the root system (Virginia NHP 1998; Hoshovsky 1998). Herbicides could harm nontargeted native vegetation, so careful application is necessary.

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Representative New Jersey Specimens Examined

Atlantic Co.: Naturalized about old house site in clearing, N of Egg Harbor City, 15 December 1940, *B. Long* 55757, PH; May's Landing, 16 September 1887, *J.E. Peters s.n.*, PH; roadside, mill at Weymouth, 24 August 1935, *O.H. Brown s.n.*, PH. **Burlington Co.:** Bordentown, 14 May 1891, [no collector's name or number], PH; margin of thickets, SSW of Fostertown, 29 February 1948, *B. Long* 66893, PH. **Camden Co.:** Low open thickets on tributary to Cooper Creek, E of Haddonfield, 15 December 1940, *B. Long* 55771, PH. **Cape May Co.:** Roadside woods, [Cape May]1902, *O.H. Brown s.n.*, PH; roadside thicket along Sunset Blvd., West Cape May, 20 August 1943, *W.M. Benner* 9866, PH. **Cumberland Co.:** Abundant about wooded knoll, East Point, 2 mi SW of Heislerville, 10 September 1933, *B. Long* 41999, PH; dry sandy open thicket, Maurice River, 2 mi S of Millville, 30 May 1934, *B. Long* 43271, PH. **Gloucester Co.:** Swedesboro, 31 July 1892, *C.D. Lippencott s.n.*, PH. **Hudson Co.:** roadside, Secaucus, 21 July 1970, *W. Sipple* 1542, PH. **Hunterdon Co.:** Alluvial bank along Pleasant Run, 1 mi NW of Pleasant Run, 6 July 1939, *W.M. Benner s.n.*, PH. **Mercer Co.:** Open thicket, W side PRR, S of Laylor St., S of Trenton, 13 August 1950, *B. Long* 71979, PH. **Monmouth Co.:** Roadside, 0.5 mi N of Glendola, 21 June 1954, *V.L. Frazee s.n.*, PH; abundantly naturalized on wooded hillslope, 1.5 mi SSW of Marlboro, 16 March 1941, *B. Long* 56057, PH. **Ocean Co.:** Naturalized about old house site near Manasquan River, NW of Point Pleasant, 26 January 1941, *B. Long* 55913, PH; Atsion, August 1881, *C.D. Fretz s.n.*, PH; dry sandy soil, SE of Fox Island Knoll, Manahawkin, 3 June 1914, *B. Long* 9969, PH. **Warren Co.:** Fence row, 0.5 mi W of Port Murray, 2 September 1954, *R.L. Schaeffer, Jr.* 47558, PH; alluvium, 2.5 mi SE of Columbia, 29 June 1948, *R.L. Schaeffer, Jr.* 27749, PH.

***Alliaria petiolata* (Bieb.) Cavara & Grande (garlic mustard)**

Description

Garlic mustard is a herbaceous biennial that ranges in height from 0.05 to 1.5 meters (Nuzzo 2000). Seedlings emerge in spring and form rosettes of kidney-shaped leaves by mid-summer. During the second year of growth, plants form one or more stems with alternate, sharply-toothed, triangular to heart-shaped leaves. The plants smell like garlic when crushed, especially the young leaves. A cluster of white, four-petaled flowers form at the end of the stems and branches in spring. Garlic mustard is pollinated by a number of small bees and flies but can self-pollinate in the absence of insects (Cruden, et al. 1996). The small oblong black seeds are held in siliques (long narrow capsules) at the ends of the stems (Nuzzo 2000). The seeds begin to mature in May and can remain viable through the summer (Rowe and Swearingen 1998). Garlic mustard has the ability to form seed banks but as demonstrated by Baskin and Baskin (1992), these seed reserves are viable for only about four years. People readily disperse the seeds when they get stuck on their boots or clothing and by automobiles and mowers. Seeds may also be dispersed by floodwaters, or indirectly by rodents, birds, and deer (Nuzzo 2000).

Habitat

Garlic mustard is primarily a woodland herb which grows in rich moist forests, floodplains, and along trails and forest edges (see specimens cited). It is especially abundant in soils occurring over limestone, trap rock, or diabase (D. Snyder, personal observation). It frequently establishes on disturbed areas such as a treefalls or trail edges, and then spreads into undisturbed habitats (Nuzzo 2000).

Distribution

Garlic mustard is indigenous to Europe and has been introduced to North Africa, India, Sri Lanka, New Zealand, and North America (Nuzzo 2000). In North America it was first recorded on Long Island, NY in 1868 and now occupies more than 30 states across New England, west to Oregon, and south to Georgia (USDA 1998; Kartesz 1999). At least nine other eastern states list it as invasive. In New Jersey, garlic mustard was collected as early as 1891 from the bank of the Raritan River near New Brunswick, Middlesex County, where it was described as, “liberally distributed over an area of several square miles...and in some places was so abundant as to be considered a weed by the farmers” (Stevens 1893). The collected range (based on specimens at PH) of garlic mustard in New Jersey is Hunterdon, Mercer, Middlesex, Monmouth, and Warren counties. It is also reported as occurring in Bergen, Burlington, Hudson and Union counties (Hough 1983). The species’ current distribution is statewide and it occurs in all physiographic provinces (D. Snyder, personal observation). It is least abundant on acid soils of the Inner Coastal Plain.

Threats

Alliaria petiolata can dominate forested understories, resulting in a decline in indigenous herb diversity (Nuzzo 2000). In turn, the decline of indigenous species alters habitat suitability for birds and other animals. Spring flowering plants and the animals dependent on them are particularly affected (Rowe and Swearingen 1998). Garlic mustard may have allelopathic effects as well, preventing plants from growing near it (Nuzzo 2000).

Control

Alliaria petiolata spreads rapidly once established. Baskin and Baskin (1992) reported that if small populations are not eradicated promptly, within a few generations, a few plants can rapidly spread and form dense populations throughout the forest. It is essential, therefore, to begin removal as soon as plants are first observed. Hand-pulling plants can control small infestations. This is most easily done when plants are small and the soil is moist (Rowe and Swearingen 1998). Plants should be pulled before seeds have matured, to prevent inadvertent dispersal. Hand-pulling should continue for at least five consecutive years in order to exhaust the seed bank. However, as Baskin and Baskin (1992) observe, it is likely that seeds will be brought in from other contaminated sites and control methods may be required indefinitely. Flower stalks can be cut in small populations to prevent seeds from maturing, and fire or herbicides can be used to control larger populations (Nuzzo 2000). Late fall is the preferred season for fire or herbicide control, because most indigenous plant species are dormant. Fire is only effective if there is a critical increase in rootcrown temperature. Rootcrowns covered by 1-2 cm of leaf litter will be protected. Removal of the leaf litter will increase seedling survival after the fire, necessitating a second burn the following year. Regardless of the control method used, sites must be monitored for at least five years to ensure that the seed bank has been exhausted (Rowe and Swearingen 1998).

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Representative New Jersey Specimens Examined

Hunterdon Co.: Alluvial woods along river, Lambertville, 28 May 1921, K.K. Mackenzie s.n., PH; Light woods, near Tumble Falls, 24 April 1958, W.L. Dix s.n., PH. **Mercer Co.:** Alluvial thicket, Washington Crossing, 7 November 1936, W.M. Benner 7514, PH; Alluvial soil between PA canal and Delaware River, 2 mi NW of Titusville, 16 November 1957, W.L. Dix s.n., PH. **Middlesex Co.:** Raritan River bluffs, New Brunswick, 20 July 1890, A.M. Vail s.n., PH; Wooded bluffs of Raritan River, very common, New Brunswick, 18 June 1916, K.K. Mackenzie s.n., PH; Flood plain of Raritan River, Weston's Mills, New Brunswick, 16 May 1931, G.A. Loughridge s.n., PH; near Raritan River, 2 mi above Highland Park, 10 May 1951, B. Long 73000, PH. **Monmouth Co.:** Rich open woods, 1.5 mi S of Middletown, 10 May 1952, V.L. Frazee s.n., PH. **Warren Co.:** Alluvium, 1 mi N of Musconetcong, 15 July 1948, R.L. Schaeffer, Jr. 28435, PH; alluvium, 1 mi SE of Springtown, 20 June 1957, R.L. Schaeffer, Jr. 54052, PH.

***Ampelopsis brevipedunculata* (Maxim.) Trautv. (porcelain berry)**

Description

Porcelain berry is a deciduous climbing vine in the grape family. It can climb to a height of 16 feet with support. The leaves are often deeply lobed, with 3-5 lobes per leaf, and are slightly hairy on the underside (Virginia NHP1998). Young twigs are also hairy. Small, inconspicuous, yellow flowers bloom in mid-summer (Antenen 1996). Fruits form in late summer, and mature in the fall. The fruits are hard and change color from white to pastel shades of yellow, lilac, and green, and finally to a sky blue color (Virginia NHP1998). Seeds are primarily bird dispersed, but the plant also can reproduce vegetatively from stem or root segments (Antenen 1996).

Habitat

Porcelain berry is tolerant of a wide range of environmental conditions (Virginia NHP1998). It is frequently found in old fields and along roadsides, railroads, and powerline right-of-ways. It tends to initially colonize disturbed open areas, such as forest edges, forest gaps, shorelines, and river banks. It is especially abundant in open thickets and sand dunes along coastal portions of New Jersey (D. Snyder, personal observation).

Distribution

Porcelain berry is indigenous to northeastern Asia, and was introduced to the United States as an ornamental landscape plant in the late 1800s (Antenen 1996). It is now abundant in the coastal zone from New England south to Georgia, and west to Wisconsin (Kartesz 1999). In New Jersey, its collected range (based on specimens at PH) is Cape May and Gloucester counties (see specimens cited), and it is reported from Camden and Middlesex counties (Hough 1983). Clemants and Glenn (1999) map nearly 40 occurrences in northern New Jersey. It occurs primarily in the Piedmont, Inner and Outer Coastal Plain physiographic provinces.

Threats

Porcelain berry forms thick mats, blanketing the ground and trees and shrubs on forest edges. It reduces the ability of indigenous plant species to establish, and makes the trees that it covers more vulnerable to wind (Antenen 1996) and ice damage.

Control

Porcelain berry is very difficult to remove once it has become established. Small plants can be hand-pulled, preferably before the plant is in fruit to avoid scattering seeds (Virginia NHP1998). Repeated cutting or mowing will control vines, but not kill them (Antenen 1996). Plants can be shaded out gradually by planting trees or cutting vines off existing trees until they mature. Herbicide application can be effective when applied in early autumn, but may damage

surrounding native plants. Treated sites need to be monitored for several years to remove new sprouts.

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Representative New Jersey Specimens Examined

Cape May Co.: Thicket on vacant lot, West Cape May, 5 September 1942, *W.M. Benner* 9838, PH. **Gloucester Co.:** Rubbish dump, North of Clayton, 18 October 1949, *B. Long* 70445, PH.

***Berberis thunbergii* BC. (Japanese barberry)**

Description

Japanese barberry is a woody deciduous shrub with dense spiny branches. It usually grows 2-3 feet high. The simple rounded leaves form rosettes along the branches in an alternate pattern. It produces solitary or small clusters of yellow flowers along the stem in spring, and the fruit ripens to a bright red oblong berry in late summer. Fruits are bird dispersed and are also eaten by small mammals (Wisconsin Dept. Natural Resources 1998). It is commonly planted as an ornamental shrub and for wildlife enhancement.

Habitat

Barberry often invades alluvial woods and open forests. It also grows along forest edges and in disturbed areas. Many collected specimens grew along creek banks and river banks (see specimens cited). It occasionally grows in saturated soil in wooded calcareous swamps (D. Snyder, personal observation).

Distribution

Indigenous to Asia, Japanese barberry was introduced to the United States as an ornamental shrub in the late 1800s. It now ranges from Maine to Georgia, and west to Wyoming and Colorado (Kartesz 1999; USDA 1998), and is considered invasive in at least nine other eastern states. In New Jersey, barberry has been collected (based on specimens at PH) from Burlington, Camden, Cape May, Gloucester, Hunterdon, Mercer, Monmouth, and Warren counties. It is also reported in Bergen, Essex, Middlesex, Morris, Passaic, and Somerset, Sussex, and Union counties (Clemants & Glenn 1999; Hough 1983; Ehrenfeld 1997). It occurs in all the physiographic regions of New Jersey, but is most abundant in the Piedmont, Highland, and Ridge & Valley provinces.

Threats

Barberry can grow in sun or shade and in many soil types (Johnson 1996). Branches touching the ground can root, and new shoots can develop from underground roots (Wisconsin Dept. Natural Resources 1998). Barberry can grow so thick in the understory of open forests that it shades out indigenous understory plants and decreases biological diversity. This could adversely affect birds and other animals dependent on the native plants (Johnson 1996). Barberry also affects soil properties, particularly pH, which can affect plant establishment (Kourtev, et al. 1998). Severe infestations of barberry can form nearly impenetrable thorny thickets that impact the recreational value of natural lands.

Control

Mechanical removal by hoe or weed wrench is effective if most of the root system can be removed (Vermont IEPFSS1998). Regular mowing can prevent reinfestation in successional fields. Herbicide treatment can be used to treat shoots that resprout (Johnson 1996). Small patches can be pulled or dug out early in the season, before seed set (Johnson 1996).

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Representative New Jersey Specimens Examined

Burlington Co.: Alluvial woods Crosswicks Creek, 2 mi NE of Bordentown, 7 May 1950, *B. Long* 70980, PH; Sandy open thickets near North Branch Rancocas Creek, 0.5 mi W of Pemberton, 30 March 1952, *B. Long* 74780, PH. **Camden Co.:** Rubbish dump by Manantico Rd., 1 mi SE of Cooper's Mill, 18 July 1946, *B. Long* 64882, PH. **Cape May Co.:** Shrubbery border, Cape May, 22 September 1922, *O.H. Brown s.n.*, PH. **Gloucester Co.:** Border of dry pine and oak woods, naturalized, 1.5 mi E of Glassboro, 22 March 1942, *B. Long* 57998, PH; Rubbish heap on wooded slope, along SW of Still Run, Mickleton, 3 July 1923, *B. Long* 27745. **Hunterdon Co.:** Open wooded slope, 0.5 mi NW of Lower Valley, 6 September 1938, *W.M. Benner* 8389, PH; Wooded alluvial bank of Delaware River, 1.5 mi SE of Stockton, 20 April 1950, *B. Long* 70921, PH. **Mercer Co.:** Rubbish heap edge of woods, 1 mi NE of Edinburg, 11 May 1951, *B. Long* 74935, PH; Moist wooded slopes of Delaware River, Washington Crossing, 31 May 1924, *B. Long* 30470, PH. **Monmouth Co.:** Rich flood plain of Manasquan River, 1.5 mi S of Farmingdale, 25 April 1954, *V.L. Frazee s.n.*, PH; Moist sandy wooded slope along streamlet, [near] Tennent, 28 May 1932, *W. M. Benner* 4434, PH. **Warren Co.:** Woods, 1 mi N of Washington, 1 July 1957, *R.L. Schaeffer, Jr.* 54575, PH; Alluvium, 1 mi SE of Columbia, 16 July 1948, *R.L. Schaeffer, Jr.* 28514, PH.

***Carex kobomugi* Ohwi (Japanese sedge)**

Description

Japanese sedge is a perennial sedge with leaves reaching a height of about 30 cm (Virginia NHP1998). Young leaves are yellow-green and stiff with rough edges. The older leaves are wider, darker green, and leathery to the touch. Flowers are held in dense clusters at the tops of stems. Bases of stems are triangular and covered with brown scales. The root system is extensive and can extend nearly a meter into the soil. Flowering heads are either male or female, with the male flower clusters being shorter and more cylindrical than the female flower clusters. Seeds are held in triangular cases called achenes. Plants spread rapidly by underground stems (Virginia NHP1998).

Habitat

In New Jersey, Japanese sedge is restricted to sea beaches and primary and secondary sand dunes (see NJ specimens cited). It was used in New Jersey for erosion control and sand stabilization.

Distribution

Japanese sedge is indigenous to eastern Asia. It grows along the coast of the eastern United States from Massachusetts south to North Carolina (Kartesz 1999; USDA 1998). It also has been reported from Oregon (Kartesz 1999). Virginia and New York both list Japanese sedge as invasive, and it appears to be spreading northward along the coast. In New Jersey, Japanese sedge is restricted to the Coastal Plain and reaches its greatest abundance on Sandy Hook, Monmouth County, and Island Beach, Ocean County (D. Snyder, personal observation). It also has been collected from small colonies at Sea Bright and near Long Branch, Monmouth County (D. Snyder, personal collection).

Threats

The stems of Japanese sedge form dense mats that crowd out indigenous dune species such as American beach grass. Because the sedge is lower growing than the native dune grasses, it leaves dunes vulnerable to shifting sands and blowouts, changing the dune profile dramatically (Virginia NHP1998). In areas of Sandy Hook National Recreation Area and Island Beach State Park, Japanese sedge forms dense monocultures 10 to 20 meters across effectively excluding most native species (D. Snyder, personal observation).

Control

Small populations can be removed by hand digging plants. Large populations can be treated with biodegradable glyphosate herbicide towards the end of the growing season. Follow up treatments will be needed with either method to eliminate new seedlings (Virginia NHP1998).

Several test plots have been sprayed with herbicide at Island Beach State Park. Initial results are promising; especially in plots that were replanted with American beach grass (G. McLaughlin, pers. comm.).

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Representative New Jersey Specimens Examined

Ocean Co.: Frontal dunes, 1 mi S of Island Beach Life Saving Station, Seaside Park, 1 February 1931, *B. Long* 34974, PH; on sand dunes, large deep rooted colony, Island Beach, 23 August 1947, *H.N. Moldenke* 19146, PH.

***Celastrus orbiculatus* Thunb. (Asian bittersweet)**

Description

Asian bittersweet is a deciduous, woody, perennial vine that can also grow into a trailing shrub (Bergmann and Swearingen 1999). It climbs by twining around a support. The leaves are alternate, with a rounded glossy appearance, and finely toothed edges. The stems are brown with noticeable lenticels (Dreyer 1994). Asian bittersweet flowers in spring, producing clusters of small greenish flowers in the leaf axils. Fruits mature in late summer to early fall. The green to yellow mature fruits split open to reveal bright red arils that surround the seeds. Asian bittersweet is sometimes confused with the similar indigenous American bittersweet (*Celastrus scandens*), especially in the nursery trade (Dreyer, et al. 1987). American bittersweet can be reliably distinguished from Asian bittersweet by having terminal, rather than axillary, clusters of female flowers and fruits, and, less reliably, by its more elliptical shaped leaves and more orange-colored fruits (Dreyer 1994). The fruits are primarily dispersed by birds and small mammals (Bergmann and Swearingen 1999). People are often dispersers as well, harvesting the branches for ornamental use and later discarding them. The vine also reproduces asexually by stolons (above-ground stems), rhizomes, and root suckering (Bergmann and Swearingen 1999).

Habitat

Asian bittersweet occupies a wide range of habitats including forest edges and gaps, floodplains, fields, hedgerows, beaches and salt marsh edges (see specimens cited and Bergmann and Swearingen 1999). It is shade tolerant, and can establish under a closed forest canopy (Dreyer, et al. 1987; TN-EPPC 1999).

Distribution

Asian bittersweet is indigenous to eastern Asia, including Japan, Korea, and parts of China. It was introduced to the United States in the late 1800s, and was planted as an ornamental and used for wildlife food and cover and erosion control (Dreyer 1994). In the United States it occurs from Maine to Georgia, and west to Iowa and Arkansas (Kartesz 1999; Virginia NHP1999). It is also present in Quebec and Ontario, Canada (Kartesz 1999). Several states consider it invasive, including Connecticut, Delaware, Maryland, Massachusetts, New York, Pennsylvania, Tennessee, Virginia, and Vermont. In New Jersey it has been collected from Burlington, Mercer, Middlesex and Monmouth counties (based on specimens at PH; Patterson 1973). Clemants and Glenn (1999) map it as widespread throughout northern New Jersey with records in all counties from Monmouth north to Sussex. It occurs in all physiographic provinces, but most collections are from the Piedmont and Inner Coastal Plain.

Threats

Trees and shrubs can be severely damaged by Asian bittersweet, as its twining branches eventually constrict their trunks and branches, and the vegetative growth can over-top and

outshade them. This makes the trees more susceptible to damage by wind, snow and ice storms (Dreyer 1994). It can form pure stands over some areas. It threatens dune areas as well, possibly altering erosion patterns and outcompeting native dune vegetation. The alteration of natural vegetation structure caused by Asian bittersweet can make recovery of an area very difficult. Preliminary investigations indicate that Asian bittersweet has a much higher percentage of pollen and seed viability than does American bittersweet and may therefore be able to outcompete American bittersweet (Dreyer, et al. 1987). There is also evidence that Asian bittersweet may be hybridizing with American bittersweet, threatening the genetic identity of American bittersweet (Dreyer, et al. 1987; Dreyer 1994).

Control

Control of Asian bittersweet can be difficult, as seed germination rates are high, and seeds are persistent in the soil bank (Dreyer 1994). Small populations can be cut repeatedly until the root stores are exhausted. Juvenile plants can be hand-pulled, but any root portions not removed can resprout (TN-EPPC 1999). All plant parts should be removed from the site to prevent reestablishment. A combination of cutting and herbicide treatment of stumps can be effective (Dreyer 1994), but herbicides could adversely affect surrounding native vegetation.

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Representative New Jersey Specimens Examined

Mercer Co.: Sunny roadside, near pumping station on Stony Brook, western edge of Princeton, 16 May 1953, *I.K. Longman s.n.*, PH. **Middlesex Co.:** Sandy thickets at Sand Hills, 1.5 mi W of Deans, 2 November 1953, *W.L. Dix s.n.*, PH. **Monmouth Co.:** Rich floodplain of Manasquan River, 1 mi W of Allenwood, 27 May 1958, *V.L. Frazee s.n.*, PH.

***Centaurea biebersteinii* DC.**
[*Centaurea maculosa* auct. non Lam.]
(spotted knapweed)

Description

Spotted knapweed is a biennial to short-lived perennial herb that forms between 1-20 stems from a basal rosette (Mauer, et al. 1987). Seedling rosette leaves are pinnately to bipinnately dissected and grow 4-8 inches long. The stems can grow 1-3 feet tall, and lower stem leaves are pinnate, becoming linear on the upper stem (Mauer, et al. 1987). In summer, pink to white tubular flowers bloom, held in a thistle-like inflorescence at the ends of branches (Virginia NHP1998). Seeds are released from late summer through fall. Seeds disperse short distances passively, but long-distance dispersal can occur via rodents, livestock, vehicles, or commercial seed (Mauer, et al. 1987).

Habitat

Spotted knapweed primarily establishes in disturbed areas, but can spread into undisturbed areas once established (Mauer, et al. 1987). Western states are heavily invaded in overgrazed areas. It can grow under very dry, low nutrient conditions, and is often found on gravelly or sandy openings in old fields and roadsides (Virginia NHP1998). In New Jersey spotted knapweed occurs abundantly in dry to moist soils along roads, powerline right-of-ways, railroad embankments, old fields, and vacant lots. It also successfully invades many natural plant communities including sand plains, trap rock and limestone glades, shale bluffs, and limestone fens (D. Snyder, personal observation).

Distribution

Spotted knapweed was introduced accidentally to the United States during the late 1800s in ballast and imported seed (Mauer, et al., 1987). It is indigenous to Europe. It has been reported from all states except Georgia, Mississippi, Oklahoma, Texas, and Alaska (Kartesz 1999). It also occurs in Nova Scotia, New Brunswick, Quebec, Ontario, British Columbia, and Yukon, Canada (Kartesz 1999). Over 1.5 million acres of pasture and rangeland are invaded by spotted knapweed in the northwestern United States. In New Jersey, spotted knapweed is reported in Atlantic, Camden, Cumberland, Hunterdon, Mercer, Middlesex, Monmouth, Morris, Ocean, and Warren counties (Hough 1983). It is also present in Sussex, Passaic, Essex, Union, Somerset, and Burlington counties (D. Snyder, personal observation).

Threats

Spotted knapweed is an excellent competitor, and is resistant to herbivores (Mauer, et al. 1987). It has been documented that spotted knapweed outcompetes and replaces indigenous plant species (Harris and Cranston 1979). High concentrations of leachates of spotted knapweed have been reported to inhibit the germination of grass and conifer seedlings (Kelsey and Bedunah 1989). Lesica and Shelly (1996) have shown that spotted knapweed reduces

recruitment and population growth of *Arabis fecunda* Rollins, a threatened plant species endemic to southwestern Montana. Spotted knapweed can increase erosion by displacing native root systems with its taproot (Mauer, et al. 1987). The Nature Conservancy's Wildland Invasive Species Program (1997) is investigating a report that spotted knapweed may contain a carcinogen that causes tumors in humans. In New Jersey, spotted knapweed invades rare natural plant communities where it replaces native plant species and significantly alters plant community structure.

Control

Most control methods have been developed for large infestations of knapweed in the western United States. It may be possible to plant indigenous grasses or other species that could outcompete spotted knapweed, but most tests of this technique have been done in western states (Mauer, et al. 1987). Removing flowering heads after plants have bolted can reduce resprouting and seed dispersal. Hand-pulling or grubbing can be used to control small populations (Virginia NHP1998). Because of the knapweed's reported, but as yet unverified, carcinogen contained in the sap, appropriate gloves should be worn when handling this species. Herbicides can be used, but they do not prevent germination from the seed bank. Four biological control agents have been introduced to the western United States, and are effective at reducing seed production (Mauer, et al. 1987).

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<http://www.state.va.us/~dcr/dnh/invcent.htm>.

Representative New Jersey Specimens Examined

No herbarium specimens were examined for this species.

***Cirsium arvense* (L.) Scop. (Canadian thistle)**

Description

Canadian thistle is a herbaceous perennial, growing from 0.5-1 meter tall (Nuzzo 1998). The stems are branched and ridged, and sometimes slightly hairy. The alternate, lance-shaped leaves have lobed spiny margins (Thunhorst and Swearingen 1998). It can be distinguished from other thistles by creeping horizontal roots, dense clonal growth, and small (1–1.5 cm diameter) dioecious flowerheads (male and female flowers on separate plants) (Nuzzo 1998). Some plants may produce self-fertile hermaphrodite flowers. The color of the insect-pollinated flowers ranges from lavender to pink, or white. Seed production is prolific, and one plant can produce an estimated 40,000 seeds, each capable of remaining viable in the soil for up to 20 years (Cheater 1992). Seeds are dispersed by wind and possibly by water, and also as contaminants in agricultural seeds, in farm animal droppings, and on farm machinery. Plants spread primarily by vegetative growth, despite high seed production. Horizontal roots can expand by 4-5 meters per year. Plants also propagate from stem and root fragments (Nuzzo 1998). Root fragments as small as an inch can resprout (Cheater 1992).

Habitat

Canadian thistle is shade intolerant, but grows along forest edges (Nuzzo 1998). It has been collected most often from disturbed areas and fields (see specimens cited) but also occurs in meadows and limestone fens.

Distribution

Canadian thistle is indigenous to Europe (Nuzzo 1998). It was introduced to North America in the early 17th century, and is now present in 41 states (USDA 1998). It is considered a noxious weed in 35 states as well as six Canadian provinces (Nuzzo 1998). In New Jersey, the collected range (based on specimens at PH) of Canadian thistle is Burlington, Camden, Hunterdon, Mercer, Middlesex, Monmouth, Salem, Somerset, and Warren counties. It is also reported to occur in Bergen, Cape May, Morris, and Sussex counties (Hough 1983). It occupies all physiographic provinces in New Jersey.

Threats

Canadian thistle is listed as a Federal Noxious Weed, primarily because of its economic impact on agriculture (Thunhorst and Swearingen 1998). Canadian thistle competes with and displaces native vegetation, changing the structure and composition of some habitats (Nuzzo 1998). It primarily threatens nonforested plant communities, such as savannas, glades, sand dunes, fields, and meadows (Thunhorst and Swearingen 1998).

Control

Because Canadian thistle expands primarily by vegetative means, killing established clones is most effective for management (Nuzzo 1998). However, seedlings are the most susceptible growth stage. Burning can increase the competitiveness of indigenous species, but does not eliminate thistle. Mowing can be effective if done during the summer, and again in early fall, leaving enough stem and leaves to avoid stimulating the rootbuds. Herbicides may be used with effectiveness in the fall, but populations differ in their susceptibility to herbicides, and herbicides could adversely affect indigenous plants. Control may be most effective when the plant is under stress, such as during drought, flood, or after a severe winter. Repeated treatments are necessary to eliminate the seed bank (Thunhorst and Swearingen 1998).

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Representative New Jersey Specimens Examined

Burlington Co.: Near railroad bridge, 0.75 mi W of Chatsworth, 23 June 1934, *W.H. Witte s.n.*, PH; roadside gravel, SE of Duke's Bridge, 6 July 1938, *B. Long 52512*, PH. **Camden Co.:** Waste ground, Kaighn's Point, 21 June 1872, *H.B. Meredith s.n.*, PH; waste field, Berlin, 18 August 1923, *M.H. Williams s.n.*, PH. **Mercer Co.:** Rocky Hill, 20 August 1885, *J.E. Peters s.n.*, PH. **Hunterdon Co.:** Swale by roadside, E of Woodglen, 18 July 1935, *B. Long 46814*, PH. **Middlesex Co.:** South Amboy, 20 July 1868, *C.A. Boice s.n.*, PH. **Monmouth Co.:** Grassy roadside, 1 mi W of Manasquan, 6 July 1956, *V.L. Frazee s.n.*, PH. **Salem Co.:** Rare in pasture-meadow, NW of Woodstown, 19 June 1924, *B. Long 30847*, PH. **Somerset Co.:** Dry soil along roadside, Watchung, 8 July 1930, *H.N. Moldenke 1331*, PH; Waste ground, Watchung, 29 July 1946, *H.N. Moldenke 18364*, PH. **Warren Co.:** Fallow field, 3 mi SW of Belvidere, 20 July

1948, *R.L. Schaeffer, Jr.* 28787, PH; Field, 1.5 mi NW of Hope, 10 August 1948, *R.L. Schaeffer, Jr.* 29614, PH.

***Dipsacus fullonum* L. ssp. *sylvestris* (Huds.) Clapham
(wild teasel)**

***Dipsacus laciniatus* L.
(cut-leaf teasel)**

Description

Teasels grow as prickly biennial or perennial herbs, up to 2 meters tall (Auld and Medd 1987; Lorenzi and Jeffery 1987). They form a rosette of lanceolate, prickly leaves in spring, and overwinter as rosettes. In the second year of growth they form angular stems with large, simple opposite leaves. The lower stem leaves may have scalloped edges. Cut-leaf teasel tends to have broader leaves than common teasel, with deeply incised lobes (Wisconsin Dept. Natural Resources 1998). Flowers bloom in summer, arranged in a 4-10 centimeter long cylindrical head. The flowers of wild teasel are purple to pink, and those of cut-leaf teasel are white (Lorenzi and Jeffery 1987; Wisconsin Dept. Natural Resources 1998). At the base of the flower heads are long, curved spiny bracts. The flower heads dry and may remain on the stem through the winter. Seeds are ribbed, hairy and 4-5 mm long (Lorenzi and Jeffery 1987).

Habitat

Teasels are commonly found in pastures, along roadsides, and in waste places, but they also invade natural plant communities, such as limestone fens, meadows and stream corridors (see specimens cited).

Distribution

Wild teasel and cut-leaf teasel are indigenous to Europe, but were introduced to North America and Australia (Auld and Medd 1987; Lorenzi and Jeffery 1987). Cut-leaf teasel ranges across at least 18 states from New York west to Colorado, and as far south as North Carolina (USDA 1998). Wild teasel is widespread throughout most of the United States (Kartesz 1999; USDA 1998). Both species are considered invasive in Delaware, New York, and Virginia, while Tennessee only considers wild teasel to be invasive. In New Jersey, wild teasel has been collected (based on specimens at PH) from Atlantic, Burlington, Camden, Cumberland, Hunterdon, Mercer, Middlesex, Ocean, Salem, and Warren counties. It is also reported from Bergen, Cape May, Morris, and Somerset counties (Hough 1983). It is especially abundant in the limestone region of Sussex and Warren counties (D. Snyder, personal observation). It occurs in all of New Jersey's physiographic provinces. Cut-leaf teasel's range is more restricted in New Jersey; it is reported in Sussex and Warren counties (Hough 1983).

Threats

Teasel plants produce large numbers of seeds with a mature plant capable of producing over 2000 seeds (Glass 1990). The seeds can remain viable in the soil for up to two years (Glass

1990). Immature seeds are also viable (Solecki 1993). Although seeds do not disperse far, they can effectively produce a monoculture of teasel lobes (Wisconsin Dept. Natural Resources 1998). Highway mowing equipment and discarded dried teasel heads from flower arrangements can lead to the establishment of new colonies. The large rosette leaves may prevent native species from persisting, or establishing. Teasels significantly alter the structure of rare natural plant communities and reduce plant diversity. In one limestone fen in Warren County, the growth of teasel is so dense that it has eliminated the habitat for several state listed endangered plant species (D. Snyder, personal observation) including spreading globe flower (*Trollius laxus*) and sessile water speedwell (*Veronica catenata*).

Control

Small rosettes can be hand-pulled in fall or early spring (Lorenzi and Jeffery 1987). The rosettes have a large taproot that must be dug up to prevent resprouting lobes (Wisconsin Dept. Natural Resources 1998). Flowering stalks can be cut once the flowers have started to bloom, but the stalks should be removed from the site since seeds can mature after the stems are cut. Stems may need to be cut for several consecutive years. (Wisconsin Dept. Natural Resources 1998). Herbicides are also used to treat infestations of teasel, but herbicides can kill untargeted indigenous plants. Application of herbicides can be done late in fall after most other plant species have become dormant lobes (Wisconsin Dept. Natural Resources 1998).

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Representative New Jersey Specimens Examined

Dipsacus sylvestris

Atlantic Co.: Dumping ground, Atlantic City, 22 July 1923, *M.H. Williams s.n.* PH. **Burlington Co.:** Marlton, 16 July 1882, *J. Stokes s.n.*, PH; Wet meadow along South West Branch Rancocas Creek, 1.75 mi E of Marlton, 9 May 1936, *J.M. Fogg, Jr. 10254*, PH. **Camden Co.:** Ship's ballast, Kaighn's Point, 7 August 1897, *B. Heritage s.n.*, PH; Ballast, Kaighn's Point, September 1889, *B. Heritage s.n.*, PH. **Cumberland Co.:** Open sand, Mt. Pleasant Cemetery, Millville, 2 May 1937, *B. Long 49743*, PH. **Hunterdon Co.:** Along Delaware River between Bull's Island and Pt. Pleasant, July 1883, *G.N. Best s.n.*, PH; Fallow field, 1 mi. NW of Milford, 31 November 1959, *R.L. Schaeffer, Jr. s.n.*, PH. **Mercer Co.:** Princeton, July 1883, *J. E. Peters s.n.*, PH; Trenton, 30 June 1886, *A.C. Apgar s.n.*, PH. **Middlesex Co.:** New Brunswick, August 1891, *Halsted's American Weeds 28*, PH. **Ocean Co.:** Roadside Long Swamp, 2 mi S of New Egypt, 31 July 1906, *J.H. Grove 626*, PH; Roadside in Barnegat, 1 September 1914, *B. Long 10782*, PH. **Salem Co.:** Open pastured woods, along Alloway Creek, SE of Penton, 26 July 1922, *B. Long 26248*, PH. **Warren Co.:** Alluvium, 2 mi NW of Delaware, 9 August 1948, *R.L. Schaeffer, Jr. 29391*, PH; Fallow field, 1 mi E of Pequest, 13 August 1959, *R.L. Schaeffer, Jr. 59626*, PH.

***Elaeagnus umbellata* Thun. var. *parvifolia* (Royle) Schneid. (autumn olive)**

Description

Autumn olive grows as deciduous shrubs or small trees. Autumn olive has small simple alternate leaves that are oval to lance-shaped (Virginia NHP1998). The underside of the leaf is covered with silver-white scales. In early spring the plant produces small, light yellow flowers along the twigs, just after leaves have appeared. Small juicy fruits ripen to pink or red, dotted with silver-white scales, in late summer. Birds eat and disperse the fruits.

Russian olive is closely related to autumn olive, and can be distinguished by its narrower lance-shaped leaves, silvery on both sides, thorny branches, and yellow, dry, mealy fruits (Virginia NHP1998). Russian olive also flowers later in the spring, well after the leaves have appeared. It commonly confused with autumn olive.

Habitat

Autumn olive has nitrogen-fixing root nodules that allow it to thrive in poor soils (Sather and Eckardt 1987; Muzika and Swearingen 1998). Typical habitats for autumn olive include disturbed areas, roadsides, pastures, fields, forest edges, and open woodlands (see specimens cited). The species invades a number of uncommon or rare plant communities including limestone and trap rock woodlands, shale bluffs, glades, limestone fens and meadows, and dune thickets. It also has been found growing in saturated soils of wooded calcareous swamps (D. Snyder, personal observation).

Distribution

Autumn olive is indigenous to Asia (Sather and Eckardt 1987). It was widely planted in the United States as an ornamental shrub, wildlife cover, and for revegetation of disturbed areas. Autumn olive is considered invasive in nearly all of the eastern states. Autumn olive occurs throughout New Jersey, occurring in all physiographical provinces. The collected range (based on specimens at PH) of autumn olive is Cumberland, Mercer, Ocean, and Somerset counties. It is also reported in Hunterdon, Sussex, and Warren counties (Hough 1983). Clemants & Glenn (1999) map it as widespread throughout all of northern New Jersey

Threats

Autumn olive could adversely affect the nitrogen cycle of native communities on poor soils (Muzika and Swearingen 1998; Sather and Eckardt 1987). It grows rapidly, resprouts when cut, and is a strong competitor. The dense shade it produces suppresses plants that require sunlight (Virginia NHP1998). At some locations, it forms dense monocultures that alter the structure of natural plant communities and reduces plant diversity.

Control

Burning and cutting stimulate resprouting. Seedlings can be dug out when the soil is moist to ensure removal of the root system. Herbicides are effective when applied in fall (Sather and Eckardt 1987), but herbicides can also harm indigenous plants. Public and governmental education is essential to controlling the further spread of this species. As recently as 1992, autumn olive was still being recommended for “habitat improvement projects designed to attract wildlife, provide barriers, beautify existing landscapes, and reclaim disturbed sites” (Dittberner, et al., 1992) with little or no warnings on its invasive nature. The species is still widely planted in New Jersey, especially along highway corridors.

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Representative New Jersey Specimens Examined

Eleagnus umbellata

Cumberland Co.: Roadside thicket, NW of Fordville, 10 November 1935, *B. Long* 47968, PH; Edge of woods by old clearing along Mill Creek, Fairton, 12 May 1935, *B. Long* 45798, PH; Abundant in open woods and thickets west of Carmel, 1.5 mi NE of Gouldtown, 15 August 1935, *B. Long* 47367, PH; Edge of dry pine woods, 2 mi SE of Woodruff, 2 December 1934, *B. Long*, 45364, PH. **Mercer Co.:** Bank of Delaware River, 0.5 mi SSE of Scudder's Falls, 30 May 1947, *W.L. Dix s.n.*, PH; Bank of Delaware River, 0.5 mi SSE of Scudder's Falls, 9 November 1947, *W. Perry s.n.*, PH. **Ocean Co.:** Old house site near Manasquan River, NW of Pt. Pleasant, 26 January 1941, *B. Long* 55923, PH. **Somerset Co.:** Thicket, extensively naturalized, Watchung, 21 May 1930, *H.N. Moldenke* 1266, PH.

***Euonymus alata* (Thunb.) Sieb. (winged spindletree)**

Description

Winged spindletree grows as a deciduous shrub or small tree to around 12 feet tall (Ebinger 1996). It has inconspicuous yellow-green flowers in the spring. Corky ridges form along the green twigs, giving the branches a winged appearance. The leaves are opposite and are elliptical in shape with toothed margins. It is also called burning bush because its leaves turn bright red to purplish red in the fall, and the seeds are contained in red or purple fruits (Ebinger 1996). The fruits are dispersed by birds.

Habitat

Winged spindletree is frequent in rich woodlands over trap rock, shale, and limestone. It also grows in alluvial soils in flood plain forests and along stream banks.

Distribution

Winged spindletree is indigenous to northeastern Asia, and was introduced to the United States in the mid 1800s as an ornamental plant (Ebinger 1996). It now occurs primarily in the northeastern states, but there are occurrences south to Louisiana and west to Arkansas and Montana (Kartesz 1999; USDA 1998). It is considered invasive in at least six other eastern states. It is documented throughout northern New Jersey (Clemants and Glenn 1999) and occurs south to at least Gloucester County (D. Snyder, personal observation). Although widespread in New Jersey, the species is poorly documented by specimen collections. By the middle 1970s, the species already was well established on the Watchung Mountains in Somerset and Union counties (D. Snyder, personal observation).

Threats

Winged spindletree replaces native shrubs in some woodland habitats (Ebinger 1996) and alters the structure of natural plant communities. Open woodlands and flood plain forests are particularly vulnerable, but upland forests are also invaded.

Control

Plants can be cut and the stumps painted with herbicide, or foliar spray can be applied in early summer for large populations (Ebinger 1996).

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http://plants.usda.gov/plants/fr_enter.cgi?earl=fr_querymenu.

***Lespedeza cuneata* (Dum.-Cours.) G. Don (Chinese bush-clover)**

Description

Lespedeza cuneata is a perennial legume, with somewhat woody, straight stems (Smith 1998; Remaley 1998). It grows in height from 1.5 to 5 feet, producing alternate leaves along the stem. The leaves are divided into three narrowly oblong, pointed leaflets, that are covered with flattened hairs. The hairs give the leaves a grayish-green or silvery appearance (Remaley 1998). The flowers are small and grow in the leaf axils from the middle and upper parts of the branches. They bloom in late summer and early fall, and are cream-colored with purple markings (Smith 1998). Natural seed dispersal is primarily by animals.

Habitat

Lespedeza cuneata tolerates a wide range of soil conditions including very sterile soils. It can invade open woodlands, forest and wetland edges, fields and prairies (Remaley 1998). In New Jersey it reaches its greatest abundance on the Coastal Plain where it grows along the edge of pine and oak woodlands and in dry, sandy soils in natural successional plant communities within the Pine Barrens. The species aggressively exploits roadside habitats where its rapid linear spread is facilitated by maintenance activities such as mowing and roadside scraping.

Distribution

Lespedeza cuneata was introduced to the United States from eastern Asia and was widely planted for bank stabilization, soil improvement, and wildlife forage and cover (Remaley 1998). It now occurs from New York and Massachusetts south to Florida, and west to Nebraska and Texas (USDA 1998; Kartesz 1999). It is considered invasive along the East Coast in Maryland, New York, North Carolina, Tennessee, and Virginia. In New Jersey, its collected range (based on specimens at PH) is Burlington, Cape May, Monmouth and Ocean counties in the Coastal Plain. It is also reported from Atlantic, Bergen, Burlington, Camden, Cumberland, Hunterdon, Mercer, Sussex, and Warren counties, which cover all of the physiographic regions of New Jersey (Hough 1983; Monachino 1962).

Threats

This plant is primarily a threat to open areas including meadows, open woodlands, and wetland borders (Smith 1998; Remaley 1998). It can form dense stands that prevent establishment of indigenous species, and it develops an extensive seed bank in the soil that allows it to persist for many years. It disrupts patterns of natural succession and displaces shade intolerant early successional species. The high tannin content in the leaves makes it unpalatable to native wildlife (Remaley 1998).

Control

Mowing plants in the flower bud stage for 2-3 years can reduce stand vigor and prevent further spread of a stand. Plants should be cut as low to the ground as possible. Herbicide treatments are most effective in early to mid summer (Remaley 1998), but many other indigenous plants will be growing during this season that could be killed by the herbicides.

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Representative New Jersey Specimens Examined

Burlington Co.: Dry bare sand along roadside, 1 mi N of Ewansville, 16 October 1947, *B. Long* 66666, PH. **Cape May Co.:** Fields and roadsides, Cape May, 18 August 1946, *O.H. Brown* s.n., PH. **Monmouth Co.:** Abandoned sandy field, 1 mi SE of Farmingdale, 20 August 1955, *V.L. Frazee* s.n., PH. **Ocean Co.:** Dike of old cranberry bog on Shannoc Brook, 1 mi ENE of Archers Corner, 17 September 1948, *B. Long* 68102, PH; Disturbed soil along Bordens Mill Branch just below dam, Colliers Mills, 2 November 1947, *B. Long* 66740, PH.

***Lonicera japonica* Thunb. (Japanese honeysuckle)**

Description

Lonicera japonica grows as a perennial trailing or climbing woody vine. Its leaves are 4-8 cm long, opposite, ovate and entire (Nuzzo 1998). The leaves are semi-evergreen, falling off in midwinter. Leaves are all separate, which distinguishes them from the indigenous vine honeysuckles, which have leaves joined at the base. Young stems are reddish-brown to light brown, and older stems are hollow with a brownish bark that peels in long strips. Flowers are produced from spring through summer. The tubular flowers are typically white (fading to yellow) with long curved stamens projecting from the corolla. *Lonicera japonica* var. *chinensis* has red flowers and is rarely found in New Jersey. Flowers are very fragrant and are borne in pairs on axillary peduncles (Nuzzo 1998). Black globose berries, 5-6 mm in diameter, mature in the late summer and early fall (TN EPPC 1998). The fruits are bird dispersed. Japanese honeysuckle creates dense thickets by stem branching, rooting at the nodes, and vegetative spread from rhizomes (Nuzzo 1998).

Habitat

Japanese honeysuckle frequently establishes in disturbed habitats, including successional fields, roadsides, forest edges and gaps, and fencerows (Nuzzo 1998). In New Jersey, the species grows in similarly disturbed or successional habitats but also occurs in limestone woods, trap rock glades, flood plain forests, sand dunes, beaches, salt marsh borders, Coastal Plain marl ravines, borders and thickets of Coastal Plain ponds, oak and pine woodlands, and shale bluffs (D. Snyder, personal observation; also see specimens cited). It grows most vigorously in full sun and on rich soil, but it is shade and drought tolerant.

Distribution

Japanese honeysuckle is indigenous to eastern Asia and was introduced to New York in 1806 as an ornamental plant (Nuzzo 1996). It has been reported from 38 states from Maine, south to Florida and the Commonwealth of Puerto Rico, west to Wisconsin, California, and Hawaii (Kartesz 1999). It also occurs in Ontario, Canada. It appears to be limited by severe winter temperatures to the northern latitudes, and by prolonged droughts to the west. It is considered invasive in all eastern states south of Massachusetts. Japanese honeysuckle has been recognized as an unwanted weed in New Jersey as early as 1892 (Harshberger 1916). The species is widespread and abundant throughout New Jersey where it occurs in all of the State's physiographic provinces. The collected range (based on specimens at PH) is Atlantic, Burlington, Camden, Cape May, Cumberland, Gloucester, Hunterdon, Mercer, Middlesex, Monmouth, Ocean, Salem, and Warren counties. It is also reported in Bergen, Essex, Hudson, Morris, Passaic, Somerset, and Sussex counties (Clemants and Glenn 1999; Hough 1983).

Threats

Japanese honeysuckle spreads rapidly and is a strong competitor, for both above and below-ground resources (Nuzzo 1998). Below-ground root competition can decrease the growth of native trees and vines. Above-ground it can change forest structure by engulfing small trees and shrubs, causing them to collapse under the weight of the vines. On the ground it can form a cover so dense that native trees, shrubs, and herbs are unable to re-establish. In New Jersey, it has been reported to occupy habitats of rare plants and is attributed as a cause of their decline (Bailey 1932; Fables 1962; Snyder 2000). Honeysuckle also leafs out very early in spring, which could inhibit flowering by spring ephemerals (Nuzzo 1998). Fernald (1950) described *Lonicera japonica* as a “most pernicious and dangerous weed, overwhelming and strangling the native flora and most difficult to eradicate; extensively planted and encouraged by those who do not value the rapidly destroyed indigenous vegetation.”

Control

Removing only above-ground vegetation, either by cutting or mowing, is ineffective because of resprouting (Nuzzo 1998). Hand-pulling can be effective if most of the roots and runners can be removed, but is probably only practical for small patches of seedlings and young plants. All parts of the plant should be removed from the site to prevent re-establishment. Some herbicides are effective, and they can be applied when native plants are dormant due to the semi-evergreen nature of Japanese honeysuckle. The best time to apply herbicides is after the first killing frost, but before the first hard frost. A combination of burning and herbicide treatment has also proved effective (Nuzzo 1998).

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Representative New Jersey Specimens Examined

Atlantic Co: Pine and oak woods about ruins of old Etna furnace, 0.5 mi E Head of River, 5 January 1941, *B. Long* 55863, PH; thickets bordering brackish marsh, back of Abescon Bay, NE of Pleasantville, 29 October 1939, *B. Long* 54062, PH. **Burlington Co.:** Crest of steep wooded slope along Delaware River, Florence, 4 February 1914, *B. Long* 9464, PH; damp waste ground, 1 mi W of Green Bank, Herman, 13 June 1917, *H. Koster* E7-12-2, PH. **Camden Co.:** Roadside thicket, S of Palmyra, 16 June 1917, *B. Long* 16269, PH; abundant on roadside bank, SW of Osage, 10 June 1919, *B. Long* 21077, PH. **Cape May Co.:** North Wildwood, 10 September 1907, *J.M. MacFarlane* s.n., PH; borders of Cape Island Creek salt marshes, NE of Cape May City, *W. Stone* s.n., PH; woods behind sand dunes, S of Peermont, 22 October 1935, *F.S. Fender* 1157, PH. **Cumberland Co.:** Fortescue Glades Wildlife Reserve edge of old field, [near] Newport, 13 October 1981, *S. Heckscher* s.n., PH; thicket bordering salt marsh, N of railroad, Bay Side, 5 November 1933, *B. Long* 42521, PH. **Gloucester Co.:** roadside thicket by Still Run, 1 mi SW of Mickleton, 6 February 1938, *B. Long* 51711, PH; abundant in thickets along Mantua Creek, Wenonah, 28 October 1917, *B. Long* 18318, PH. **Hunterdon Co.:** Ringoes, 10 July 1898, *H.L. Fisher* s.n., PH; crest of wooded slope along Delaware River, 1 mi above Lambertville, 23 June 1940, *B. Long* 54525, PH. **Mercer Co.:** Open thickets Mt. Canoe, 1 mi S of Harborton, 13 June 1936, *B. Long* 48723, PH; weedy field, 1 mi NW of Ewingville, 23 October 1954, *W.L. Dix* s.n., PH. **Middlesex Co.:** Roadside thickets, 1 mi S of Cranbury, 27 November 1941, *B. Long* 57636, PH; rubbish dump, 1 mi NE of Cranbury, 29 July 1951, *B. Long* 73786, PH. **Monmouth Co.:** Overrunning apple orchard, 6/8 mi SW of Church and Main

Streets, Allentown, 8 June 1939, *S.D. Wikoff 1*, PH; damp woods, Wickatunk, 17 June 1956, *V.L. Frazee s.n.*, PH. **Ocean Co:** Thicket, 1.5 mi SE of Barnegat, 1 October 1937, *H. Koster C7-12-1*, PH. **Salem Co.:** Sandy beach along Delaware River, near Elsinboro Pt., 3 mi SW of Salem, 31 October 1933, *B. Long 42478*, PH; abundant on roadside bank by Cool Run, Aldine, 27 February 1938, *B. Long 51782*, PH. **Warren Co.:** Fence row, 1 mi N of Springtown, 7 August 1956, *R.L. Schaeffer, Jr. 52402*, PH; woods, 2 mi SE of Broadway, 23 August 1951, *R.L. Schaeffer, Jr. 37728*, PH.

***Lonicera morrowii* Gray**
(Morrow's bush honeysuckle)

***Lonicera tatarica* L.**
(twinsisters, Tartarian honeysuckle)

Description

These honeysuckles grow as upright deciduous shrubs that range from 6 to 15 feet in height (Williams 1998). Unlike most indigenous honeysuckles, the nonindigenous bush honeysuckles have hollow stems (Williams 1998). The simple, entire, opposite leaves are oblong to ovate in shape, ranging in length from 1 to 2.5 inches (Vermont IEPFSS 1998). *Lonicera morrowii* has downy leaves, whereas *L. tatarica* has smooth hairless leaves. Pairs of tubular fragrant flowers are borne in the leaf axils along the stems in spring. *Lonicera morrowii* has white flowers that turn pale yellow with age. *Lonicera tatarica* has pink to white flowers that do not turn yellow with age. The showy fruits range in color from red to orange or yellow, and each fruit contains many seeds. The fruits are dispersed by birds (Converse 1998).

Habitat

Nonindigenous honeysuckles are frequent in disturbed areas and at the edges of forests and wetlands, but they can also be found in forested areas (Vermont IEPFSS 1998; Williams 1998). Morrow's honeysuckle tends to be more widespread than Tartarian honeysuckle, and it occupies wetter sites (Converse 1998). In New Jersey, both species have been collected from disturbed or successional habitats such as old fields, roadsides, thickets, and fencerows, but also occur in calcareous woods and bluffs, rich rocky woods, traprock glades, floodplain forests, calcareous fens, and damp woods.

Distribution

Lonicera morrowii is indigenous to Japan, and *L. tatarica* is indigenous to Eurasia. *Lonicera morrowii* is reported from Maine south to South Carolina and west to Wyoming and Colorado, as well several provinces of Canada (Kartesz 1999). *Lonicera tatarica* occurs south only to Virginia but extends west to Alaska and California (Kartesz 1999). Scattered throughout northeastern North America is *Lonicera x bella* Zabel, a hybrid between *L. morrowii* and *L. tatarica*. This hybrid is also highly invasive, especially in parts of the Midwest. They are considered invasive in at least eight other eastern states. *Lonicera morrowii* has been collected (based on specimens at PH) from Camden, Cumberland, Hunterdon, Mercer, Monmouth, and Warren counties, and is reported from Sussex, Passaic, Bergen, Morris, Essex, Somerset, Union, and Middlesex counties. (Clemants and Glenn 1999; Hough 1983). *Lonicera tatarica* has been collected (based on specimens at PH) from Warren County and has been reported from Sussex, Passaic, Bergen, Morris, Hunterdon, Somerset, and Camden counties (Clemants and Glenn 1999; Hough 1983). *Lonicera tatarica* is more frequent in the Piedmont, Highlands, and Ridge and

Valley physiographic regions of New Jersey, whereas *Lonicera morrowii* occurs in all physiographic regions.

Threats

The bush honeysuckles can rapidly form a dense shrub layer that can alter light availability to understory plants and deplete soil moisture and nutrients. There may also be allelopathic effects of the fruit and vegetative parts of the honeysuckles (Converse 1998). Nonindigenous bush honeysuckles may also compete with indigenous plants for pollinators; reducing seed set of indigenous plants (Williams 1998). Additionally, the fruits of the bush honeysuckles are not high in the fats and nutrients migrating birds acquire feeding on native fruits. Fruits of *Lonicera morrowii* honeysuckle have been shown to change the plumage color of cedar waxwings when the birds feed primarily on the fruits (Witmer 1996).

Control

Seedlings can be pulled by hand, using care to ensure that the roots are removed. However, the disturbed soil may be easily re-invaded (Converse 1998). Repeated clipping of adult plants can be successful in shaded forest habitats (Williams 1998). Well-established older stands can be cut and the stumps treated with herbicide. Seedlings can also be treated with herbicides (Converse 1998). Herbicides can damage co-existing indigenous plants, and should be used with caution.

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Representative New Jersey Specimens Examined

Lonicera morrowii

Camden Co: Filled in area, 0.5 mi NW of Clementon, 17 May 1947, *R.L. Schaeffer, Jr.* 25454, PH; bushy field near Mt. Ephrain Park, Fairview, 27 June 1926, *G.M. Bassett s.n.*, PH. **Cumberland Co.:** Roadside thicket – escaped from nearby hedge planting, 1 mi SE of Pleasantville, 25 July 1937, *B. Long* 50840, PH. **Hunterdon Co.:** Open-bushy slope along Delaware River, 1 mi WNW of Stockton, 27 October 1940, *B. Long* 55480, PH. **Mercer Co.:** Thicket along Shabakunk Creek, 1 mi W of Prospect Heights, 14 April 1954, *W.L. Dix s.n.*, PH. **Monmouth Co.:** Gravelly hill, Brielle, 10 May 1954, *V.L. Frazee s.n.*, PH; damp woods, 0.5 mi E of Wickatunk, 28 May 1956, *V.L. Frazee s.n.*, PH. **Warren Co.:** Wooded slope, 2 mi NE of Phillipsburg, 18 June 1956, *R.L. Schaeffer, Jr.* 50930, PH; fence row, 1 mi SE of Belvidere, 25 August 1950, *R. L. Schaeffer, Jr.* 34829, PH.

Lonicera tatarica

Warren Co.: Old field, 2 mi E of Still Valley, 13 August 1956, *R.L. Schaeffer, Jr.* 52781, PH; on Delaware River on limestone bluff, below Phillipsburg, May 1883, *T. C. Porter s.n.*, PH.

***Lythrum salicaria* L. (purple loosestrife)**

Description

Purple loosestrife is a perennial herb, with square woody stems, that typically grows up to three or four feet in height, but under favorable conditions may grow up to 10 feet tall (Bender 1987; Swearingen 1998). The leaves are lance-shaped, and either heart-shaped or rounded at the base. They are arranged opposite or whorled in groups of three or four along the stem. In summer, plants produce large showy spikes of magenta or occasionally white or light pink flowers. Each flower has 5-7 petals. The fruit is a capsule containing minute (0.06 mg) seeds. A single mature plant may produce up to 2.7 million seeds (Gutin 1999). The seeds are mostly wind dispersed, but they can be transported on the feet of waterfowl or by other wetland animals. Seeds float and are also dispersed by water. Plants have strongly developed taproots (Bender 1987). Plants can spread by underground roots and shoots as well as by seed (Vermont IEPFSS 1998).

Habitat

Purple loosestrife occurs in wetland areas including cattail marshes, sedge meadows, and open bogs (Bender 1987). It often occurs along river and stream banks, and in disturbed wet areas. It can tolerate a wide range of soil conditions and up to 50 percent shade (Bender 1987). In New Jersey it occurs abundantly along the Delaware River and other river edges, lake and pond shores, salt and freshwater marsh edges, meadows, limestone fens, floodplain forests, and from disturbed areas such as ditches and filled wetlands (see specimens cited).

Distribution

Indigenous to Eurasia, purple loosestrife was introduced to the United States in the early 1800s (Bender 1987). It occurs in nearly every state, but is particularly concentrated in northeastern wetlands (Bender 1987). The U.S. Fish and Wildlife Service estimates that it covers more than 400,000 acres (USFWS 1998). It is one of the most widespread invasive plants occurring in New Jersey. It occurs abundantly in wetlands throughout the state, with the exception of the central Pine Barrens where it occurs only rarely in ditches and recently disturbed wetlands. The collected range (based on specimens at PH) of purple loosestrife is Bergen, Burlington, Camden, Cape May, Gloucester, Hunterdon, Mercer, Monmouth, Ocean, Salem, and Warren counties. It is also reported in Hudson, Morris, Passaic, and Somerset counties (Hough 1983). Purple loosestrife occurs in all of New Jersey's physiographic provinces.

Threats

Once it becomes established, purple loosestrife displaces native vegetation through rapid growth and heavy seed production (Bender 1987). Uncontrolled, purple loosestrife eventually forms a near monoculture that alters the structure of natural plant communities and reduces

biological diversity. Dense stands can change drainage patterns by restricting the flow of water (Colorado Division of Plant Industry 2000). Wildlife can be affected by the displacement of indigenous food items such as cattails and pondweed. Waterfowl are threatened by the loss of favorable habitat to purple loosestrife (Swearingen 1998). In 1995, the National Park Service determined that purple loosestrife was a potential threat to state listed endangered plant species, special concern plant species, and two globally rare calcareous riverside plant communities documented from the Delaware Water Gap National Recreation Area (Shank and Shreiner 1999). This led to a joint effort between the New Jersey Department of Environmental Protection through its Office of Natural Lands Management and the National Park Service to qualify these threats. This was done by establishing baseline data on population dynamics and community composition which will allow future statistical comparisons to be made to assess the effectiveness of biological control agents introduced to control the further spread of purple loosestrife (Shank and Shreiner 1999). Several limestone fens, another globally rare plant community, are threatened by the invasion of purple loosestrife. These fens support a remarkably diverse assemblage of state and globally rare plant, animal, and insect species. In New Jersey, several populations of the federally listed bog turtle (*Clemmys muhlenbergii*) are threatened by loss of habitat through the invasion of purple loosestrife (J. Teasuro, pers. comm.). A population of the state listed endangered wiry panic grass (*Panicum flexile*) was lost when its open fen habitat was succeeded by a dense stand of purple loosestrife (D. Snyder, personal observation). The Nature Conservancy is attempting to control the spread of purple loosestrife in a limestone fen at their Johnsonburg Preserve, Warren County (A. Heasley, pers. comm.). The Fish and Wildlife service estimates that purple loosestrife costs about \$45 million dollars a year in control costs and lost forage (USFWS 1998). Many cultivars of purple loosestrife have been developed and are sold as landscape plants. It is currently illegal in 13 states to purchase and plant purple loosestrife (Vermont IEPFSS 1998).

Control

Large populations are almost impossible to eradicate, and the best management strategy may be to contain the populations and try to limit seed production (Bender 1987). Herbicides should be used with caution given that loosestrife is restricted to wetlands, often covering extensive acreage. Hand-pulling before plants have set seed can be effective for small populations and isolated stems, as long as root fragments are completely removed. Uprooted plants and broken stems should be removed since stems can resprout. Biological control of purple loosestrife is being tested with six insect species, and three of these insects have been approved by the U. S. Department of Agriculture (Swearingen 1998). In New Jersey, biological control of purple loosestrife is currently underway in several state natural areas and wildlife management areas, federal wildlife management areas, and Nature Conservancy preserves.

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Representative New Jersey Specimens Examined

Bergen Co.: Ditch edge, off Moonachie Rd., Moonachie, 22 July 1970, *W. Sipple s.n.*, PH. **Burlington Co.:** Moist sandy tidal shore along Delaware River, SW of Fieldsboro, 1 September 1923, *B. Long 29158*, PH; alluvial marshes along Delaware River, 1 mi NE of Delanco, 4 July 1944, *B. Long 61267*, PH. **Camden Co.:** Sandy shore of Delaware River at Cooper's Bridge, first noted 1864, Camden, 25 June 1865, *I. Burk s.n.*, PH; Rubbish dump, Collins Ave., Collingswood, 22 July 1957, *B. Long 73650*, PH. **Cape May Co.:** Edge of sandy parking lot, Avalon, 28 August 1960, *N. Erisman s.n.*, PH; old garden site, Cold Spring, 20

August 1900, *O.H. Brown s.n.*, PH; along salt marsh, Cape May, 31 July 1919, *O.H. Brown s.n.*, PH. **Gloucester Co.:** Marshes along Delaware River, 1.5 mi NW of Bridgeport, 13 February 1949, *B. Long 68710*, PH; peaty swale bordering swampy woods along Crown Pt. Rd., SW of Westville, 29 July 1923, *B. Long 28164*, PH. **Hunterdon Co.:** Tumble Station, August 1884, *G.N. Best s.n.*, PH; wet, gravelly and muddy, alluvial shore along Delaware River, Treasure Island, 28 August 1932, *B. Long 38334*, PH. **Mercer Co.:** Mud flats, Lambertville reservoir, 24 August 1972, *M.L. Roberts 3061*, PH; sandy alluvial shore along Delaware River, NW of Trenton, 7 November 1936, *B. Long 49307*, PH. **Monmouth Co.:** Deal Beach, August 1894, *C. S. Williamson s.n.*, PH. **Ocean Co.:** Moist meadow and wood margins, dense showy colony, 23 August 1947, *H.N. Moldenke 19160*, PH. **Salem Co.:** Tidal shore along Delaware River, 2 mi SW of Harrisonville, 29 October 1934, *J.M. Fogg, Jr. 7868*, PH; wet ground, 1 mi NE of Penns Grove, 18 June 1892, *H.B. Meredith s.n.*, PH. **Warren Co.:** River bank above Foul Rift, 31 August 1907, *S.S. VanPelt s.n.*, PH; alluvial swamp, 1 mi E of Pequest, 13 August 1959, *R.L. Schaeffer, Jr. 59692*, PH.

***Melilotus officinalis* (L.) Pallas**
(including ***Melilotus alba* Desr. ex Lam.**)
(yellow sweetclover)

Description

Yellow sweetclover is a biennial herbaceous plant. It has sweet-scented leaves divided into three leaflets with serrated edges. The yellow or white flowers bloom in summer, and are held in small spike-like racemes. The seeds form in small leathery pods, and are mostly dispersed by water. A long taproot makes the plants drought tolerant and winter-hardy (Eckardt 1987). Although traditionally recognized as two distinct species, Kartesz (1999) synonymizes *M. alba* under *M. officinalis*.

Habitat

Yellow sweetclover generally establishes in disturbed areas, such as roadsides and fallow fields. It also grows in open habitats maintained by natural disturbances such as fire, flooding, or ice scouring. Once established, it can invade any moist open area, often out competing native vegetation by its rapid growth and heavy seed production. Yellow sweetclover occurs abundantly on calcareous riverside seepage communities along the Delaware River in northwestern New Jersey. It has been collected from moist to dry soils in open habitats such as successional fields, limestone fens, floodplains, and sand dunes (see specimen citations).

Distribution

Yellow sweetclover is indigenous to the Mediterranean, Central Europe, and parts of Asia. It occurs across much of the United States. It has been used as a forage crop and soil builder since the early 1900s (Eckardt 1987) which has facilitated its rapid spread. In New Jersey its collected range (based on specimens at PH) is Burlington, Camden, Cape May, Cumberland, Gloucester, Hudson, Hunterdon, Mercer, Monmouth, Ocean, Salem, Somerset, Sussex and Warren counties. It is also reported in Atlantic, Bergen, and Middlesex counties (Hough 1983). It occurs in all of New Jersey's physiographic provinces.

Threats

Yellow sweetclover primarily threatens plants species that depend on open areas such as stream edges (Cole 1991), fens, floodplains, and dunes. It is one of the three most invasive species that have invaded globally rare plant communities along the Delaware River in the Delaware Water Gap National Recreation Area (Shank and Shreiner 1999). Once established it forms dense stands that prevents or reduces the establishment of indigenous species. It significantly alters the structure of natural plant communities and disrupts the process of natural plant succession. The species produces a large number of seeds that remain viable in the seed bank for several years.

Control

A series of burns, or combination of mowing and burning, can be used to control yellow sweetclover in grassland communities or fens (Eckardt 1987). Herbicides can also be used in combination with burning, but herbicides can harm indigenous plant populations. Hand-pulling first year plants in late summer or early fall can be effective on small sites. Mowing is only effective if plants are cut very close to the ground (Eckardt 1987). Because seeds remain viable in the soil for several years, treatments may need to be repeated (Lorenzi and Jeffery 1987).

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- ### Representative New Jersey Specimens Examined
- Burlington Co.:** Railroad ballast, freight siding, Atsion, 22 June 1922, *B. Long* 9148, PH; sunny roadside, Camp Ockanickon, 1.5 mi SE of Medford Lakes, 7 June 1952, *I.K. Langman* 4054, PH. **Camden Co.:** Rubbish dump, Gloucester City, 22 July 1951, *B. Long* 73673, PH; Brooklawn, 15 October 1934, *F.R. Spiers s.n.*, PH; Camden, 8 August 1881, *F. Ball s.n.*, PH. **Cape May Co.:** Lighthouse Ave. near Sunset Blvd., Cape May Point, 2 July 1953, *R.C. Alexander s.n.*, PH; Waste ground, Cape May City, 8 July 1917, *W. Stone s.n.*, PH. **Cumberland Co.:** Roadside, S of Haleysville, 24 June 1934, *B. Long* 1934, PH; Old field near Burnt Mill Branch, 1 mi E of Pleasantville, 30 May 1938, *B. Long* 52267, PH. **Gloucester Co.:** Rubbish dump in old sand pits, N of Clayton, 18 October 1949, *B. Long* 70407, PH. **Hudson Co.:** Field over fill, near Little Snake Hill, 21 July 1970, *W. Sipple* 1552, PH. **Hunterdon Co.:** Along Musconetcong River, 1 mi E of Bloomsbury, 17 July 1927, *J.R. Bebler s.n.*, PH; Califon,

25 June 1904, *H.L. Fisher s.n.*, PH; Open ground by old road along Musconetcong River, above Warren Glen, 4 September 1939, *B. Long 53851*, PH. **Mercer Co.:** Roadside head of Shabkunk Creek, 0.5 mi SE of Pennington, 19 June 1937, *B. Long 50112*, PH; Trenton, 20 June 1884, *A.C. Apgar s.n.*, PH. **Monmouth Co.:** Waste places, Allenwood, 24 June 1954, *V.L. Frazee s.n.*, PH. **Ocean Co.:** Forked River "C.G.S.", Island Beach, 18 July 1950, *J. A. Small s.n.*, PH; Fallow field, Bogans (Osborne) Island, 5 August 1913, *B. Long 9148*, PH. **Salem Co.:** Roadside along Nihomus Run, 1 mi SW of Woodstown, 8 June 1934, *J.M. Fogg, Jr. 6802*, PH. **Somerset Co.:** Dry soil along roadside, Watchung, 26 July 1930, *H.N. Moldenke 1340*, PH. **Sussex Co.:** Dry shale outcrop, 2 mi SW of Fredon, 8 July 1934, *A.G. Lisi s.n.*, PH. **Warren Co.:** Roadside, 0.5 mi NE of Uniontown, 27 July 1953, *R.L. Schaeffer, Jr. 44338*, PH; Alluvium, 1 mi NW of Columbia, 3 September 1948, *R.L. Schaeffer, Jr. 30705*, PH; Fallow field, 1 mi W of Brass Castle, 18 August 1950, *R.L. Schaeffer, Jr. 34413*, PH.

***Microstegium vimineum* (Trin.) A. Camus (Japanese stiltgrass)**

Description

Japanese stiltgrass grows as an annual grass (Mehrhoff 2000) with a sprawling habit, and can reach heights of up to 3 feet (Swearingen 1998; TN EPPC 1998). It has thin, pale green, lance-shaped leaves, about 3 inches in length, that grow alternately along a branched stalk. The leaves have a silvery stripe of reflective hairs down the center of the upper leaf surface (Swearingen 1998). The stalk is distinctly divided by nodes, with the segments between the nodes flattened and widening toward the upper end (Smith 1998). The flowers bloom along a delicate spike that emerges from the stalk tips in late summer and early fall (Swearingen 1998). The seeds mature in mid to late fall, and can remain viable for more than five years in the soil (TN EPPC 1998). Plants spread locally by rooting at the nodes. Seed dispersal is by animals, water, or deposition with fill dirt (TN EPPC 1998). The report that there is a rhizomatous perennial form occurring in eastern North America (Ehrenfeld 1999), has been challenged by Mehrhoff (2000), who believes the report is based on misidentification of the indigenous grass, *Leersia virginica* L. The two species are vegetatively similar and grow in similar habitats, often growing in mixed populations (Mehrhoff 2000). Vegetative plants can be distinguished by the silvery stripe running along the middle of the leaves of Japanese stiltgrass, a character lacking in *Leersia virginica*. The two species are easily distinguished when in flower or fruit.

Habitat

In New Jersey, Japanese stiltgrass is found in a range of habitats, from wetlands to early successional fields and forested uplands (Hunt and Zaremba 1992). It reaches its greatest abundance in floodplain forests and moist soils over shale, diabase, and glauconite (D. Snyder, personal observation). Although it is a shade adapted species (Winter, et al. 1982), it also grows in full sunlight, especially in disturbed habitats such as roadsides, powerline right-of-ways, ditches, agricultural lands, lawns and gardens. It appears to favor soils that are moist, acidic to neutral, and high in nitrogen (Swearingen 1998).

Distribution

Indigenous to Asia, Japanese stiltgrass was introduced to the United States in the early 1900s (Fairbrothers and Gray 1972). It has spread to 23 eastern states, from New York and Connecticut south to Florida, west to Missouri and Texas and also the District of Columbia and the Commonwealth of Puerto Rico (Kartesz 1999). It is considered invasive in at least eight eastern states. It was first collected in New Jersey in 1950, and has subsequently and rapidly spread statewide (Hunt and Zaremba 1992; D. Snyder personal observation). The species is poorly represented by herbarium collections (Fairbrothers and Gray 1972; Kourtev, et. al. 1998; Hunt and Zaremba 1992; D. Snyder, personal observation). By the early 1980s, Japanese stiltgrass was already common throughout much of the Piedmont, Inner Coastal Plain, and parts of the Highlands and Ridge and Valley provinces (D. Snyder, personal observation). There are collections from Burlington, Mercer, Middlesex, Morris, Somerset, and Warren counties (see

specimens cited; Hunt and Zaremba 1992). It is also reported to occur in Hunterdon and Passaic counties (Hunt and Zaremba 1992; Hough 1983). Most collections are from the Piedmont.

Threats

Japanese stiltgrass alters the structure of natural plant communities and reduces biodiversity by displacing indigenous herbaceous vegetation through its dense growth, which rapidly forms monocultures that are sometimes acres in extent. Because of its rapid and dense growth, it alters light and moisture regimes and likely affects seed germination. Kourtev, et al. (1998) speculated that Japanese stiltgrass in association with Japanese barberry (*Berberis thunbergii*) raises pH and reduces the organic horizons in soils.

Control

Prevent introduction of Japanese stiltgrass from invaded sites to adjacent natural areas by avoiding disturbance to vegetation and soil in the natural areas (Swearingen 1998). Small infestations can be hand-pulled, but pulling will have to be repeated until the seed bank is exhausted. Plants can be mowed when flowers are blooming, but before seed set. Herbicides can be effective, and should be applied before plants set seed (TN EPPC 1998). Herbicides should be used with caution, as they could harm indigenous co-occurring plants.

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Representative New Jersey Specimens Examined

Burlington Co.: Open thicket, shore of Delaware River, Fieldsboro, 28 September 1950, *B. Long* 72292, PH. **Mercer Co.:** Canal bank, River Rd. and Yardley Bridge, Wiburtha, 15 September 1950, *B. Long* 72238, PH; alluvial woods along Delaware River, Somerset, 1 September 1950, *B. Long* 72240, PH. **Middlesex Co.:** Dried meadow off Tices Lane, East Brunswick, 1 September 1983, *D.E. Fairbrothers*, *F.P. Peterson*, *P. Manos s.n.*, PH. **Warren Co.:** Wooded bank along Delaware River, N of Riegelsville, 2 November 1950, *B. Long* 72613, PH; alluvium, 0.5 mi SE of Columbia, 27 August 1953, *R.L. Schaeffer, Jr.* 45180, PH.

***Myriophyllum spicatum* L.** **(Eurasian water-milfoil)**

Description

Eurasian water-milfoil is a submersed, rooted, perennial herb that can form large mats of floating vegetation (Remaley 1998; Jacono 1998). It has long underwater stems that branch and produce leaves near the surface. The leaves are grayish-green in color and occur in whorls of 3-4 along the stem. The leaves divide finely into 12-16 pairs of threadlike leaflets about 1.5 inches long, giving the plant a feathery appearance. The yellow flowers are 4-parted and held on a spike, projecting 2-4 inches above the surface of the water. They bloom in late summer. Hard segmented capsules contain the seeds (Remaley 1998). Most regeneration and dispersal is from fragmented stems and rhizomes rather than from seeds (TN EPPC 1998). Preliminary data suggests that while the rate of successful seed germination is low among natural populations, laboratory studies indicate that the seeds are highly viable, and likely contribute to the long-term survival of the species through seed banking (Madsen and Boylen 1989). Patten (1956) discusses the biology of this species in great detail.

Habitat

Eurasian water-milfoil grows in lakes, low-energy areas of rivers, and other bodies of fresh to brackish water (Remaley 1998). It is tolerant of pollutants and establishes readily in disturbed habitats and habitats where indigenous plants are growing poorly.

Distribution

Water-milfoil is indigenous to Eurasia and northern Africa, and was introduced into the United States in the 1940s (Jacono 1998; Pullman 1992). Earlier reports of this species in the United States are based on misidentifications (Pullman 1992). It now occurs throughout most of the United States (Kartesz 1999). Schuyler (1989) reported that the first New Jersey collection of water-milfoil was from Lake Musconetcong, Sussex County in 1952. It now occurs in all of the major watersheds in New Jersey (Jacono 1998). Its collected range (based on specimens at PH) is Camden, Hunterdon, Mercer, Ocean, and Warren counties. It is also reported from Cape May, Monmouth, Middlesex, Passaic, and Sussex counties (Hough 1983; D. Snyder, personal observation). It is especially abundant in northwestern New Jersey and the Delaware River drainage.

Threats

Eurasian water-milfoil begins growing earlier in spring than most indigenous aquatic plants. It quickly forms a dense canopy that overtops, outshades, and outcompetes surrounding vegetation (Jacono 1998). Indigenous plant diversity and abundance decline once water-milfoil establishes. A study conducted at Lake George, New York State, documented quantitatively that the number of indigenous aquatic plants species present in a 3 meter² grid decreased by more than half--from 20 species to nine--within three years (Madsen, et al. 1991). Vegetative

fragments do not need an organic substrate to continue to grow (Madsen, et al., 1988) and are a major mechanism of dispersal between aquatic systems. Recreational activities, such as swimming and boating, contribute significantly to the spread of this species. Waterfowl are affected because it has lower food value than native plants, and fish are affected because the plants support a lower abundance and diversity of invertebrates. The dense cover does allow for higher survival of young fish, but larger fish and predatory fish lose foraging space. Water quality and dissolved oxygen levels decline with the decay of the thick vegetation. The amount of light reaching lower growing aquatic plant species is reduced. Dense beds of Eurasian water-milfoil also impair recreational activities such as boating, swimming and fishing (Jacono 1998).

Control

In small areas Eurasian water-milfoil can be removed mechanically with a rake. In large areas, hydro-raking, dredging, and diver operated suction harvesting can be employed (Vermont IEPFSS 1998). The best time for mechanical removal is in early summer just before peak biomass, but multiple harvests are most effective (Remaley 1998). If water levels can be manipulated, plants can be “drowned” by not having access to enough light, and by lowering the water level plants can be dehydrated or frozen, depending on the time of year. Water level manipulation is most effective when used with shade barriers and herbicides (Remaley 1998). Most of these control methods can have drastic impacts on indigenous aquatic plant species, especially rare or declining species. Snyder (2000) speculated that methods used to control Eurasian water-milfoil at a lake in northwestern New Jersey may have contributed to the decline or loss of state-listed endangered or special concern aquatic plant species. Barriers can also be used to prevent the movement or spread of plants. There is a milfoil specific herbicide available that should be applied when the plants are actively growing (Remaley 1998). Several insects are currently being tested as possible biocontrol agents (Univ. Florida 1998). One of these biocontrol agents being tested is an aquatic weevil (*Euhrychiopsis lecontei*). Studies have shown that the weevil can have “rapid and substantial effects” to both plant stems and roots (Newman, et al., 1996). According to Sheldon and Creed (1995) this weevil is known to feed on Eurasian milfoil and the North American indigenous species *Myriophyllum sibiricum*, which is listed as a state endangered plant in New Jersey. Although these authors stress that the weevil “did not appear to have a significant negative impact on [*M. sibiricum*] in the field,” this may not be true when populations of *M. sibiricum* are at critically low numbers. The possible negative effect that biological control methods could have on indigenous plants and other aquatic organisms should always be considered before use. In the summer of 1999, Ohio-grown weevils (*Euhrychiopsis lecontei*) were introduced into two lakes at Swartswood Lake Park in an effort to control Eurasian water-milfoil at a cost of more than 72,000 dollars (Brown 1999). Three to five years are needed to evaluate whether the program has been successful. At recreational areas infested by Eurasian water-milfoil, a method should be made available to allow the operators of boats to hose-down their vehicles and trailers to remove fragments of Eurasian water-milfoil in order to reduce the possibility of further spread.

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Representative New Jersey Specimens Examined

Camden Co.: Back channel of Delaware River between Petty Island and Camden, wet depression exposed at low tide, Pyne Point Park, 12 September 1991, *M.E. Garback & A.E. Schuyler* 7549, PH. **Hunterdon Co.:** Delaware River at lower end of Upper Black Eddy, abundant in riffle, 2 km SE of Milford, 12 July 1988, *M.E. Garback, K. Larsen, & A.E. Schuyler* 7055, PH; Round Valley reservoir, S end of lake, 5 mi E of Allerton, 27 June 1972, *M.L. Roberts* 2426, PH. **Mercer Co.:** Delaware River near mouth of Duck Creek, SE of Trenton, 15 October 1981, *R.W. Hastings s.n.*, PH; Delaware River, uncommon in 1 foot water with sandy bottom, 29 August 1972, *M.L. Roberts* 3086, PH. **Ocean Co:** Abundant in Old Sam's Pond, Point Pleasant Beach, 7 September 1980, *A.E. Schuyler* 5572, PH. **Warren Co.:** Musconetcong River, Allamuchy Township, 17 August 1977, *E.A. Laport s.n.*, PH.

***Polygonum cuspidatum* Sieb. & Zucc. (Japanese knotweed)**

Description

Japanese knotweed is a herbaceous perennial that forms large clumps up to 13 feet tall (Seiger 1996). The smooth stems are stout and hollow like bamboo, and they show little branching (Seiger 1992). The leaves are broadly ovate, 2-6 inches long and taper to a point. The plants are dioecious (male and female flowers on separate plants), and bloom in late summer and early fall. The greenish-white flowers are very small, and are arranged in branched sprays from the leaf axils (Remaley 1998). When in full bloom, the plant has masses of flowers all along the stem. The seeds are held in winged, triangular, shiny black-brown achenes that are generally wind dispersed, but can also be dispersed by water and by transportation of fill dirt. The plant also produces long rhizomes (up to 20 m in length) that allow the plant to spread quickly locally, and when rhizome fragments are transported to new sites they can initiate a new population (Seiger 1992).

Habitat

Japanese knotweed tolerates a wide range of soil types, pH levels, and nutrient levels (Seiger 1992). It prefers open areas, but can tolerate shade (Vermont IEPFSS 1998; TN EPPC 1998). It has become a characteristic species of floodplain forests throughout northern New Jersey and the Inner Coastal Plain. It typically forms dense monocultures along the banks of rivers and streams. It also grows on the margins of ponds and lakes, open woods and thickets, meadows and successional fields. It invades disturbed areas, such as ditches, roadsides, dredge spoils, and recently cleared or filled areas. Once established, it quickly spreads into moist or damp soils in adjacent undisturbed natural plant communities.

Distribution

Japanese knotweed is indigenous to eastern Asia, and was introduced to the United States as an ornamental before 1890 (Seiger 1992; TN EPPC 1998). It is now widespread across the United States, and is considered invasive in at least nine eastern states. It is also invasive in the United Kingdom, where it is prohibited to introduce the plant into the wild (Seiger 1992). In New Jersey, Japanese knotweed has been collected (based on specimens at PH) from Atlantic, Bergen, Burlington, Camden, Cape May, Gloucester, Mercer, Monmouth, Ocean, Somerset, and Warren counties. It is also reported in Essex, Hudson, Hunterdon, Middlesex, Salem, Sussex, and Union counties (Hough 1983; Snyder personal observation). It occurs throughout New Jersey's physiographic provinces, but is especially abundant in the Delaware River drainage.

Threats

The early spring emergence of Japanese knotweed, and its dense growth, prevent indigenous species from establishing, in turn reducing species diversity and wildlife habitat (Vermont IEPFSS 1998). Because Japanese knotweed favors damp areas and areas that have

been disturbed, riparian corridors are particularly at risk (Vermont IEPFSS 1998). It can cause flooding by decreasing water flow through stream channels (Seiger 1996). Once established, it is extremely persistent (Remaley 1998).

Control

Natural areas should be monitored to prevent establishment of Japanese knotweed. Small stands can be controlled by repeatedly cutting the stems during the growing season, and by revegetating once knotweed growth is reduced (Seiger 1992). All plant parts should be removed from the site (TN EPPC 1998). Digging out rhizomes creates soil disturbance and may spread rhizome fragments (Seiger 1992). Shading with black plastic or shade cloth may also reduce growth. Large stands can be treated effectively with herbicides, but many of the most effective herbicides are nonselective and may persist in the soil. Chemical control is currently being tested at the Cheesequake Natural Area, in Middlesex County (R. Cartica, pers. comm.). Biological control agents are being investigated in Europe, but research is still in the early stages (Seiger 1992).

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Representative New Jersey Specimens Examined

Atlantic Co.: Small colony, sandy woods, 1 mi E of Devonshire, 4 October 1958, *J.W. and M.T. Adams* 8786, PH. **Bergen Co.:** Field, E of Schuyler Ave., North Arlington, 18 June 1970, *W. Sipple s.n.*, PH. **Burlington Co.:** Rubbish dump along Assicunk Creek, Burlington, 15 June 1950, *B. Long* 71311, PH; edge of woods, bank of Delaware River, Riverton, 10 September 1932, *F.J. Hermann* 3800, PH. **Camden Co.:** Open sandy shore of Delaware River, N of Delair, 22 October 1950, *B. Long* 72551, PH; Kaighn's Point, 10 September 1914, *C.D. Fretz s.n.*, PH. **Cape May Co.:** Waste places, Cape May, 5 September 1899, *O.H. Brown s.n.*, PH; abundantly naturalized on vacant lot, Cape May City, 6 August 1933, *B. Long* 34966, PH. **Gloucester Co.:**

Large colonies in old field, NW of Dilkesboro, 4 September 1937, *B. Long* 51442, PH; disturbed soil of embankment, road over Still Run, SW of Mickleton, 6 May 1919, *B. Long* 20487, PH; rubbish heap, woods along still Run, 1 mi SW of Mickleton, 22 September 1949, *B. Long* 70173, PH. **Mercer Co.:** Waste ground and rubbish heap along PRR., S of Laylor St., S of Trenton, 3 November 1949, *B. Long* 70521, PH. **Monmouth Co.:** Roadside thicket by head of Shoppen Run, 1 mi NNW of Cream Ridge, 13 September 1942, *B. Long* 58649, PH; sterile soil, 2 mi NE of Wickatunk, 27 August 1958, *V.L. Frazee s.n.*, PH. **Ocean Co.:** Naturalized about old ruined house, toward Cedar Creek, SW of Barnegat Park, 10 September 1919, *B. Long* 22101, PH; naturalized about old house site near Manasquan River, NW of Point Pleasant, 26 January 1941, *B. Long* 55921, PH. **Somerset Co.:** Moist soil along ditch, Watchung, 26 August 1930, *H.N. Moldenke* 1369, PH; hedgerow, Watchung, 10 September 1935, *H.N. Moldenke* 8255, PH. **Warren Co.:** Alluvium, 1 mi NW of Carpentersville, 24 August 1948, *R.L. Schaeffer, Jr.* 30073, PH.

***Polygonum perfoliatum* L. (mile-a-minute)**

Description

Mile-a-minute grows as an annual vine, climbing up to 20 feet in height (Mountain 1989). Its rapid growth--up to a half a foot per day-- accounts for its common name. The leaves are bright green and triangular, from 1-3 inches wide. Both the leaves and stems have short spines and prickles. The pea-size fruits are blue in color, and mature in late summer. The seeds are dispersed by birds, rodents, and water. It can be distinguished from other species of *Polygonum* by its triangle-shaped leaves and the flaring, saucer-shaped sheath at the base of each leaf (Virginia NHP 1998).

Habitat

In New Jersey, mile-a-minute has been collected from dredge spoil (see specimen citation below) and from damp soil at the edge of wooded thickets, old fields, meadows, forest edges, and railroad and highway right-of-ways (D. Snyder, private herbarium). The species can climb to heights of 15 feet or more (D. Snyder, personal observation). Typical habitats in adjacent Pennsylvania also include nurseries, reforestation clear-cuts, utility right-of-ways, meadows and stream banks (Mountain 1989). Mile-a-minute establishes quickly on damp disturbed ground where there is plenty of sun, but it also grows in shadier habitats where the leaf litter keeps the ground damp. In Gloucester County, New Jersey, the species has been observed flowering and fruiting in full shade of a closed canopy red maple-black gum forest (D. Snyder, personal observation).

Distribution

Indigenous to Japan, mile-a-minute was introduced accidentally into Pennsylvania in the 1940's, apparently as a contaminant in imported holly seeds and its subsequent spread may be, at least in part, as a soil contaminant in nursery grown rhododendrons (Hickman and Hickman 1978; Rhoads 1999). It has spread north into New York State, west to Ohio, and south to North Carolina (Kartesz 1999). There are apparently disjunct occurrences reported from Mississippi, Oregon, and British Columbia, Canada (Kartesz 1999; USDA 1998). It is considered invasive in Delaware, Maryland, New York, North Carolina, Ohio, Pennsylvania, and Virginia. In New Jersey, the only collections seen were from Salem (see specimen cited below) and Gloucester, Mercer, and Monmouth counties (D. Snyder, private herbarium). It has recently been reported from Union County (Misseck 2000) and there are unvouchered reports from Burlington County (Wycoff 1998), Bergen County (K. Anderson, pers. comm.), and from several locations in central New Jersey (F. Yoder, pers. comm.). At present, the species reaches its greatest abundance in the Delaware River valley in Gloucester and Salem counties where some infestations occupy an acre or more of old field habitat.

Threats

The rapid and dense growth of mile-a-minute allows it to overtake native vegetation, smothering seedlings and outcompeting mature plants (Virginia NHP 1998; USDA 1992). Large infestations significantly alter the structure of natural plant communities and ultimately reduce biodiversity. Within the last decade, mile-a-minute has rapidly become a significant pest in several locations along the Delaware River in Gloucester and Salem counties (D. Snyder, personal observation) and in the Watchung Reservation, Union County (Misseck 2000). It is of particular concern in wet meadows that may harbor rare wetland plants (Virginia NHP 1998). A Gloucester County population of the state listed endangered Lancaster sedge (*Cyperus lancastricensis*) was destroyed within the span of a decade when its habitat was overrun and smothered by mile-a-minute (D. Snyder, personal observation). It is also weed of gardens and landscaped yards. It has the potential to become a serious pest in agricultural lands (D. Snyder, personal observation).

Control

Mile-a-minute can be hand-pulled (wearing gloves) from small areas before they set seed, and before they grow so much as to overtake other vegetation (Virginia NHP 1998). The plants lack deep-seated roots and are fairly easy to pull. Mowing or weed whacking is effective as long as it is done prior to fruiting (Mountain 1989). Removing thick litter layers may also help to control the spread of the plant. Heavily infested areas can be treated with herbicides before the plants go to seed. Herbicides should be used with caution as they can harm co-occurring indigenous plants. Research on a biological control agent (a beetle, *Rhinoncomimus latipes*) is underway at the University of Delaware (L. Morse, pers. comm.). Because mile-a-minute is apparently not yet widespread in New Jersey, successful control may be relatively easily achieved if aggressively pursued.

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Representative New Jersey Specimens Examined

Salem Co.: Along access road to spoil banks, W of Rt. 130 and S of Rt. 602, Oldman's Twp., 27 September 1991, *J. Courtney s.n.*, PH.

***Potamogeton crispus* L. (curly leaf pondweed)**

Description

Curly leaf pondweed grows as a submersed, perennial aquatic plant (Vermont IPEFSS 1998; Lorenzi and Jeffery 1987). The reddish-green, alternate leaves are wavy, with finely toothed margins (Vermont IPEFSS 1998). Leaves grow to be 2-3 inches long and 1.5 inches wide. The stems are smooth and somewhat flattened. Flowers are small and inconspicuous, arranged on dense spikes attached to the stems. Plants produce seeds in midsummer, but they do not play a big role in the dispersal of the plant. Dispersal is mostly by burr-like winter buds called turions that drop to the sediment and germinate the following year (Vermont IPEFSS 1998).

Habitat

Curly leaf pondweed can occupy a range of aquatic habitats (Vermont IPEFSS 1998). It grows best in alkaline or nutrient-rich water. It occurs in freshwater lakes, ponds, rivers and streams, and in slightly brackish water, in both shallow and deep water (12 feet deep or more). Pondweed is tolerant of low light and low water temperatures. In New Jersey it has been collected from rivers, creeks, lakes, ponds, and marl pits (see specimens cited).

Distribution

Curly leaf pondweed is indigenous to Eurasia, Africa and Australia (Vermont IPEFSS 1998). In the United States it was probably first introduced to the East Coast; the earliest dated specimen having been collected from Philadelphia, Pennsylvania in 1841 or 1842 (Tehon 1929). The species now occurs in almost every state (USDA 1998). It is considered invasive in the eastern United States in CT, MA, NY, PA, TN, and VT. In New Jersey, the collected range (based on specimens at PH) is Burlington, Camden, Hunterdon, Mercer, Salem, and Warren counties. It is also reported from Middlesex, Morris, Sussex, and Union counties (Hough 1983). It occurs in most of the major watersheds of New Jersey. In 1880, it was noted that *Potamogeton crispus* was so abundant at one locality in Union County “as to choke up the stream” (Tweedy 1880).

Threats

Curly leaf pondweed begins to grow earlier in spring than most other aquatic species, and forms dense beds that can outshade and outcompete native aquatics (Vermont IPEFSS 1998). The dense mats of pondweed also disrupt boating, swimming, and fishing.

Control

Mechanical removal and herbicides have been used with varying degrees of success (Vermont IPEFSS 1998). Herbicides should be used cautiously as they could harm indigenous aquatic plants and other aquatic organisms.

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Representative New Jersey Specimens Examined

Burlington Co.: SW branch of Rancocas Creek, 0.75 miles NE of Marlton, 2 July 1937, *J.M. Fogg, Jr. 12254*, PH. **Camden Co.:** Camden, June 1870, *I.C. Martindale s.n.*, PH; S branch of Pensauken Creek, deep water in channel, Pensauken, 10 July 1926, *J.W. Adams & H.W. Trudell 377*, PH. **Hunterdon Co.:** Delaware River, shallow backwater among rocks, 0.9 km NW of Titusville, 17 June 1988, *M.E. Garback, K. Larsen, & A.E. Schuyler 7045*, PH; Raven Rock, 1886, *G.N. Best s.n.*, PH; Raritan River, shallow pool protected from current, 5 mi E of Clinton, 27 June 1972, *M.L. Roberts 2431*, PH; Spruce Run Reservoir, sand-silt in shallow water along W shore, near Clinton, 27 June 1972, *M.L. Roberts 2437*, PH. **Mercer Co.:** Trenton, 24 May 1887, *A.C. Apgar s.n.*, PH; Delaware River near mouth of Duck Creek, 15 October 1981, *R.W. Hastings s.n.*, PH; Assunpink Creek near US 1, below Bakersville, 31 October 1958, *G. Claus s.n.*, PH. **Salem Co.:** Marl pits, Woodstown, 20 May 1893, *B.J. Heritage s.n.*, PH; small pond on tributary to Fenwick Creek, 0.75 mi SW of Acton, 29 April 1936, *J.M. Fogg, Jr. 10224*, PH. **Warren Co.:** Millpond N of Green Pond, 22 May 1910, *H.W. Pretz 2470*, PH; Delaware River below Sandts Eddy and upstream from Marble Hill, 28 July 1988, *K. Larsen, T. Remaley & A.E. Schuyler 7066*, PH; Delaware River above Foul Rift, 31 August 1907, *S.S. Van Pelt s.n.*, PH.

***Ranunculus ficaria* L. (lesser celandine)**

Description

Lesser celandine is an annual herbaceous plant that grows in early spring (Swearingen 1999). It has glossy, dark green, rounded leaves arranged in a low-growing rosette with both fibrous and tuberously thickened roots. The leaves appear in late winter and die back by early June. Bright yellow buttercup-like flowers bloom in March and April, held above the leaves. Seeds mature by May, but reportedly are rarely formed (Rhoads 1999). Vegetative reproduction is by small underground tubers and by axillary bulblets formed on the stems. Both tubers and bulblets are readily dispersed during flooding events (Swearingen 1999).

Habitat

Lesser celandine is characteristic of moist alluvial soils in forested floodplains. It also invades grassy meadows, roadsides, lawns, and less frequently drier soils of embankments and open woodlands (D. Snyder, personal observation). The earliest New Jersey collection was collected from ship ballast (see specimen citations).

Distribution

Lesser celandine was introduced from Europe both deliberately as a garden plant (Rhoads 1999) and accidentally as contaminant in ship ballast (see specimens cited). In the eastern United States, lesser celandine occurs from New England west to Wisconsin and Missouri, then south to Tennessee and Virginia (Kartesz 1999). In the western United States it has been reported from Washington and Oregon (Kartesz 1999). It is also reported from Newfoundland, Quebec, Ontario, and British Columbia, Canada (Kartesz 1999). In New Jersey, lesser celandine has been either undercollected, or its current widespread distribution has been achieved in the later part of the 20th century. It was first collected in New Jersey in 1898. Starting in 1932, and continuing through the 1970s, lesser celandine was collected at least once a decade (Snyder 1987). In a survey conducted by Snyder (1987) in 1982, lesser celandine was found to be rampant throughout the Raritan River drainage and other locations in central New Jersey. Its collected range in New Jersey is Burlington, Camden, Hunterdon, Middlesex, Somerset, Union, and Warren counties (Snyder 1987). It is also reported for Mercer and Salem counties by Snyder (1987), Monmouth County by Hough (1983), and Essex County (Glenn and Dutton 1996). It occurs mostly in the Piedmont and Inner Coastal Plain physiographic provinces.

Threats

The invasive nature of lesser celandine was first reported by Snyder (1987) who noted that it was “aggressive and spreads rapidly once established” and that it has “already become a serious pest in some areas of New Jersey.” Lesser celandine forms near monocultures of extensive acreage (Rhoads 1999; Snyder 1987) in the early spring. Because of its early emergence and aggressive nature, lesser celandine poses a serious threat to indigenous spring

ephemerals (Rhoads 1999; Swearingen 1999). It has significantly altered the structure of natural plant communities.

Control

Small infestations can be dug up, taking care to remove all the tubers and bulblets, but for larger populations, digging may create too much soil disturbance (Swearingen 1999). Herbicides can be used as soon as the leaves appear, but before when indigenous plants begin to grow. Herbicides should be used very cautiously to avoid harming indigenous plant and amphibian populations.

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Representative New Jersey Specimens Examined

Burlington Co.: Moorestown, 16 April 1932, *J. Stokes s.n.*, PH; **Camden Co:** Ballast, Kaighn's Point, 23 April 1898, *C.F. Saunders, s.n.*, PH.

***Rhamnus cathartica* L. (common buckthorn)**

Description

Common buckthorn is a deciduous shrub or small tree that can grow up to 20 feet high (Converse 1998; Vermont IEPFSS 1998). The leaves (1-2.5 inches long) are dull green, smooth, and oblong in shape with very finely toothed edges (Converse 1998). The leaves are arranged nearly opposite along the stem (Vermont IEPFSS 1998). First year seedlings have two heart-shaped leaves (Samuels 1996). Gray-black bark and twigs have prominent raised patches (lenticels) and the twigs can be tipped with sharp thorns (Converse 1998; Vermont IEPFSS 1998). Buckthorn bears fragrant greenish-yellow flowers in spring. The four-petaled flowers are borne in umbrella shaped clusters (umbels) along the stem, from the leaf axils (Converse 1998). The black fruits ripen in fall, and are small and round, each containing 3-4 seeds (Converse 1998; Vermont IEPFSS 1998). The fruits persist on the plants throughout much of the winter (Vermont IEPFSS 1998). Birds are the primary dispersers of the seeds. Dry fruits and seeds can also float for several days, and water dispersal may be important in areas with extensive fall and winter flooding (Converse 1998).

Habitat

Buckthorn occurs in a variety of habitats including woodlands, fields, and roadsides (Vermont IEPFSS 1998; Samuels 1996). It prefers alkaline soils, but is not limited to them (Converse 1998). Although widely in scattered in northern New Jersey, the species has been undercollected and habitat information is poorly known. In New Jersey, it has been observed or collected from roadside thickets, fence rows, waste ground, and in upland woods and thickets over traprock. It occurs in floodplain forests and margins of sinkhole ponds. It appears to be most frequent along the edges of calcareous fens and in open woods adjacent to the fens (D. Snyder, personal observation).

Distribution

Common buckthorn is indigenous to Eurasia, and was brought to the United States primarily to use in shelter belt plantings (Samuels 1996). It is now widespread in North America from Nova Scotia to Saskatchewan, south to Missouri, and east to Virginia (Converse 1998). The collected range in New Jersey includes Sussex County (see specimen cited), but Hough (1983) also reports it from Camden, Hunterdon, Mercer, Middlesex, and Somerset counties. It inhabits a range of physiographic provinces including the Ridge and Valley, Piedmont, and Inner Coastal Plain provinces. It is especially abundant in the Wallkill River valley in Sussex County and other areas in Sussex and Warren counties that are underlain by dolomites and limestones (D. Snyder, personal observation). This species appears to be undergoing a rapid population explosion in the northern part of the state.

Threats

Because of its long growing season and rapid growth rate, common buckthorn poses a serious threat to indigenous vegetation (Converse 1998). It can rapidly form dense thickets that outcompete indigenous plants for light and other resources. All parts of the plant are poisonous to humans if ingested, and the plants are an alternate host for the fungus that causes oat rust (Samuels 1996).

Control

Seedlings are easily pulled by hand (Samuels 1996). Mature shrubs or trees can be cut repeatedly, or treated with herbicide after cutting (Converse 1998; Vermont IEPFSS 1998). Herbicides could harm indigenous co-occurring plants. In open areas, mowing can keep seedlings from establishing.

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Representative New Jersey Specimens Examined

Sussex Co.: Fence row, Montague, 16 June 1884, *H.H. Rusby & N. L. Britton s.n.*, PH.

***Robinia pseudoacacia* L. (black locust)**

Description

Black locust is a fast growing deciduous tree, growing up to 80 feet tall (Sargent 1922; Converse 1998; Hunter 1996). Older trees have dark brown deeply furrowed bark, and the branches usually have stout spines. The compound leaves are alternately arranged, with 7-21 elliptical leaflets. The fragrant white flowers, which are blotched with yellow at the base, are borne in drooping clusters in late May and early June. Red-brown 3-4 inch long pods develop during the summer. The seeds are reported to be viable in the soil for a minimum of 88 years (Haynes 1956). Seedlings grow rapidly and are easily identified by the presence of long paired thorns (Wieseler 1998). Trees reproduce vegetatively through extensively spreading underground runners.

Habitat

In the southern and central Appalachian Mountains, where black locust is indigenous, trees grow singly or in small groups in forests and woodlands at altitudes up to 3,500 feet (Sargent 1922; Weakley 2000). In New Jersey, black locust is abundant in successional or disturbed habitats such as old fields, roadsides, hedge-rows, railroad and utility right-of ways, waste ground, fallow agricultural fields, and dredge spoils. It also invades and readily establishes in natural plant communities such as floodplain forests and rivershores, greensand marl ravines, grasslands, and pine and oak woods (see specimen citations; D. Snyder, personal observation).

Distribution

The indigenous historic range of black locust was primarily along the Appalachian Mountains and the Ozarks. The species is now so widespread in the northeastern states, it is sometimes mistakenly considered as indigenous. Darlington (1853) in his flora of Chester County, Pennsylvania, noted, "This tree—so common in our mountains, and so valuable for its durable timber—is naturalized in many places, --and often cultivated; but it has never appeared to me as truly indigenous, in this County." Britton and Brown (1913) report the indigenous range as: "Monroe Co., Pa, south, especially along the western slopes of the mountains, to Georgia, west to Iowa, Missouri and Oklahoma. Extensively naturalized elsewhere in the United States and eastern Canada and in Europe." Valued for its durable wood, black locust was planted widely across the United States, and now occurs in all states except Alaska and Hawaii (Kartesz 1999; USDA 1998). On the East Coast it is considered invasive in MA, NY, and VT. The collected range (based on specimens at PH) in New Jersey is Burlington, Camden, Cape May, Gloucester, Hunterdon, Mercer, Monmouth, Ocean, Salem, and Warren counties. It is also reported as occurring in Bergen, Essex, Middlesex, Morris, Passaic, Somerset, Union, and Sussex counties (Hough 1983; Clemants and Glenn 1999). It occurs in all physiographic provinces.

Threats

The New Jersey Forest Service describes black locust as, “one of the most aggressive successional species in New Jersey” (Martine 1998). Black locust creates dense stands in open habitats such as old fields and grasslands, where it alters the process of natural succession and displaces indigenous plant species (Hunter 1996; D. Snyder, personal observation). In riparian habitats, especially floodplain forests, it can become dominant in the overstory. Because black locust is a nitrogen fixing plant, it may change the available soil nutrients in plant communities (Converse 1998). The seeds, leaves and bark are toxic to humans and livestock (Hunter 1996).

Control

Mowing and burning are not effective because they tend to increase suckering and root sprouting (Converse 1998). Freshly cut stumps can be painted with a systemic herbicide that will enter the root system (Converse 1998; Wieseler 1998), but herbicides leaching out of the root system could harm indigenous plants. Treated stumps should be monitored for several years (Wieseler 1998).

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Wieseler, S. 1998. Black Locust NPCI Exotic Plant Working Group Fact Sheet. Available online: <http://www.nature.nps.gov/npci/epwg/rops1.htm>.

Representative New Jersey Specimens Examined

Burlington Co.: Naturalized about old clearings, Calico, 28 July 1937, *B. Long* 50913, PH; N side Mt. Holly, 27 June 1922, *H.B. Meredith s.n.*, PH. **Camden Co.:** Thickets, along Cooper Creek, N of Haddonfield, 17 April 1914, *B. Long* 9516, PH; Kresson Rd., 3 mi E of Haddonfield, 15 May 1938, *L.P. Hynes s.n.*, PH. **Cape May Co.:** Cape May Court House, 12 August 1918, *O.H. Brown s.n.*, PH; abundant along field margin, 1 mi N of Fishing Creek, 31 July 1941, *W.M. Benner* 9678, PH. **Gloucester Co.:** Mantua Twp., 29 May 1870, *C.P. Burrough s.n.*, PH; Swedesboro, 30 May 1892, *C.D. Lippencott s.n.*, PH; abundant in dry, sandy old field, N of Jefferson, 26 March 1937, *B. Long* 49692, PH. **Hunterdon Co.:** Margin of gravelly thicket, shore of Delaware River, Treasure Island, 21 May 1933, *B. Long* 39977, PH. **Mercer Co.:** Princeton Junction, 29 May 1906, *E.B. Bartram s.n.*, PH; Rocky Hill, 3 June 1885, *J.E. Peters s.n.*, PH. **Monmouth Co.:** Naturalized in pine and oak woods from old house site, 0.5 mi E of Charleston Springs, 29 May 1938, *B. Long* 52217, PH; roadside and hedge rows, Allenwood, 20 May 1953, *V.L. Frazee s.n.*, PH. **Ocean Co.:** New Egypt, 28 May 1908, *J.H. Grove* 644, PH; abundant on roadside, fields and woods, SW of Prospertown, 7 June 1924, *B. Long* 30594, PH. **Salem Co.:** Sandy thickets, N end artificial island, 4 mi W of Hancocks Bridge, 23 October 1934, *J.M. Fogg, Jr.* 7785, PH. **Warren Co.:** Alluvium, 1-2 mi S of Carpentersville, 12 July 1948, *R.L. Schaeffer, Jr.* 27963, PH.

***Rosa multiflora* Thunb. (multiflora rose)**

Description

Multiflora rose grows as a thorny perennial shrub with arched canes (Eckardt 1987) but can also sprawl or climb in trees 10 feet or more (Gleason and Cronquist 1991; D. Snyder, personal observation). The compound leaves are divided into 4-11 oval leaflets with toothed margins. The leaves are arranged alternately along the stems. Multiflora rose flowers in spring and early summer with clusters of white to pinkish-white flowers. The fruits, or rose hips, mature in fall, turning bright red. A single bush is capable of producing up to a million seeds in one season (TN EPPC 1998). The seeds are dispersed by many species of birds and by other animals. The seeds are reported to remain viable for many years, perhaps as long as 10-20 years (Eckardt 1987; TN EPPC 1998). Multiflora rose also reproduces vegetatively from root sprouts and from the rooting of the tips of the canes (Eckardt 1987).

Habitat

Multiflora rose occurs abundantly in disturbed or successional habitats like fields, roadsides, railroad and utility rights-of-way, old home sites, thickets, and agricultural lands. It also invades natural plant communities like floodplain forests, calcareous fens, grasslands, and forest gaps. Most early collections have come from woods, roadsides, and other disturbed areas.

Distribution

Multiflora rose was introduced from Asia in the late 1800s as an understock for ornamental roses (Eckardt 1987). It has been widely planted as living fences to contain livestock, as wildlife cover, and used in soil conservation and highway projects (Eckardt 1987). It occurs throughout the eastern and central United States and Canada, and also in Washington, Oregon, and California (Kartesz 1999). Virginia and North Carolina both designate multiflora rose as a noxious weed, and most eastern states consider it invasive. The collected range (based on specimens at PH) in New Jersey is Cumberland, Gloucester, Mercer, Middlesex, Monmouth, Ocean, Passaic, and Warren counties. It is also reported in Cape May, Hunterdon, and Somerset counties (Hough 1983). The species, like most widespread nonindigenous plants species occurring in New Jersey, is poorly represented in herbaria (D. Snyder, personal observation). A more accurate depiction of its distribution in the state is presented in Clements and Glenn (1999), where more than 150 locations are mapped in northern and central New Jersey. It occurs in all of New Jersey's physiographic provinces.

Threats

Multiflora rose can produce dense, impenetrable monocultures that exclude indigenous plants and restrict the movement of some animals (Eckardt 1987). It is a strong competitor for below-ground resources, inhibiting the growth of indigenous plant species and also commercial crops in adjacent agricultural fields (Eckardt 1987). It is tolerant of some shade, and of a range

of moisture conditions, enabling it to invade a variety of natural plant communities. It significantly alters natural plant community structures and reduces overall biological diversity.

Control

Repeated mowing or cutting can be used to control the spread of small populations, but will not eradicate them (Eckardt 1987) since multiflora rose can resprout from stumps. Small plants can be dug out, provided the entire root is removed (Virginia NHP 1998). Plant growth regulators have been used effectively to prevent plantings from spreading, and herbicides can be used to kill plants (Eckardt 1987). Herbicides should be used with caution, as they could harm indigenous plants. Several potential biological control agents are under investigation (Eckardt 1987).

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Representative New Jersey Specimens Examined

Cumberland Co.: Edge of dirt road, Fostescue Glades Wildlife Refuge, 2.5 km [near] Newport, 7 June 1983, *S. Heckscher s.n.*, PH; along old earth road through woods, Shiloh, 30 May 1933, *B. Long 40140*, PH. **Gloucester Co.:** Open ground, dry bushy field, S of Sewell, 6 June 1920, *B. Long 23088*, PH. **Mercer Co.:** Thicket, 1 mi S of Ewingville, 1 November 1954, *W.L. Dix s.n.*, PH. **Middlesex Co.:** Thicket near rubbish dump, 1 mi NE of Cranbury, 29 July 1951, *B. Long 73797*, PH; open thicket along NJ Rt. 20, SW of New Brunswick, 3 June 1951, *B. Long 73250*, PH. **Monmouth Co.:** Ravine by Crosswicks Creek, rich wooded slope, 2 mi SW of Hornerstown, 14 April 1949, *B. Long 68879*, PH; naturalized on roadside bank, 1 mi W of Cream Ridge, 25 May 1941, *B. Long 56678*, PH. **Ocean Co.:** About old house site, E of Manahawkin, 21 August 1923, *B. Long 28842*, PH. **Passaic Co.:** Old quarry, just W of Patterson, 10 July 1949, *R.L. Schaeffer, Jr. 31089*, PH. **Warren Co.:** Fallow slope, 1 mi N of Sarepta, 23 July 1959, *R.L. Schaeffer, Jr. 59299*, PH; woods, 1 mi W of Oxford furnace, 15 August 1950, *R.L. Schaeffer, Jr. 34225*, PH.

***Rubus phoenicolasius* Maxim (wineberry)**

Description

Wineberry grows from biennial arching canes, which reach up to 2 m long. The leaves are divided into three leaflets whose undersides are covered in small, dense white hairs. The stems and buds are covered by dense 3-5 mm long purple hairs, which give the stems a shaggy appearance (Gleason and Cronquist 1991). The five-petaled flowers are white and bloom in late spring to early summer. The fruits mature in mid to late summer (Hough 1983). Fruits are red, juicy berries dispersed by birds and other animals.

Habitat

Wineberry is frequent in open or disturbed habitats such as thickets, fields, and forest edges, railroad and utility rights-of-way, and old homesites. It also successfully invades wooded ravines, floodplain forests, calcareous forests, shale bluffs, and traprock and diabase forests.

Distribution

Wineberry was introduced into the eastern United States from Asia (Fernald 1950). Originally grown in cultivation, wineberry is now widespread throughout the Eastern United States where it occurs from Vermont south to Georgia, and west to Arkansas (Kartesz 1999; USDA 1998). The collected range (based on specimens at PH) in New Jersey is Burlington, Camden, Cape May, Cumberland, Hunterdon, Mercer, Sussex, and Warren counties. It is also reported from Bergen, Essex, Hudson, Middlesex, Monmouth, Passaic, Somerset and Union counties (Hough 1983; Clemants and Glenn 1999). It occurs throughout New Jersey's physiographic provinces, but reaches its greatest abundance in the Piedmont, Highlands, and Ridge and Valley provinces (D. Snyder, personal observation).

Threats

Wineberry forms an extensive, nearly impenetrable understory layer in favorable locations such as moist soils in forests over dolomite, marble, shale, diabase, and traprock (D. Snyder, personal observation). These substrates are known to support several rare plant communities and unique plant assemblages. Thickets of wineberry alter the structure of natural plant communities, outcompete rare or declining plant species, and contribute to the loss of biological diversity. In the Piedmont and the Kittatinny limestone valley of the Ridge and Valley Province, wineberry frequently occurs with the invasive nonindigenous species Japanese barberry (*Berberis thunbergii*), Japanese honeysuckle (*Lonicera japonica*), and Japanese stiltgrass (*Microstegium vimineum*) (D. Snyder, personal observation). Such wholly unnatural plant associations can dominate an acre or more of woodland, with an obvious reduction in the diversity of indigenous understory and herbaceous species. Bailey (1932) reported that wineberry, in association with Japanese honeysuckle and the nonindigenous invasive tree-of-heaven, had completely altered the habitat at the type locality of a rare indigenous species of

blackberry in Monmouth County, New Jersey, and was directly contributing to the species decline.

Control

There is currently no control information specific to wineberry, but other *Rubus* species are controlled mechanically and with herbicides (Hoshovsky 1998). Small plants can be hand-pulled, and larger plants can be dug out. It is important to remove the root crown, as plants will resprout from the crown. Root crowns and stumps can also be treated with herbicides if left in the ground, but herbicides can harm adjacent indigenous plants.

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- ## Representative New Jersey Specimens Examined
- Burlington Co.:** Ravine along Delaware River, Florence, 22 June 1924, *R.R. Dreisbach* 2197, PH; moist wooded slope back of PRR Station along brook tributary to Delaware River, Kinkora, 27 April 1917, *B. Long* 15724, PH. **Camden Co.:** Loamy wooded slope along streamlet tributary to S. Branch Timber Creek, NW of Blackwood, 13 October 1915, *B. Long* 13866, PH. **Cape May Co.:** Fence rows, Cold Spring, 27 September 1905, *O.H. Brown* s.n., PH; waste ground, Cape May City, 15 July 1917, *W. Stone* s.n., PH. **Cumberland Co.:** Bramble thicket edge of woods, W of Deerfield, 29 March 1934, *B. Long* 42784, PH; roadside below mill,

Seeley, 10 July 1941, *B. Long* 56977, PH. **Hunterdon Co.:** Abundant on Laport farm, Mountain Rd., East Amwell Twp., 14 June 1973, *E.A. Laport s.n.*, PH; High Bridge, 25 June 1902; *H.L. Fisher s.n.*, PH. **Mercer Co.:** Margin of open woods, 1 mi NW of Pennington, 30 June 1937, *W.M. Benner* 7876, PH; 2 mi SW of Princeton, 19 June 1938, *L.P. Hynes s.n.*, PH. **Sussex Co.:** Newton, 7 July 1907, *C. S. Williamson s.n.*, PH. **Warren Co.:** Alluvial woods, 1 mi SW Belvidere, 30 July 1948, *R.L. Schaeffer, Jr.* 35515, PH; woods, 1 mi SE of Hazen, 22 June 1951, *R.L. Schaeffer, Jr.* 35515, PH.

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