Cover: Northern Harrier in the Croton grassland, Croton Point Park. Courtesy of Jeff Seneca.
Contents

DESIGN & MANAGEMENT SPECIFICATIONS for the Croton Grassland at Croton Point Park

Westchester County
Dept. of Parks, Recreation, & Conservation

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I. PROJECT AREA

This document serves as a management manual for an approximately 100-acre constructed grassland within the 508-acre Croton Point Park, which is located along the eastern shore of the Hudson River in Westchester County, New York. The grassland was established in the mid-to-late 1990s on a capped landfill that operated from the late 1920s through 1986. The grassland is now managed by the Department of Environmental Facilities (DEF), which also monitors and manages methane emissions for the capped landfill.

Fig. 1: Croton Point Park with project area delineated in red. Inset images show the project area as a historic wetland in 1931, as a functioning landfill in 1973, during the capping process in 1996, and as a seeded grassland in 2000.
II. PROJECT OBJECTIVES

A. Identify target grassland nesting bird species to manage for and when to manage for them.

B. Provide detailed management procedures with supporting rationales that:
   - *Preserve and enhance habitat for target grassland nesting birds and other relevant grassland birds of conservation concern.*
   - *Restore and preserve the long-term ecological health and overall aesthetics of the Croton grassland.*
   - *Prevent incursion of problem weeds and woody plants that could jeopardize the integrity of the landfill cap.*
   - *Reduce maintenance requirements over time.*

C. Provide seed mix and live plant specifications that:
   - *Enhance the overall aesthetics and ecological health of grassland areas.*
   - *Diversify the types of grassland bird habitat available.*
   - *Include species able to thrive under existing conditions given appropriate management procedures.*

D. Propose monitoring well path configurations that reduce maintenance requirements and limit disturbance to wildlife habitat while maintaining monitoring access.

E. Format specifications to ensure ease of use in the field with easy recordkeeping.

*Fig. 2: Croton grassland, looking northwest, near the top rock-lined swale, May 2014. Note the prior year’s top growth of Little Bluestem (Schizachyrium scoparium) along the rock-lined swale on the left side of the image.*
III. GRASSLANDS OVERVIEW

Understanding grasslands ecology is key to managing grasslands effectively. Below is an overview of grasslands ecology as well as brief discussion of the critical role grasslands play in providing habitat for grassland nesting birds.

Functions & Services
Grasslands perform many important ecological functions and services, including soil stabilization, water infiltration, drought resistance, carbon sequestration, and wildlife habitat.

Composition
Grasslands are open, sunny landscapes featuring a dense tapestry of grasses, grass-like plants (sedges and rushes), and occasional wildflowers with few, if any, trees. The composition and arrangement of species vary in accordance with site conditions, such as hydrology, soil type, and amount of sun. Grasslands in North America are often categorized as tall grass, mixed grass, and short grass.

Spatial Niches
Plants in a mature grassland occupy different spatial niches as they compete for access to light, water, and soil. Like vegetation layers in a woodland, canopy plants grow over shorter species. Below ground, space is divided by roots of various shapes, sizes, and depths. Mat forming roots occupy the upper soil layers while fibrous and tap roots occupy lower layers, sometimes reaching lengths that are two to three times as long as above-ground growth.

When desired vegetation occupies all available spatial niches, there is little opportunity for weed incursion since there is simply no place left for weeds to grow. This kind of structural complexity does not exist in monocultural plantings like turf.

Temporal Niches
Grasslands feature two types of temporal niches: 1) seasonal niches; and 2) niches over years of growth. Seasonal niches pertains primarily to grasses. Those grasses that achieve maximum growth rates during cooler periods (early spring and late fall) are referred to as cool season grasses. Grasses that achieve their peak growth rate during warmer months (late spring and summer) are known as warm season grasses. Grasslands containing both cool and warm season species are less susceptible to weed invasion since they consist of actively growing vegetation throughout the growing season (see Fig. 3).

![Fig. 3: Cool season and warm season grassland growth](image)

Grasslands also contain early, mid, and late succession species. Early succession species—
predominantly annual and biennials—establish cover and flower during the first two years of growth. Mid-succession species establish cover in the first year of growth but do not flower until their second or third year. Long lived, late succession species establish slowly and begin to flower in three to four years and can continue flowering indefinitely assuming the grassland is managed to prevent the incursion of woody vegetation.

Grasslands that contain early, mid, and late succession herbaceous species are more resilient to weed invasion and other stresses. When small-scale disturbances do occur (e.g., soil erosion, trampling, etc.), dormant yet viable seeds of early successional species germinate quickly and serve as "gap fillers" in areas that might otherwise be colonized by weeds or woody vegetation.

**Succession**

Succession refers to the natural replacement of one group of species by another over time. As described above, mid and late-stage herbaceous species replace early successional herbaceous plants; shrubs and pioneer trees in turn replace the herbaceous community. If left undisturbed, the community will progress to forest (see succession continuum in Fig. 4).

The prevalence of invasive non-native shrubs such as Honeysuckle (*Lonicera* spp.) and Multiflora Rose (*Rosa multiflora*) can expedite the process of grasslands becoming shrublands. Invasive herbaceous plants such as Mugwort (*Artemisia vulgaris*) can also rapidly out-compete a diverse matrix of grassland vegetation, as can some aggressive native forbs including Canada Goldenrod (*Solidago canadensis*) and some asters.

To establish a permanent grassland in a region where forest predominates is to arrest the process of ecological succession at the herbaceous perennial stage through mowing or otherwise preventing the incursion of woody species. Consequently, grasslands are never "maintenance free." Yet when we understand nature’s next "move" on the succession continuum, management can be more effective, and we can even harness the succession process to achieve management goals.

**Wildlife Habitat**

Native grasslands are home to a diversity of plants that support a diversity of life forms—from microbes at the soil level to insects and the birds that depend upon those insects to feed their young. Grasslands also support butterflies, bats, meadow voles, meadow jumping mice, white-tailed deer, red foxes, and predatory birds, including hawks and owls.
Warm season grasses constitute the dominant component of native grasslands. The form and structure of these grasses are critical to the habitat requirements of a range of wildlife. A native warm season grass (also known as bunch grass) forms a large bunch with many stems, allowing for bare ground or a light litter layer between individual plants. Birds and small mammals can then move easily across the ground with a protective cover of vegetation overhead. Chicks of many native ground nesting birds require this combination of open ground and protective cover to move around safely in search of food. In comparison, tall non-native fescues and other non-native cool season grasses grow so densely and are prone to matting down such that they hinder ground-level travel of songbirds, rabbits, and quail searching for food and bare patches for nesting sites. Native warm season grasses are also more often associated with a greater number of food sources from broadleaf forbs and associated insects than are non-native cool season grasses.

Native warm season grasses are structurally durable with resilient or rigid stems capable of withstanding heavy snow loads, thereby avoiding lodging or flattening. Wildlife can then secure winter cover under this rigid dead top growth and procure nesting material the following spring. Non-native cool season grasses, by comparison, mat down easily from winter storms, providing poor winter cover and limiting nesting in the spring.

**Grassland Nesting Birds**

Although grasslands provide habitat to diverse range of insects, birds, and mammals, concerns in recent years about grassland habitat have focused on the precipitous decline in obligate grassland nesting birds. Many birds use grasslands during some portion of their life cycle, but the term grassland nesting birds rely on grass-dominated ecosystems in order to complete all aspects of their life cycle.

Due to severe habitat loss and fragmentation, the decline in grassland birds has been faster than any other habitat-species suite in the northeast (Morgan and Burger, 2008). Across New England and New York, at least nine species of grassland birds are now listed as regionally threatened or endangered.

Grassland bird habitat in the northeast is often categorized as follows based on widely used guidelines developed by the Massachusetts Audubon Society (Jones and Vickery, 1997):

**Small, isolated grasslands:** 10-75 acres. Provide summer breeding habitat for Bobolinks, Bobwhite, Eastern Meadowlarks, and Savannah Sparrows and fall foraging for migrating sparrows, larks, and warblers.

**Large grasslands:** 75 or more contiguous acres containing a mosaic of short, sparse growth and tall, dense grasses and wildflowers. Serve as important nesting habitat for grassland nesting birds, notably the Grasshopper Sparrow, Northern Harrier, Ring-necked Pheasant, and other species.

**Grassland Nesting Birds of Management Concern or Considered At Risk in the Hudson River Valley**

- Species | When using grasslands in NY
- --- | ---
- Bobolink | Breeding, migration
- Clay-colored Sparrow | Breeding, migration
- Dickcissel | Breeding, migration
- Eastern Bluebird | Breeding, migration, wintering
- Eastern Meadowlark | Breeding, migration, wintering
- Grasshopper Sparrow* | Breeding, migration
- Henslow’s Sparrow | Breeding, migration
- Horned Lark | Breeding, migration, wintering
- Northern Harrier* | Breeding, migration, wintering
- Savannah Sparrow | Breeding, migration, wintering
- Sedge Wren | Breeding, migration
- Upland Sandpiper | Breeding, migration
- Vesper Sparrow* | Breeding, migration

* Require 75+ acre grasslands for nesting

and Vesper Sparrow. Also serve as hunting ground for American Kestrels and Red-tailed Hawks. Provide fall foraging for migrating sparrows, larks, and warblers. Can meet the winter habitat requirements of short-eared owls and snowy owls.

**Agricultural grasslands**: Active hayfields, crop fields, and pastures. Need to remain substantially unmown during the breeding season to provide productive nesting habitat.

While such area designations can be a helpful tool for establishing target species and making management decisions, determining adequate habitat size for a viable population can be difficult. A species may select and occupy an area of a certain size but the bird’s population may not be viable. Studies attempting to determine habitat size also differ in methodology (Sample and Mossman, 1997), and area requirements may vary by region.

Grassland nesting birds respond strongly to the amount of perimeter to interior habitat, otherwise known as perimeter:area ratio. In general, circular shaped grasslands with lower perimeter:area ratios are preferrable to narrow, rectangular shaped fields that have higher perimeter:area ratios. With more edge habitat comes higher predation rates and nest parasitism. Some studies suggest the edge-interior ratio may in fact be more of a determining factor in habitat suitability than grassland size (Helzer and Jelinski, 1999).

Grassland nesting birds also respond to vegetative structure and composition, including vegetation height and density, litter depth and cover, woody vegetation height and cover, amount of exposed soil, and cover from standing residual (dead) growth and live herbaceous growth. Horned Larks, for example, need short, sparse vegetation while Henslow’s Sparrows and Sedge Wrens nest in taller, more dense growth. Some birds prefer recently grazed or burned grasslands while others are associated with growth that has been left undisturbed for several years; others opt for habitat in between these extremes. In order to meet such a range of habitat needs, management protocols must promote a mosaic of habitat types.

**In the New England-New York region, nine species of grassland birds are listed as endangered, threatened, or of special concern, largely due to habitat loss. Many of the species in this region are area-sensitive and limited to the few remaining large grassland tracts available, making management of these sites critical to population persistence in the region.**


**Diversity of grasses and forbs within patches and overall has also been shown to be important. A study conducted in Missouri showed that more grassland nesting birds successfully used fields of several species of cool season grasses over monoculture plantings of the native warm season Switchgrass, *Panicum virgatum* (McCoy et al, 2001).**

In the New York region, breeding grassland birds begin seeking nesting territories and sites from late April through May. Birds build nests and lay eggs through early June, and young hatch by mid-to-late June. Fledging typically occurs by early July. The Eastern Meadowlark, the Grasshopper Sparrow, and the Vesper Sparrow, all of which have

**Fig. 5: Clutch of eggs from a grassland nesting bird, possibly a Ring-Necked Pheasant.**
short breeding cycles, may produce two broods in one season, with the second fledging in late July. In cooler or wetter seasons, nesting and brood development are often delayed.

Many grassland birds will abandon nesting in an area if disturbed. Of species occurring in New York, Bobolink and Eastern Meadowlark are particularly sensitive. Some birds may remain to forage for insects and some may attempt to nest again in nearby unmowed areas if the season allows.

Grassland management actions must be carefully timed such that a grassland does not become an ecological trap in which grassland birds attempt to nest but fail due to management actions, and populations of already imperiled species decline further as a result. Timing of management actions must strike a balance between the optimal time for favoring desired vegetation and avoiding adverse impacts to the local population of grassland birds or other birds of conservation concern.

**Status of Native Grasslands in the Northeast**

The extent of native grasslands in the northeast have fluctuated over millenia in response to climate changes, grazing, and human land uses, such as fires started by Native Americans managing for game and forage. Since European settlement, agriculture, reduction in the use of fire, and development have reduced the quality and quantity of native grasslands to isolated remnant patches that continue to decrease in size and diversity. (In contrast, woodlands are increasing in area in eastern North America). Today, some plant species once found in grasslands can be found along roadways, railroad right-of-ways, in remnant fields, and in conservation plantings. Contemporary plantings that mimic naturally occurring native grasslands represent an opportunity to regain some of the ecological services and other benefits provided by grasslands.

**Misconceptions**

Grasslands are occasionally accused of being weedy, but if properly established and managed, grasslands actually inhibit weed growth by forming a dense vegetative cover that prevents weed seeds from germinating. People also fear the presence of deer ticks in meadows or grasslands. Wide mown paths and mown sitting areas can reduce the chances for exposure to such organisms.

**Benefits and Increasing Popularity of Grasslands**

Designed grasslands and meadow-like plantings are increasingly popular in public parks, residential settings, and corporate landscapes as they provide a wide range of benefits, including:

- **Economic Benefits**
  - Reduced long-term labor and material costs compared to turf
  - No long term irrigation, pesticide, or fertilization requirements

- **Ecological Benefits**
  - Wildlife habitat
  - Pollution filtration
  - Erosion prevention
  - Drought resistance
Reduced carbon emissions from decreased mowing
Increased stormwater retention and groundwater recharge
Reduced herbicide use (compared to conventionally managed turf)
Improved soil structure through organic material and macropore formation

**Educational Benefits**
Opportunities for learning about ecology, wildlife, horticulture, and design

**Aesthetic Benefits**
Visually dynamic, with aesthetic interest year round
Wildlife viewing opportunities

*Fig. 6: Northern Harrier in the Croton Grassland, October 2014. Courtesy Jeff Seneca.*
IV. SITE ANALYSIS

A. CONTEXT

Managing the Croton grassland for habitat must take into account the grassland's relative isolation from comparable habitat types as well as the Park's status as a year-round destination for active and passive recreation. The Croton grassland is one of the few large grasslands of its kind within the lower Hudson Valley, where the majority of land is either in some form of suburban/urban development, smaller meadows, or in woody growth. No comparably large grasslands exist within 20 miles (Ward Pound Ridge features smaller configured meadows); the nearest comparably large grassland is Floyd Bennett Field in Brooklyn, approximately 40 miles to the south. Ensuring restoration and management strategies succeed will also require informing and educating the Park's users—particularly birders, joggers, and dog walkers—about project goals.

Fig. 7: Relative isolation of the Croton grassland amidst suburban/urban development and wooded areas.

Photo: Google Earth, 2014.
B. WILDLIFE

The Croton grassland provides habitat for a range of wildlife, including mammals, butterflies, and many types of birds. It is especially suited, however, to meeting the needs of grassland nesting birds, an obligate species type facing precipitous population declines. Croton’s suitability is due to several factors. The site is large, has a circular shape with significant interior habitat relative to edge habitat, and, due to being a capped landfill, is programmed to remain in herbaceous, non-woody growth.

Both obligate grassland birds, which use grasslands for their entire life cycle, and associated grassland birds, which use grasslands for part of their life cycle, occur at Croton Point. Understanding which species occur and when is necessary to determine which species to manage for and when to manage for them. Target species are identified in Section V.

Table 1 lists obligate grassland species and Table 2 lists associated grassland species occurring at Croton Point based on data from eBird, an online site for reporting bird observations. Confirmed nesters as well as incidental vagrant species or chance occurrences are as noted. The tables below do not reflect abundance, density, frequency of occurrence, or population ecology (source/sink).

**Table 1: obligate grassland birds occurring at Croton Point according to 2010-2015 eBird listings.**

B = breeding (April–Aug 15) · M = migration (March–May, Aug. 15–Nov.) · W = Wintering (Nov.–Feb.)

<table>
<thead>
<tr>
<th>Obligate Grassland Birds Observed 2010-2015 (from eBird)</th>
<th>Year/Season Observed</th>
<th>Conservation Listing – NY</th>
<th>Breeding Bird Survey</th>
<th>Partners in Flight Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dickcissel <em>Dendroica pensylvanica</em></td>
<td>2011: M³</td>
<td></td>
<td>Rarely breeds in NY</td>
<td>Watch List</td>
</tr>
<tr>
<td>Golden Eagle <em>Aquila chrysaetos</em></td>
<td>2015: M³ 2012: M³</td>
<td>Endangered</td>
<td>No breeding pairs in NY</td>
<td></td>
</tr>
</tbody>
</table>

*Fig. 8: Coyote in the Croton grassland, 2007. Photo by Spencer Grant.*

|---|---|---|---|---|
| **Grasshopper Sparrow**  
*Ammodramus savannarum* | 2015: B  
2014: B*  
2013: B | Special concern | Declining | |
| **Horned Lark**  
*Eremophila alpestris* | 2013-15: M, W  
2012: M  
2011: W  
2010: M, W | Special concern | Declining | |
| **Killdeer**  
*Charadrius vociferus* | 2014-15: B, M  
2012-13: B, M, W  
2011: B, M  
2010: B, M, W | | | Declining |
| **Northern Harrier**  
*Circus cyaneus* | 2015: W, M  
2013-14: B, M, W  
2011: B, M, W  
2010: M, W | Threatened | | Slight increase in Hudson Valley in last 20 years |
| **Savannah Sparrow**  
*Passerculus sandwichensis* | 2015: B, M, W  
2014: B*, M, W  
2013: B, M, W  
2012: B, M  
2011: B, M, W  
2010: B, M, W | | Declining statewide but stable in Hudson Valley | Regional concern |
| **Short-eared Owl**  
*Asio flammeus* | 2014: W  
2013: W | Endangered | | Deficient data |
| **Vesper Sparrow**  
*Pooecetes graminius* | 2014: B, M  
2013: B, M  
2012: B  
2011: M, W  
2010: M | Special concern | | Declining |
| **Upland Sandpiper**  
*Bartramia longicauda* | 2015: B*  
2011: M* | | | Declining |

TOTAL obligates: 12

1 Presumed incidental vagrant (Askins, personal communication, 2015).
2 One confirmed nest (Swaim, email, 2015).
3 Presumed incidental vagrant (Askins, personal communication, 2015).
4 Three confirmed nests (Swaim email).
5 Presumed nesting but not confirmed (Swaim email).
6 Presumed incidental vagrant (Askins, personal communication, 2015).
Table 2 lists grassland associated and generalist species of conservation concern occurring at Croton Point. Species without a concern rating listed are of conservation concern with the U.S. Fish and Wildlife Service and/or the New York State Comprehensive Wildlife Conservation Strategy.

B = breeding (April–Aug 15) · M = migration (March–May, Aug. 15–Nov.) · W = Wintering (Nov.–Feb.)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>American Kestrel <em>Falco sparverius</em></td>
<td>B, M</td>
<td></td>
<td>Declining</td>
<td>Regional concern</td>
</tr>
<tr>
<td>American Woodcock <em>Scolopax minor</em></td>
<td>B (spring display), M</td>
<td></td>
<td>Insufficient data</td>
<td></td>
</tr>
<tr>
<td>Great Horned Owl <em>Bubo virginianus</em></td>
<td>B, M, W</td>
<td></td>
<td>Declining</td>
<td></td>
</tr>
<tr>
<td>Lapland Longspur <em>Calcarius lapponicus</em></td>
<td>M</td>
<td></td>
<td>Does not breed in NY</td>
<td></td>
</tr>
<tr>
<td>Merlin <em>Falco columbarius</em></td>
<td>B, M</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Peregrine Falcon <em>Falco peregrinus</em></td>
<td>B, M, W</td>
<td></td>
<td>Endangered</td>
<td></td>
</tr>
<tr>
<td>Prairie Warbler <em>Dendroica discolor</em></td>
<td>B, M</td>
<td></td>
<td></td>
<td>Watch List</td>
</tr>
<tr>
<td>Red-headed Woodpecker <em>Melanerpes erythrocephalus</em></td>
<td>W</td>
<td></td>
<td>Special concern</td>
<td>Declining</td>
</tr>
<tr>
<td>Red-shouldered Hawk <em>Buteo lineatus</em></td>
<td>B, M, W</td>
<td></td>
<td></td>
<td>Stewardship Species</td>
</tr>
<tr>
<td>Rough-legged Hawk <em>Buteo lagopus</em></td>
<td>M, W</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sharp-shinned Hawk <em>Accipiter striatus</em></td>
<td>B, M, W</td>
<td></td>
<td>Special concern</td>
<td></td>
</tr>
<tr>
<td>Snow Bunting <em>Plectrophenax nivalis</em></td>
<td>W</td>
<td></td>
<td>Does not breed in NY</td>
<td>Continental Concern: 10 Of 20</td>
</tr>
</tbody>
</table>

Grassland associated birds: 4
Generalists: 8
TOTAL: 12

Fig. 9: Rough-legged Hawk, Croton grassland, 2014. Courtesy Jeff Seneca.

Fig. 10: American Kestrel in the Croton grassland. Courtesy Jeff Seneca.
C. SOILS

Specifications for existing and proposed vegetation must account for the chemical and physical constraints of existing soils. Capped landfills like Croton frequently suffer from soil degradation, including decreased permeability, lack of structure and texture, diminished soil fauna, and reduced organic material (Ewing, 2002). Fill, even if classified as "clean," is often compacted, resulting in restricted drainage and aeration. Fill also typically lacks beneficial microbes necessary for nutrient cycling and mycorrhizae growth important to many plants.

Capping specifications for the Croton landfill required that topsoil pH to be 5.5 to 7.6, a broad range which many species can tolerate, including many of the most common weeds. Weed species now found on the site may have also arrived in the capping soils either in the soil seed bank or in vegetative fragments capable of rooting.

Soils in the Croton grassland (Fig. 11) are classified by the Natural Resource Conservation Service as predominantly "Udorthents, smoothed" (Ub), well drained soils altered by cutting and filling. A typical Ub profile is moderately acid, gravelly loam in the first four inches, with soils below four inches being slightly acid, very gravelly loam. An area bordering the grassland's easternmost gravel access road is Udorthents, wet substratum (Uc), another disturbed soil type described as moderately well drained, gravelly, and sandy. These are broad classifications, however, and actual characteristics may be highly variable.

Broadscale soil amendments are not recommended at this time due to the implications of site disturbance and expense over such a large area. Management and planting specifications must therefore take into account the physical and chemical characteristics of existing soils.

![Fig. 11: Soil classifications in the Croton grassland.](image-url)
D. EXISTING VEGETATION

If left unmanaged, aggressive problem weeds in the Croton grassland will outcompete remaining native seeded species over time and compromise habitat value overall. Setting management priorities will be key to addressing problem weeds on such a large scale.

There are five major existing vegetation zones (Fig. 12), including extensive weed stands, to non-native cool season grass areas, to patches of native warm season grasses remaining from the original seeding in the mid-to-late 1990s. Hydrology, soil, and solar aspect combined with establishment, management, and disturbance histories have likely been contributing factors in the present-day composition of these five zones. The associated Table 3 (a foldout) establishes management priorities for these major vegetation zones, with the highest quality areas being top priority.

Fig. 12: Major existing vegetation assemblages in the Croton grassland. Area delineations are approximate, based on visual field assessments and aerial photography.
E. AVIAN USE OF EXOTIC HERBACEOUS VEGETATION IN THE CROTON GRASSLAND

Given the significant presence of non-native herbaceous vegetation in the Croton grassland, design and management recommendations must take into account avian use of exotic species, whether for nesting, foraging, cover, or perches.

Use by grassland nesting birds of native grassland vegetation is well established, and native grassland habitat restoration efforts prioritize establishment of native grasses and forbs. Some research, however suggests that non-native cool season grasses do not always negatively impact grassland birds. Several studies have shown higher abundance of certain grassland birds in non-native cool season rhizomatous grass dominated grasslands than in conservation plantings of native warm season grasses (Madden et al., 2000, McCoy et al, 2001, Davis et al., 2013). This may have more to do with habitat structure than plant origin, however. Some exotic cool season grasses may be structurally similar enough to the original habitat associations of certain birds that these species have adopted introduced vegetation as breeding habitat. Restoration actions must therefore balance the habitat benefits of some non-native species with the potential for these exotic species to spread and compromise habitat quality overall.

In comparison to research into avian use of cool season grasses, relatively little is known about how target grassland species use problem weedy forbs. Mugwort (Artemisia vulgaris) represents one of the most pernicious of the weedy forbs in the Croton grassland. Field assessments and aerial photographs suggest it may cover approximately 45 acres of the site, possibly more. As evident in Fig. 13, Savannah Sparrows do occur amidst Mugwort, but they are likely using it as secondary habitat or stopovers near more prime habitat (Hinickle, personal communication). Of the target species for the Croton grassland, Savannah Sparrows are also the least selective about nesting habitat (Hinickle, personal communication).

Leafy Spurge (Euphorbia esula) is also found in throughout the Croton grassland. Populations declines in native grassland bird species have been documented at sites in the Great Plains region with moderate to high densities of Leafy Spurge (Nowierski and Pemberton, 2002).

Given that at least one target bird species may use Mugwort even as secondary habitat, management recommendations outlined in this manual take a conservative approach. To the extent possible, recommendations are strategically timed to avoid disturbances during the critical breeding period and to minimize impacts during migration and overwintering. That noted, in the efforts to control and eradicate Mugwort, decisions will sometimes need to be made to forgo providing undisturbed habitat in favor of restoring more suitable habitat conditions and otherwise preventing Mugwort from deteriorating existing areas further. In these instances, the long-term benefits of restoring quality habitat are deemed preferable to short-term habitat loss. Restoration efforts can also be phased in by area rather than being conducted all at once such that some combination of habitat types always remain during the restoration process.

Fig. 17: Savannah Sparrow perched on Mugwort in the Croton grassland, Nov. 2014. Courtesy Billy Liljeroos.
F. INSECTS

Native insects serve as a key food source for the young of terrestrial birds, including target bird species for the Croton grassland. Local naturalists (Boudon, Gambino) have documented insect populations at Croton Point, but interpreting these findings is beyond the scope of this project. It is generally acknowledged, however, that ensuring the presence of native plants helps to attract native insects that native bird species depend on (Tallamy, 2009).

The results of insects documented at Croton Point are reproduced below. Further research into the association between insect populations and the presence of target bird species could be conducted. Regardless, ensuring the presence of native plant species, on which native insects feed, will help ensure the presence of target bird species.

Fig. 18: Biodiversity samples of bees, wasps, ants, and sawflies from Croton Point Park, 1999. Courtesy Parker Gambino.

Cursory morning examinations of Croton Point Park restrooms by Jim Bourdon during the summer and early fall of 2014 yielded approximately 200 species of moths (largely deemed common) and 30 crane fly taxa.
G. METHANE EMISSIONS

No research was found indicating that methane emissions impact desired vegetation, target bird species, or insects that might be found at Croton Point.

As a former landfill, the Croton grassland emits methane. No published studies were found attesting to effects of methane emissions or other landfill gasses on native grassland vegetation, target bird species, or insect populations. A number of scientists were also consulted, and they did not suspect significant impact. A study of a landfill in eastern Pennsylvania was located showing that Turkey Vultures used thermals above flared methane vents to gain altitude (Mandel and Bildstein, 2007).

H. SITE ANALYSIS SUMMARY

Over the last 100 years, the area now occupied by the Croton grassland has seen major environmental change. Once a large tidal wetland, it was used intensively as a landfill for much of last half of the twentieth century. When the landfill was capped, a visionary plan seeded the area as habitat for grassland birds. Unfortunately, aggressive weeds now threaten the site’s ability to serve as quality habitat and potentially compromise whether the site can fulfill the original restorative vision.

A site-specific, adaptive management strategy combined with realistic target species, effective monitoring, and user outreach could, however, reverse this trend. If successfully implemented, this wholistic, multi-faceted approach could ensure that the Croton grassland serves as regionally unique grassland habitat and provides a productive and viable home for grassland bird species of critical conservation concern long into the future.
V. TARGET BIRD SPECIES & THEIR SEASONAL DISTRIBUTION

Since obligate and associated grassland birds have species-specific habitat requirements, identifying reasonable target species based on birds that already occur at Croton Point or could occur based on regional populations helps ensure resources are allocated appropriately.

Tables 4 and 5 below identify high and low priority target species, with obligate and associate grassland birds being the highest priority and generalist species being lower priority. Dickcissel, Golden Eagle, and Upland Sandpiper are not included as target species for while they have been sited at Croton Point, they are presumed incidental vagrants. Unless noted otherwise, the habitat characteristics listed in Tables 4 and 5 pertain to when target species would be managed for at Croton Point (i.e., breeding habitat characteristics are not provided if the species is unlikely to breed in the Croton grassland). The conservation and breeding status of each species is as noted.

Table 4: High priority target species for the Croton grassland.

<table>
<thead>
<tr>
<th>High Priority Target Species</th>
<th>Oblige When to Manage</th>
<th>Habitat Characteristics</th>
</tr>
</thead>
</table>
| **American Woodcock**  
* Scolopax minor  
BREEDING BIRD STATUS (NY): Insufficient data | Spring display (March-June) | Male spring courting display requires open areas, typically low grass. Roosts at night in patchy, 3-5 acre open areas. Ground nests in open deciduous forests and shrubby fields. |
| **Bobolink**  
* Dolichonyx oryzivorus  
BREEDING BIRD STATUS (NY): Declining | B M W (limited) | Grasslands, meadows, and fallow fields, typically 1-6 acres, with mix of grasses and scattered forbs, 8-12” in height. Associated with lowlands for nesting. Uses shrubs, posts, and small trees for singing perches. |
| **Eastern Meadowlark**  
* Sturnella magna  
BREEDING STATUS (NY): Significant reduction in the Hudson Valley | B M W | Sparse to dense grass-dominated cover, moderately tall grasslands, at least 6 acres, 15-20 preferred. Requires elevated song perches (shrubs, posts, tall forbs, etc.). Forages on the ground. Nests in dense herbaceous growth, sometimes building roofs and tunnel entrances from woven grasses. Female will abandon nest if disturbed. |
| **Grasshopper Sparrow**  
* Ammodramus savannarum  
BREEDING STATUS (NY): Declining  
CONSERVATION STATUS (NY): Special Concern | B M | Grasslands 30+ acres featuring clumped 4-12” vegetation interspersed with patches of bare ground, small amounts of litter, and sparse tall forbs for song perches. Forages exclusively on exposed bare ground. Nests in loose colonies with an individual territory of 2-4 acres. Nest cup usually well concealed with a dome made of overhanging grasses and a side entrance. |
| **Horned Lark**  
* Eremophila alpestris  
BREEDING STATUS (NY): Declining  
CONSERVATION STATUS (NY): Special Concern | M W | Overwinters but rarely breeds in the Hudson Valley, forming large nomadic flocks. Prefers open habitats, including croplands, pastures, airfields, and roadsides. Avoids wooded areas. Feeds mainly on the ground amidst short vegetation. Usually nests on bare ground. |
| **Kildeer**  
* Charadrius vociferus  
BREEDING STATUS (NY): Declining | B M W | Uses very short grasslands, even lawns and golf courses, for foraging. Nests on bare ground, often on slight rises using light colored sticks, stones, and trash. May make multiple nest scrapes to confuse predators. |
### High Priority Target Species

<table>
<thead>
<tr>
<th>Species</th>
<th>Obligate</th>
<th>When to Manage</th>
<th>Habitat Characteristics</th>
</tr>
</thead>
</table>
| **Northern Harrier**  
*Circus cyaneus*  
BREEDING STATUS (NY): Slight increase in Hudson Valley in last 20 years  
CONSERVATION STATUS (NY): Threatened | ✓        | B M W          | Breeds and hunts in open wet areas dominated by low, thick vegetation, often grasses, sedges, reeds, and cattails. Flies low over the ground when hunting. Perches on low posts or trees. Winters in pastures, grasslands, oldfields, and open floodplains. Ground roosts in groups in the winter, sometimes with Short-eared Owls. |
| **Savannah Sparrow**  
*Passerculus sandwichensis*  
| **Short-eared Owl**  
*Asio flammeus*  
BREEDING STATUS (NY): Deficient data  
CONSERVATION STATUS (NY): Threatened | ✓        | B M W          | Large grasslands, pastures, and marshlands where small mammals are abundant. Ground nests in a scrape lined with grasses. New York represents the southern edge of the breeding range. Hunts mainly at dawn and dusk in winter, flying low over the ground. |
| **Snow Bunting**  
*Plectrophenax nivalis*  
| **Vesper Sparrow**  
*Pooecetes gramininus*  
BREEDING STATUS (NY): Declining  
CONSERVATION STATUS (NY): Special Concern | ✓        | B M W          | Dry, open areas with short, sparse, patchy growth (1-8”), low grass:forb ratio, and limited shrubs and tall forbs. Prefers breeding areas 35 acres+. Nests are shallow cups of woven grasses. Ground forager. Perches and sings on fence posts, shrubs, and small trees. |

Total obligates: 9  
Total associates: 2

### Table 5: Lower priority (generalist) target species for the Croton grassland.

B = breeding (April–Aug. 15)  ·  M = migration (March–May, Aug. 15–Nov.)  ·  W = wintering (Nov.–Feb.)

<table>
<thead>
<tr>
<th>Lower Priority Target Species</th>
<th>When to Manage</th>
<th>Habitat Characteristics</th>
</tr>
</thead>
</table>
| **American Kestrel**<sup>1</sup>  
*Falco sparverius*  
BREEDING STATUS (NY): Declining | B  
M | Meadows, pastures, old fields, open parkland, and agricultural fields near woodlands, trees, snags, and perch spots. Nests in woodpecker and natural cavities and nest boxes. Prefers nest surrounded by perch spots and large open areas in short growth.  
| **Merlin**  
*Falco columbarius*  
BREEDING STATUS (NY): Increasing, possibly due to urban nesting | B  
M | Breeds in open and semi-open areas using nests built by other birds in trees. Uses grasslands, open forests, and coastal areas during migration.  
Source: [http://www.allaboutbirds.org/guide/Merlin/lifehistory](http://www.allaboutbirds.org/guide/Merlin/lifehistory) |
| **Peregrine Falcon**  
*Falco peregrinus*  
CONSERVATION STATUS (NY): Endangered  
BREEDING STATUS (NY): Increasing | B  
M  
W | Uses open habitats in migration and winter, including mudflats, coastlines, and grasslands.  
Source: [http://www.allaboutbirds.org/guide/peregrine_falcon/lifehistory](http://www.allaboutbirds.org/guide/peregrine_falcon/lifehistory) |
| **Red-shouldered Hawk**  
*Buteo lineatus*  
CONSERVATION STATUS (NY): Threatened  
BREEDING STATUS (NY): No significant trend, sparse data | B  
M  
W | Lowland woodland raptor but can be found in open areas. Nests in trees.  
| **Rough-legged Hawk**  
*Buteo lagopus*  
BREEDING STATUS (NY): Does not breed in New York | M  
W | Winters in grasslands and open cultivated areas. Breeds in the Arctic.  

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<sup>1</sup> American Kestrel nestboxes will be installed at the Croton grassland perimeter in time for the 2015 breeding season as part of an Eagle Scout project in collaboration with Saw Mill River Audubon and Westchester County Department of Parks, Recreation, and Conservation. Due to these efforts, it has been recommended that Great Horned Owls, which prey upon Kestrels as well as Northern Harriers, not be included as a target species at this time.

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*Fig. 20: Snow Bunting in the Croton grassland, Nov. 2014. Courtesy Karen Fung.*
Table 6 lists the seasonal distribution of both high and low priority target species, showing that the spring and late summer/fall migration period represent the times when the most target species are being managed for.

**Table 6: Seasonal distribution of high and lower priority target species.**

<table>
<thead>
<tr>
<th>Breeding Season</th>
<th>Migration Season</th>
<th>Overwintering</th>
</tr>
</thead>
<tbody>
<tr>
<td>April 23–Aug. 15 (unless noted otherwise)</td>
<td>March–May Aug. 15–November</td>
<td>December–February</td>
</tr>
<tr>
<td>American Woodcock (Mar-June)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bobolink</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Eastern Meadowlark</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grasshopper Sparrow</td>
<td>Horned Lark</td>
<td></td>
</tr>
<tr>
<td>Killdeer</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Northern Harrier</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Savannah Sparrow</td>
<td>Snow Bunting</td>
<td>Short-eared Owl</td>
</tr>
<tr>
<td>Vesper Sparrow</td>
<td></td>
<td></td>
</tr>
<tr>
<td>American Kestrel</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Merlin</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Peregrine Falcon</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Red-shouldered Hawk</td>
<td>Rough-legged Hawk</td>
<td></td>
</tr>
<tr>
<td><strong>High priority species - 8</strong></td>
<td><strong>High priority species - 9</strong></td>
<td><strong>High priority species - 8</strong></td>
</tr>
<tr>
<td><strong>Lower priority species - 4</strong></td>
<td><strong>Lower priority species - 5</strong></td>
<td><strong>Lower priority species - 3</strong></td>
</tr>
<tr>
<td><strong>Breeding Season Total - 12</strong></td>
<td><strong>Migration Season Total - 14</strong></td>
<td><strong>Wintering Season Total - 11</strong></td>
</tr>
</tbody>
</table>

*Fig. 21: Northern Harrier in the Croton grassland. Courtesy Jeff Seneca.*
VI. DESIGN SPECIFICATIONS

A. SUMMARY OF RECOMMENDATIONS & OPTIONS

Recommendations for the major existing plant assemblages in the Croton grassland are shown in Fig. 22 below and listed according to priority in Table 7 (see foldout). Alternatives are as noted. Detailed installation and management specifications appear in subsequent sections of this document.

*Fig. 22: Management and restoration priorities according to major plant assemblage type. Area delineations are approximate based on visual field assessments and aerial photography.*
B. APPROACH TO PROPOSED PLANTINGS

Vegetative Structure
A grassland’s suitability as habitat for grassland nesting birds is affected by a range of factors, from adjacent land uses to the site’s size, openness, and amount of edge-to-interior habitat. Vegetation height-density also plays a role. For instance, Killdeer and Vesper Sparrows prefer low, sparse cover while Eastern Meadowlarks are associated with taller, denser growth. The ratio of grasses to forbs (broad-leaved herbaceous plants) may contribute to bird community differences as well.

For restored and constructed grasslands like Croton, much still remains to be learned about appropriate plant compositions and planting densities. Results of this research could help ensure grassland restorations provide vegetative compositions that adequately support viable populations of target species.

Mosaic of Designed Habitats
A diverse vegetative mosaic tends to maximize avian diversity. Seed mixes and live plant combinations for the Croton grassland have therefore been developed to provide varied vegetation height-density and a range of grass-to-forb ratios. Existing plant assemblages and other site conditions are also taken into account. Specifications for proposed plantings accord with the following height and grass-to-forb categories (from Sample and Mossman):

<table>
<thead>
<tr>
<th>Height</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Shortgrass:</td>
<td>&lt;1’</td>
</tr>
<tr>
<td>Mid-height:</td>
<td>1’ – 3’</td>
</tr>
<tr>
<td>Tallgrass:</td>
<td>3’ – 7’</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Grass-to-Forb Ratio</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>High:</td>
<td>2½:1</td>
</tr>
<tr>
<td>Medium:</td>
<td>1:1 to 2½: 1</td>
</tr>
<tr>
<td>Low:</td>
<td>&lt; 1:1</td>
</tr>
</tbody>
</table>

The grass-to-forb ratio in the specified seed mixes reflects the percentage grass seed to percentage forb seed (as opposed to percentage grass to forb species). Sedges and rushes, due to their grasslike nature, are grouped with grass species.

Critical Role of Monitoring and Adaptive Management
Designing and managing for a particular habitat type is no guarantee that target species will occur within that habitat type. Monitoring avian responses to restoration efforts and then adapting management strategies as necessary will be an important part of the ongoing effort to meet habitat needs of high and lower priority target bird species.

Herbicide Resistant Seed Mixes
Species in all proposed seed mixes are resistant to the selective herbicide used for targeting Mugwort, an especially pernicious weed occupying nearly half of the Croton grassland. Seeding can therefore occur even as efforts to control Mugwort are ongoing. Once Mugwort is adequately under control and requires only sporadic spot treatment, non-herbicide resistant species (namely those in the Aster and legume families) can be installed in live form in small, concentrated patches. These species can then seed themselves around as site conditions and natural factors allow.
Emphasis on Native Plants with High Forage Value for Target Bird Species

Seed mixes and live plant combinations consist of native, regionally endemic species, particularly those with high forage value and heavy seed rain for target bird species. By being native species, the grasses and forbs in the specified mixes also help attract native insects that then serve as a critical protein source for adult birds to feed rapidly growing chicks. Non-native clovers, which are sometimes included in grassland restoration mixes for bird forage, are not used as these introduced legumes often outcompete seeded native grasses, ultimately compromising overall habitat value. Although native legumes cannot be included in seed mixes as they are not resistant to the herbicide used for targeting Mugwort, legumes can be installed as live plants once Mugwort is adequately controlled.

Species That Do Not Come Well from Seed or Are Too Aggressive from Seed

Seed mixes do not include species which do not come well from stored seed or establish too thickly and aggressively when planted from seed. Such species are included in live plant combinations, however. The more aggressive species will be less dominant if installed amidst established competitive vegetation.

Seed Mixes Calibrated for One Acre

Seed mixes (SM) are calibrated for one acre. Once a square footage or acreage is determined for a target seeding location, seed quantities can be adjusted accordingly on a one-acre basis. LWLA can assist with mix calibration if necessary.

Emphasis on Straight Species Rather than Cultivars

All live plant specifications feature straight species rather than cultivated varieties. Although sometimes more commonly available in the trade than straight species, cultivars can have reduced fitness in response to local environmental conditions as a result of their adaptations to and artificial selection within the nursery environment. Use of cultivars may be appropriate in some garden settings, but they should generally be avoided in restoration plantings. The primary concern is that cultivated varieties will transfer traits to wild populations (cultivated-wild hybrids often exhibit enhanced vigor).

Substitutions Available Upon Request

Contact LWLA for assistance in making appropriate substitutions for species that cannot be sourced either in seed form or as live plants.

Suppliers and Contractors

For lists of native seed suppliers, grassland installation contractors, and weed control contractors, see the References and Resources section in the Appendix.
C. PROPOSED PLANTING SCENARIOS

Seed mixes and live plant combinations have been developed with the intent of creating a diverse mosaic of grassland habitat types that meet the needs of Croton's target bird species. How this mosaic plays out depends on how quickly problem weed areas are converted and whether cool season grass-dominated areas, which constitute nearly half of the Croton grassland, are maintained as is, are converted to warm season grass communities over time, or are aggressively eradicated and replanted. The Westchester County Department of Parks, Recreation, and Conservation has indicated that for the time being cool season grass areas will be maintained as is, with weed control conducted as recommended.

To provide a better understanding of what possible matrixes could look like and how they would meet the needs of Croton's target grassland birds, two possible scenarios are shown here: one being fairly conservative in its approach and the second more aggressive.

The first, Fig. 23, shows a projected habitat matrix assuming cool season grass areas remain as is, with weed control as necessary. Problem weed areas are replaced with specified seed mixes and, if desired, enhanced with native plants. Table 8 (a foldout) details the seed mixes and live plant combinations used, the resulting habitat characteristics, and the target bird species served.

The second scenario, shown in Fig. 24, projects a possible scenario in which cool season grass areas are replaced. This scenario features a more extensive matrix of short, mid-height, and tall grassland types than the scenario shown in Fig. 23. The corresponding Table 9 (a foldout) details the seed mixes and live plant combinations used, along with a summary of the established habitats and target bird species served.

Both scenarios maximize site factors. South and west-facing slopes (typically hotter and drier) are seeded with short upland plant communities while tall lowland species are established in lower, wetter areas. Stone-lined swales act as buffers between habitat types where possible. The more aggressive second restoration scenario includes live plants installed near monitoring wells, allowing for easy installation access. As the planted species disperse and proliferate from these fixed reference points, their dispersal pattern will be clearly evident and allow for a more refined understanding of habitat conditions. Fig. 24 also shows live plants installed in the visually prominent hillside near the Park's entrance.

Some alterations upon these two different restoration scenarios are possible based on site conditions and phasing. LWLA can delineate additional scenarios upon request.
Fig. 23: The projected habitat matrix shown below assumes problem weed areas are replaced and cool season grass areas remain as is, with weed control in these areas as necessary. Vegetation zone delineations are approximate based on visual field assessments and aerial photography.

1. Tallgrass lowland zone (formerly Phragmites) reseeded with SM3 and/or SM4. Enhance with live plant combinations LP4 and LP5 if desired.

2. Midheight grassland zone (formerly mixed mugwort stand reseeded with SM2). Enhance with live plant combinations LP4 and LP5 if desired.

3. Tallgrass lowland zone (formerly monotypic mugwort zone reseeded with SM3 and/or SM4). Enhance with live plant combinations LP4 and LP5 if desired.

4. Cool season grass areas maintained as is with weed control to eradicate problem forbs.

5. Existing warm season grass areas maintained as is with weed control as necessary. Enhance with live plant combinations LP1, LP2, and LP3 if desired.
Fig. 24: The projected habitat matrix shown below eradicates weed-dominated areas and replaces existing cool season grass areas. This matrix features a more extensive and diverse arrangement of short, mid-height, and tall grassland types than the scenario shown in Fig. 23. Vegetation zone delineations are approximate based on visual field assessments and aerial photography.

1. Short upland native grasses and forbs (formerly cool season grasses) reseeded with SM1.
2. Midheight existing native warm season grasses.
3. Midheight native grasses and forbs (formerly mixed Mugwort) reseeded with SM2. Shown with live plant combinations (LP2, LP3) installed around monitoring wells.
4. Midheight/tall native grasses and forbs (formerly cool season grasses) reseeded with SM2 and SM3.
5. Tall native grasses and forbs (formerly cool season grasses and monotypic Mugwort stands) reseeded with SM3 and SM4. Shown with live plant combinations (LP3, LP4) installed around monitoring wells and along the slope facing the Park’s entrance.
D. PATH LAYOUT SPECIFICATIONS

Prior mowing patterns for monitoring well access paths measure approximately 14,550 linear feet, not including mown strips along rock-lined swales or the central gravel road. By cutting through larger grassland patches, this mowing pattern also increases edge effect associated with higher predation rates and nest parasitism. The larger mower size further reduces habitat quality.

*Fig. 25: Previous mowing pattern for monitoring well access paths in the Croton grassland.*

Fig. 26 proposes an alternative mowing pattern that reduces habitat fragmentation as well as the overall footprint for routine mowing by approximately 50% (to 7,260 linear feet), not including mown strips along swales or the central gravel road. This proposed pattern aligns with a pattern previously proposed by the Department of Parks, Recreation and Conservation with two exceptions: the Department’s proposed route (shown in blue in Fig. 26 below) in the southeast corner could be shortened to the alignment shown in red. Several path alignments can also be used as partial buffers between cool season and warm season grass management zones.
In a large area like the Croton grassland, the site’s over 100 monitoring wells could serve as useful reference markers for field personnel and others engaged in vegetation and bird monitoring. For instance, "address Mugwort around Well ___" or "Bobolink nest observed between Wells ___ and ___." If the existing labeling system does not prove sufficient toward this end, an alternative alpha-numeric labeling system is shown in Fig. 26. In this concept, each band of the landfill mound as separated by one of the six stone-lined swales is given a letter moving from west to east; the wells are then numbered consecutively within each band, moving from north to south, west to east. Many users may find this grid-like labeling system assists with self-orientation in the field over a non-gridded system. Using a vertical mount for labeling the wells could assist with visibility and provide a perch for birds (many species already use the monitoring well poles).

Fig. 26: Proposed access path mowing pattern and an alpha-numeric labeling system for monitoring wells and rock-lined swales.
E. SEED MIX SPECIFICATIONS

As noted previously, seed mixes are calibrated for one acre. Once a square footage or acreage is determined for a target seeding location, seed quantities can be adjusted accordingly (LWLA can assist with quantification if necessary.)

SM1 – Shortgrass Upland Mix

**Target Locations:** Dry, well-drained areas, particularly the crowns and midslopes of south and west facing slopes

**Grass-Forb Ratio:** 2⅓:1 (high)

**Height Type:** Short (<1’). Flower spikes on some species exceed 1’.

**Target Bird Species:** Grasshopper Sparrow
Horned Lark
Killdeer
Northern Harrier
Vesper Sparrow

**Notes:** Clopyralid resistant

<table>
<thead>
<tr>
<th>Botanical Name</th>
<th>Common Name</th>
<th>Qty</th>
<th>Substitutions/Comments</th>
<th>Ht (ft/in)</th>
<th>Season/Color</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Grasses &amp; Rushes</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Agrostis hyalina</td>
<td>Hair Grass</td>
<td>1.36 oz</td>
<td></td>
<td>1-2’</td>
<td>Cool</td>
</tr>
<tr>
<td>Bouteloua gracilis</td>
<td>Blue Grama Grass</td>
<td>45.74 oz</td>
<td></td>
<td>1-2’</td>
<td>Warm</td>
</tr>
<tr>
<td>Danthonia spicata</td>
<td>Poverty Grass</td>
<td>36.59 oz</td>
<td></td>
<td>6”</td>
<td>Cool</td>
</tr>
<tr>
<td>Deschampsia caespitosa</td>
<td>Tufted Hairgrass</td>
<td>3.24 oz</td>
<td></td>
<td>6”</td>
<td>Cool</td>
</tr>
<tr>
<td>Eragrostis spectabilis</td>
<td>Purple Lovegrass</td>
<td>1.96 oz</td>
<td></td>
<td>1-2’</td>
<td>Warm</td>
</tr>
<tr>
<td>Hordeum jubatum</td>
<td>Foxtail Barley</td>
<td>5.68 oz</td>
<td></td>
<td>1-2’</td>
<td>Cool</td>
</tr>
<tr>
<td>Juncus tenuis</td>
<td>Path Rush</td>
<td>0.30 oz</td>
<td></td>
<td>1”</td>
<td>Cool</td>
</tr>
<tr>
<td>Sporobolus cryptandrus</td>
<td>Sand Dropseed</td>
<td>4.57 oz</td>
<td></td>
<td>2-3”</td>
<td>Warm</td>
</tr>
<tr>
<td><strong>Forbs (Wildflowers)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Allium cernuum</td>
<td>Nodding Pink Onion</td>
<td>27.51 oz</td>
<td></td>
<td>1-2’</td>
<td>Summer</td>
</tr>
<tr>
<td>Asclepias tuberosa</td>
<td>Butterfly Weed</td>
<td>6.68 oz</td>
<td></td>
<td>1-3’</td>
<td>Summer</td>
</tr>
<tr>
<td>Monarda punctata</td>
<td>Horsemint</td>
<td>8.71 oz</td>
<td></td>
<td>1-2’</td>
<td>Summer</td>
</tr>
<tr>
<td>Oenothera parennis</td>
<td>Sundrops</td>
<td>2.61 oz</td>
<td></td>
<td>1”</td>
<td>Summer</td>
</tr>
<tr>
<td>Rivina humilis</td>
<td>Wild Petunia</td>
<td>10.65 oz</td>
<td></td>
<td>1-2”</td>
<td>Summer</td>
</tr>
<tr>
<td>Salvia lyrata</td>
<td>Lyre Leaved Sage</td>
<td>8.11 oz</td>
<td></td>
<td>1”</td>
<td>Summer</td>
</tr>
<tr>
<td>Siene virginica</td>
<td>Fire Pink</td>
<td>7.26 oz</td>
<td></td>
<td>6-8”</td>
<td>Summer</td>
</tr>
<tr>
<td>Sisymbrium angustifolium</td>
<td>Stout Blue-eyed Grass</td>
<td>3.48 oz</td>
<td></td>
<td>3-4”</td>
<td>Summer</td>
</tr>
<tr>
<td>Viola cornuta</td>
<td>Johnny Jump Up</td>
<td>31.36 oz</td>
<td></td>
<td>4-8”</td>
<td>All</td>
</tr>
</tbody>
</table>

**Nurse Crop Options**

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>Seeding</th>
</tr>
</thead>
<tbody>
<tr>
<td>Avena sativa</td>
<td>Oats</td>
<td>Spring</td>
</tr>
<tr>
<td>Hordeum vulgare</td>
<td>Barley</td>
<td>Summer</td>
</tr>
<tr>
<td>Lolium multiflorum</td>
<td>Annual Ryegrass</td>
<td>Summer, Fall</td>
</tr>
<tr>
<td>Secale cereale</td>
<td>Rye</td>
<td>Summer, Fall</td>
</tr>
<tr>
<td>Triticeum</td>
<td>Winter Wheat</td>
<td>Fall</td>
</tr>
</tbody>
</table>

**Notes:**
1. USE THE FOLLOWING ECOTYPES IF AVAILABLE:
   NORTH EAST
   PA, NY, NJ, CT
2. CLOPYRALID RESISTANT
3. CONTACT LWLA TO QUANTIFY MIX FOR AREAS LARGER OR SMALLER THAN ONE ACRE.
4. HIGH GRASS TO FORB RATIO
SM2 – Midheight Mix

Target Locations: Dry to moist areas

Grass-Forb Ratio: 1½:1 (medium)

Height Type: Midheight (2–3’)

Target Bird Species: Bobolink
Eastern Meadowlark
Grasshopper Sparrow
Northern Harrier
Savannah Sparrow

Notes: Clopyralid resistant

<table>
<thead>
<tr>
<th>Botanical Name</th>
<th>Common Name</th>
<th>Qty</th>
<th>Seeding Notes</th>
<th>Substitutions/Comments</th>
<th>Ht (ft/in)</th>
<th>Season/Color</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agropyron smithii</td>
<td>Hair Grass</td>
<td>1.16 oz</td>
<td></td>
<td></td>
<td>1-2'</td>
<td>Cool</td>
</tr>
<tr>
<td>Andropogon virgicus</td>
<td>Needlegrass</td>
<td>13.84 oz</td>
<td></td>
<td></td>
<td>2-4'</td>
<td>Warm</td>
</tr>
<tr>
<td>Bouteloua curtipendula</td>
<td>Sideoats Grama</td>
<td>174.24 oz</td>
<td></td>
<td></td>
<td>1-3'</td>
<td>Warm</td>
</tr>
<tr>
<td>Carex vulpinoidea</td>
<td>Fox Sedge</td>
<td>2.51 oz</td>
<td></td>
<td></td>
<td>1-3'</td>
<td>Cool</td>
</tr>
<tr>
<td>Elymus villosus</td>
<td>Silky Wild Rye</td>
<td>9.50 oz</td>
<td></td>
<td></td>
<td>1-3'</td>
<td>Cool</td>
</tr>
<tr>
<td>Paspalum amarum</td>
<td>Atlantic Coastal Panic Grass</td>
<td>4.07 oz</td>
<td></td>
<td></td>
<td>5-6'</td>
<td>Warm</td>
</tr>
<tr>
<td>Schizachyrium scoparium</td>
<td>Little Blue Stem</td>
<td>156.32 oz</td>
<td></td>
<td></td>
<td>2-3</td>
<td>Warm</td>
</tr>
<tr>
<td>Tridens flavus</td>
<td>Purpletop</td>
<td>9.24 oz</td>
<td></td>
<td></td>
<td>2-5</td>
<td>Warm</td>
</tr>
</tbody>
</table>

Forbs (Wildflowers)

<table>
<thead>
<tr>
<th>Botanical Name</th>
<th>Common Name</th>
<th>Qty</th>
<th>Seeding Notes</th>
<th>Substitutions/Comments</th>
<th>Ht (ft/in)</th>
<th>Season/Color</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bupleurum irsota</td>
<td>Hairy Wood Mint</td>
<td>0.73 oz</td>
<td></td>
<td></td>
<td>2-3</td>
<td>Summer</td>
</tr>
<tr>
<td>Lobelia spathulata</td>
<td>Great Blue Lobelia</td>
<td>0.70 oz</td>
<td></td>
<td></td>
<td>1-4</td>
<td>Fall</td>
</tr>
<tr>
<td>Mendonina punctata</td>
<td>Horsemint</td>
<td>7.74 oz</td>
<td></td>
<td></td>
<td>1-2'</td>
<td>Summer</td>
</tr>
<tr>
<td>Oenothera frutiosa</td>
<td>Sundrops</td>
<td>3.87 oz</td>
<td></td>
<td></td>
<td>1-3'</td>
<td>Spring</td>
</tr>
<tr>
<td>Persicaria digitata</td>
<td>White Beardtongue</td>
<td>5.56 oz</td>
<td></td>
<td></td>
<td>2-4'</td>
<td>Spring</td>
</tr>
<tr>
<td>Perilla frutescens</td>
<td>Hairy Beardtongue</td>
<td>1.09 oz</td>
<td></td>
<td></td>
<td>1-2'</td>
<td>Spring</td>
</tr>
<tr>
<td>Dianthus utilisimum</td>
<td>Sauer Mountain Mint</td>
<td>1.38 oz</td>
<td></td>
<td></td>
<td>2-3'</td>
<td>Summer</td>
</tr>
<tr>
<td>Tradescantia spathulata</td>
<td>Ohio Spiderwort</td>
<td>21.78 oz</td>
<td></td>
<td></td>
<td>2-4'</td>
<td>Spring</td>
</tr>
<tr>
<td>Verbena stricta</td>
<td>Hoary Vervain</td>
<td>3.73 oz</td>
<td></td>
<td></td>
<td>2-4'</td>
<td>Spring</td>
</tr>
</tbody>
</table>

Nurse Crop Options

<table>
<thead>
<tr>
<th>Botanical Name</th>
<th>Common Name</th>
<th>Qty</th>
<th>Seeding Notes</th>
<th>Substitutions/Comments</th>
<th>Ht (ft/in)</th>
<th>Season/Color</th>
</tr>
</thead>
<tbody>
<tr>
<td>Avena sativa</td>
<td>Oats</td>
<td>19.80 lb</td>
<td></td>
<td></td>
<td>Spring seeding</td>
<td></td>
</tr>
<tr>
<td>Hordeum vulgare</td>
<td>Barley</td>
<td>29.70 lb</td>
<td></td>
<td></td>
<td>Summer seeding</td>
<td></td>
</tr>
<tr>
<td>Lolium multiflorum</td>
<td>Annual Ryegrass</td>
<td>4.95 lb</td>
<td></td>
<td></td>
<td>2-4'</td>
<td>Summer, Fall seeding</td>
</tr>
<tr>
<td>Secale cereale</td>
<td>Rye</td>
<td>29.70 lb</td>
<td></td>
<td></td>
<td>2-4'</td>
<td>Summer, Fall seeding</td>
</tr>
<tr>
<td>Triticum</td>
<td>Winter Wheat</td>
<td>9.90 lb</td>
<td></td>
<td></td>
<td>Fall seeding</td>
<td></td>
</tr>
</tbody>
</table>

Notes:
1. Use the following eco types: if available:
   NORTH EAST
   PA, NY, NJ, CT
2. Clopyralid resistant.
3. Contact UWA to quantify mix for areas larger or smaller than one acre.
4. Medium grass-to-forb ratio.
SM3 – Tallgrass Lowland Mix

**Target Locations:** Lowland areas, particularly where Mugwort and/or Phragmites has been eradicated

**Grass-Forb Ratio:** 1½:1 (medium)

**Height Type:** Tall (3–6’)

**Target Bird Species:**
- Bobolink
- Eastern Meadowlark
- Northern Harrier

**Note:** Clopyralid resistant

---

<table>
<thead>
<tr>
<th>Botanical Name</th>
<th>Common Name</th>
<th>Qty</th>
<th>Seeding Notes</th>
<th>Substitutions/Comments</th>
<th>Ht (ft/in)</th>
<th>Season/Color</th>
</tr>
</thead>
<tbody>
<tr>
<td>Andropogon gerardi</td>
<td>Blue Grass</td>
<td>70.57oz</td>
<td></td>
<td></td>
<td>4-6'</td>
<td>Warm</td>
</tr>
<tr>
<td>Carex viridula</td>
<td>Cut Sedge</td>
<td>76.86oz</td>
<td></td>
<td></td>
<td>1-3</td>
<td>Cool</td>
</tr>
<tr>
<td>Elymus canadensis</td>
<td>Canada Wild Rye</td>
<td>135.71oz</td>
<td></td>
<td></td>
<td>3-6</td>
<td>Cool</td>
</tr>
<tr>
<td>Panicum anserinum</td>
<td>Beaked Panic Grass</td>
<td>104.54oz</td>
<td></td>
<td></td>
<td>2-4</td>
<td></td>
</tr>
<tr>
<td>Panicum rigidulum</td>
<td>Red-Top Panic Grass</td>
<td>4.72oz</td>
<td></td>
<td></td>
<td>2-4'</td>
<td>Warm</td>
</tr>
<tr>
<td>Sorghastrum nutans</td>
<td>Indian Grass</td>
<td>39.20oz</td>
<td></td>
<td></td>
<td>5-7</td>
<td>Warm</td>
</tr>
<tr>
<td>Tradescantia flava</td>
<td>Purpletop</td>
<td>33.25oz</td>
<td></td>
<td></td>
<td>2-5</td>
<td>Warm</td>
</tr>
</tbody>
</table>

**Forbs (Wildflowers)**

<table>
<thead>
<tr>
<th>Botanical Name</th>
<th>Common Name</th>
<th>Qty</th>
<th>Seeding Notes</th>
<th>Substitutions/Comments</th>
<th>Ht (ft/in)</th>
<th>Season/Color</th>
</tr>
</thead>
<tbody>
<tr>
<td>Angelica atropurpurea</td>
<td>Angelica</td>
<td>29.04oz</td>
<td></td>
<td></td>
<td>5-10</td>
<td>Spring</td>
</tr>
<tr>
<td>Cacalia striatocolla</td>
<td>Indian Plantain</td>
<td>5.23oz</td>
<td></td>
<td></td>
<td>3-7</td>
<td>Summer</td>
</tr>
<tr>
<td>Lobelia cardinalis</td>
<td>Cardinal Flower</td>
<td>1.25oz</td>
<td></td>
<td></td>
<td>2-5</td>
<td>Fall</td>
</tr>
<tr>
<td>Monarda fistulosa</td>
<td>Wild Bergamot</td>
<td>6.27oz</td>
<td></td>
<td></td>
<td>2-4</td>
<td>Summer</td>
</tr>
<tr>
<td>Pycnanthemum muticum</td>
<td>Big Leaf Mountain Mint</td>
<td>3.14oz</td>
<td></td>
<td></td>
<td>2-3</td>
<td>Summer</td>
</tr>
<tr>
<td>Pycnanthemum nigrescens</td>
<td>Mountain Mint</td>
<td>3.50oz</td>
<td></td>
<td></td>
<td>3-4</td>
<td>Summer</td>
</tr>
<tr>
<td>Thalictrum discipatum</td>
<td>Purple Meadow Rue</td>
<td>11.40oz</td>
<td></td>
<td></td>
<td>5-7</td>
<td>Summer</td>
</tr>
<tr>
<td>Thalictrum peregrinum</td>
<td>Tall Meadow Rue</td>
<td>10.45oz</td>
<td></td>
<td></td>
<td>5-7</td>
<td>Summer</td>
</tr>
</tbody>
</table>

**Nurse Crop Options**

<table>
<thead>
<tr>
<th>Botanical Name</th>
<th>Common Name</th>
<th>Qty</th>
<th>Seeding Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Avena sativa</td>
<td>Oats</td>
<td>19.80 lb</td>
<td>Spring seeding</td>
</tr>
<tr>
<td>Hordeum vulgare</td>
<td>Barley</td>
<td>29.70 lb</td>
<td>Summer seeding</td>
</tr>
<tr>
<td>Lolium multiflorum</td>
<td>Annual Rye Grass</td>
<td>4.95 lb</td>
<td>Summer, Fall seeding</td>
</tr>
<tr>
<td>Secale cereale</td>
<td>Rye</td>
<td>29.70 lb</td>
<td>Summer, Fall seeding</td>
</tr>
<tr>
<td>Tritium</td>
<td>Winter Wheat</td>
<td>9.90 lb</td>
<td>Fall seeding</td>
</tr>
</tbody>
</table>

**Notes:**
1. USE THE FOLLOWING ECOTYPES IF AVAILABLE:
   - NORTH EAST
   - PA, NY, NJ, CT

2. CLOPYRALID RESISTANT
3. CONTACT IAWA TO QUANTIFY MIX FOR AREAS LARGER OR SMALLER THAN ONE ACRE.
4. MEDIUM GRASS-TO-FORBS RATIO
SM4 – Tallgrass Lowland Mix

**Target Locations:** Lowland areas, particularly where Mugwort or Phragmites have been eradicated

**Grass-Forb Ratio:** 100% grasses

**Height Type:** Tall (3–6’)

**Target Bird Species:** Eastern Meadowlark
Northern Harrier

**Notes:** Clopyralid resistant
Grass only

---

### Project: Croton Point Park Grassland

<table>
<thead>
<tr>
<th>Mix Name</th>
<th>SM4 - Tall Grass Lowland, All Grass</th>
</tr>
</thead>
<tbody>
<tr>
<td>Area in acres</td>
<td>1.0</td>
</tr>
<tr>
<td>Area in sq ft</td>
<td>43560</td>
</tr>
<tr>
<td>Total seeds per sq ft</td>
<td>180</td>
</tr>
<tr>
<td>% graminoids</td>
<td>100%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Botanical Name</th>
<th>Common Name</th>
<th>Qty</th>
<th>Seeding Notes</th>
<th>Substitutions/Comments</th>
<th>Ht (ft/in)</th>
<th>Season/Color</th>
</tr>
</thead>
<tbody>
<tr>
<td>Andropogon gerardii</td>
<td>Big Bluestem</td>
<td>78.41 oz</td>
<td></td>
<td></td>
<td>4.8'</td>
<td>Warm</td>
</tr>
<tr>
<td>Calamagrostis canadensis</td>
<td>Bluejoint Reedgrass</td>
<td>0.94 oz</td>
<td></td>
<td></td>
<td>3.5'</td>
<td>Cool</td>
</tr>
<tr>
<td>Carex jubata</td>
<td>Fox Sedge</td>
<td>11.76 oz</td>
<td></td>
<td></td>
<td>1.3'</td>
<td>Cool</td>
</tr>
<tr>
<td>Elymus canadensis</td>
<td>Canada Wild Rye</td>
<td>256.33 oz</td>
<td></td>
<td></td>
<td>3.6'</td>
<td>Cool</td>
</tr>
<tr>
<td>Sanguisorba minor</td>
<td>Indian Grass</td>
<td>130.68 oz</td>
<td></td>
<td></td>
<td>3.7'</td>
<td>Warm</td>
</tr>
<tr>
<td>Schizachyrium scoparium</td>
<td>Little Bluestem</td>
<td>78.41 oz</td>
<td></td>
<td></td>
<td>2.3'</td>
<td>Warm</td>
</tr>
<tr>
<td>Trisetum flavus</td>
<td>Purpletop</td>
<td>65.41 oz</td>
<td></td>
<td></td>
<td>2.5’</td>
<td>Warm</td>
</tr>
</tbody>
</table>

**Nurse Crop Options**

<table>
<thead>
<tr>
<th>Botanical Name</th>
<th>Common Name</th>
<th>Qty</th>
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</thead>
<tbody>
<tr>
<td>Avena sativa</td>
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<td>16.80 lb</td>
<td>Spring seeding</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hordeum vulgare</td>
<td>Barley</td>
<td>29.70 lb</td>
<td>Summer seeding</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lolium multiflorum</td>
<td>Annual Ryegrass</td>
<td>4.95 lb</td>
<td>Summer, Fall seeding</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Secale cereale</td>
<td>Rye</td>
<td>28.70 lb</td>
<td>Summer, Fall seeding</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Triticum</td>
<td>Winter Wheat</td>
<td>5.90 lb</td>
<td>Fall seeding</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Notes:**

1. USE THE FOLLOWING ECOTYPES IF AVAILABLE:
   NORTH EAST
   PA, NY, NJ, CT
2. CLOPYRALID RESISTANT
3. CONTACT LWLA TO QUANTIFY MIX FOR AREAS LARGER OR SMALLER THAN ONE ACRE.
F. LIVE PLANT SPECIFICATIONS

LP1 – Short Upland Combination

Target Locations: Dry, well-drained areas, particularly the crowns and midslopes of south and west facing slopes

Height Type: Short (4–12”)

Target Bird Species: Grasshopper Sparrow
Horned Lark
Killdeer
Northern Harrier
Vesper Sparrow

Notes: To be installed post-seeding (if desired).
Not Clopyralid resistant.
Straight species recommended.
Larger container sizes (quart, gal.) recommended when planting amidst established growth.
On-center spacing ranges as noted. Quantity can be based on budget and size of target area.

<table>
<thead>
<tr>
<th>BOTANICAL NAME</th>
<th>COMMON NAME</th>
<th>ON-CENTER MATURE SPACING</th>
<th>FLOWER HEIGHT</th>
<th>FLOWER COLOR</th>
<th>BLOOM TIME J F M A M J J A S O N D</th>
<th>COMPETITIVE LEVEL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asclepias verticillata</td>
<td>Whorled Milkweed</td>
<td>1'-2'</td>
<td>1'-2'</td>
<td>J F M A M J J A S O N D</td>
<td>Moderate</td>
<td></td>
</tr>
<tr>
<td>Aster ericoides</td>
<td>Heath Aster</td>
<td>1'-2'</td>
<td>1'-3'</td>
<td>J F M A M J J A S O N D</td>
<td>Strong</td>
<td></td>
</tr>
<tr>
<td>Solidago tenuifolia (Euthamia)</td>
<td>Grass Leaved Goldenrod</td>
<td>1.5'-2'</td>
<td>1'-2'</td>
<td>J F M A M J J A S O N D</td>
<td>Moderate</td>
<td></td>
</tr>
<tr>
<td>Sporobolus heterolepis</td>
<td>Northern Dropsedge</td>
<td>1.5'-2'</td>
<td>15'</td>
<td>J F M A M J J A S O N D</td>
<td>Moderate</td>
<td></td>
</tr>
</tbody>
</table>
LP2 & LP3 – Midheight Combinations

Target Locations: Dry to moist areas

Height Type: Midheight to tall (3–6’)

Target Bird Species: Bobolink
Eastern Meadowlark
Grasshopper Sparrow
Northern Harrier
Savannah Sparrow

Notes: To be installed post-seeding (if desired).
Not Clopyralid resistant.
Straight species recommended.
Larger container sizes (quart, gal.) recommended when planting amidst established growth.
On-center spacing ranges as noted. Quantity can be based on budget and size of target area.

<table>
<thead>
<tr>
<th>BOTANICAL NAME</th>
<th>COMMON NAME</th>
<th>ON-CENTER SPACING</th>
<th>MATURE HEIGHT</th>
<th>FLOWER COLOR</th>
<th>BLOOM TIME</th>
<th>COMPETITIVE LEVEL</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Herbaceous Perennials</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>LP2</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aster elongifolius (Symphyotrichum)</td>
<td>Fragrant Aster</td>
<td>2.3’</td>
<td>18.24’</td>
<td></td>
<td>JFMAMJASOND</td>
<td>Strong</td>
</tr>
<tr>
<td>Lespedeza virginica</td>
<td>Sander Bush Clover</td>
<td>1.5-2’</td>
<td>1.3’</td>
<td></td>
<td>JFMAMJASOND</td>
<td></td>
</tr>
<tr>
<td>Liatris scariosa</td>
<td>Northern Blazing Star</td>
<td>1’</td>
<td>1.2’</td>
<td></td>
<td>JFMAMJASOND</td>
<td></td>
</tr>
<tr>
<td>Physostegia virginiana</td>
<td>Obedient Plant</td>
<td>1’</td>
<td>2.5’</td>
<td></td>
<td>JFMAMJASOND</td>
<td>Strong</td>
</tr>
<tr>
<td>Solidago graminifolia (Euthamia)</td>
<td>Thin-leaf Goldenrod</td>
<td>1-2’</td>
<td>1.4’</td>
<td></td>
<td>JFMAMJASOND</td>
<td>Strong</td>
</tr>
<tr>
<td><strong>LP3</strong></td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Aster Jaevis (Symphyotrichum Jaevis)</td>
<td>Smooth Aster</td>
<td>1-2’</td>
<td>1-3’</td>
<td></td>
<td>JFMAMJASOND</td>
<td></td>
</tr>
<tr>
<td>Baptisia australis</td>
<td>Blue False Indigo</td>
<td>2.3’</td>
<td>2.4’</td>
<td></td>
<td>JFMAMJASOND</td>
<td>Strong</td>
</tr>
<tr>
<td>Boltonia asteroides</td>
<td>False Aster</td>
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<td>3.5’</td>
<td></td>
<td>JFMAMJASOND</td>
<td>Strong</td>
</tr>
<tr>
<td>Monarda didyma</td>
<td>Oswego Tea</td>
<td>1.2’</td>
<td>3.4’</td>
<td></td>
<td>JFMAMJASOND</td>
<td>Strong</td>
</tr>
<tr>
<td>Liatris spica</td>
<td>Blazing Star</td>
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<td>2.4’</td>
<td></td>
<td>JFMAMJASOND</td>
<td></td>
</tr>
<tr>
<td>Phlox paniculata</td>
<td>Summer Phlox</td>
<td>2’</td>
<td>2.5’</td>
<td></td>
<td>JFMAMJASOND</td>
<td>Strong</td>
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</tbody>
</table>
LP4 & LP5 – Tall Lowland Combinations

**Target Locations:** Lowland areas, particularly where Mugwort or Phragmites have been eradicated

**Height Type:** Tall (3–8‘)

**Target Bird Species:** Bobolink
Eastern Meadowlark
Northern Harrier

**Notes:**
- To be installed post-seeding (if desired)
- Straight species recommended.
- Clopyralid resistant
- Larger container sizes (quart, gal.) recommended when planting amidst established growth.
- On-center spacing ranges as noted. Quantity can be based on budget and size of target area.

---

### GRASSES & HERBACEOUS PERENNIALS

<table>
<thead>
<tr>
<th>BOTANICAL NAME</th>
<th>COMMON NAME</th>
<th>ON-CENTER SPACING</th>
<th>MATURE HEIGHT</th>
<th>FLOWER COLOR</th>
<th>BLOOM TIME</th>
<th>COMPETITIVE LEVEL</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Andropogon gerardii</em></td>
<td>Big Bluestem</td>
<td>3-4’</td>
<td>5-8’</td>
<td>JF MAM J JA S O N D</td>
<td>Strong</td>
<td></td>
</tr>
<tr>
<td><em>Aster novae-angliae</em> (<em>Symphyotrichum</em>)</td>
<td>New England Aster</td>
<td>1-2’</td>
<td>2-6’</td>
<td>JF MAM J JA S O N D</td>
<td>Moderate</td>
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<tr>
<td><em>Cenchrus tinctoria</em></td>
<td>Tall Cenchrus</td>
<td>2-3’</td>
<td>3-6’</td>
<td>JF MAM J JA S O N D</td>
<td>Strong</td>
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<tr>
<td><em>Desmodium canadense</em></td>
<td>Canada Tick-Trefoil</td>
<td>1-2’</td>
<td>3-5’</td>
<td>JF MAM J JA S O N D</td>
<td>Strong</td>
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<tr>
<td><em>Filipendula rubra</em></td>
<td>Queen of the Prairie</td>
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<td>3-7’</td>
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<td><em>Helopsis heliophium</em></td>
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<td><em>Eupatorium fistulosum</em></td>
<td>Joe Pye Weed</td>
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<td>3-8’</td>
<td>JF MAM J JA S O N D</td>
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<td><em>Monarda didyma</em></td>
<td>Oswego Tea</td>
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<td>3-4’</td>
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<td><em>Panicum virgatum</em></td>
<td>Switchgrass</td>
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<td><em>Rudbeckia laciniata</em></td>
<td>Green Head Coneflower</td>
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<td>3-6’</td>
<td>JF MAM J JA S O N D</td>
<td>Moderate</td>
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<tr>
<td><em>Solidago rigida</em> (<em>Oligoneuron rigidum</em>)</td>
<td>Stiff Goldenrod</td>
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<td>2-5’</td>
<td>JF MAM J JA S O N D</td>
<td>Moderate</td>
<td></td>
</tr>
<tr>
<td><em>Vernonia novaboracensis</em></td>
<td>New York Ironweed</td>
<td>2-3’</td>
<td>4-8’</td>
<td>JF MAM J JA S O N D</td>
<td>Strong</td>
<td></td>
</tr>
</tbody>
</table>
VII. INSTALLATION SPECIFICATIONS

A. SEED PROCUREMENT SPECIFICATIONS

1. Order seed eight (8) weeks prior to seeding. (Contact LWLA for suppliers if needed.)
2. Direct seed suppliers to package species individually, which allows seeds to be segregated by seed type and size at installation. Seed sizes are defined as:
   - SMALL SEED: Individual seed can be picked up by hand (<25,000 seeds/oz)
   - VERY FINE SEED: Individual seed too small to be picked up by hand (>25,000 seeds/oz)
   - GRAIN: Large wildflower seed or cover crop grain seed
   - FLUFFY SEED: Seed with fluffy, feathery coat.

B. SITE PREPARATION SPECIFICATIONS

Sequencing and Timing Overview

A site preparation and seeding sequence have been developed that minimizes as much as possible disturbances to the bird breeding period (designated for New York as April 22–August 15). While the bird breeding season will necessarily be impacted for one year during site preparation and establishment, the sequence outlined below represents the least amount of impact possible. It should be noted that this sequence is less optimal for weed control purposes because the cover cropping and weed flushing stage does not include an entire growing season in which both cool and warm season weeds can germinate and be eradicated. Instead, this period has been reduced to the late summer post-bird breeding and the following spring.

According to this sequence, site preparation begins in late summer on August 15 after bird breeding ends. Following weed eradication, the target area is sown with a cover crop. Weeds that germinate are eradicated in subsequent herbicide treatments in the fall. Thatch from the treated cover crop and weeds in the target area provides erosion control over the winter. (For discussion on the use of herbicides, see the Weed Control Guide – Section X.A.)

Following a series of additional preparatory steps in the spring, seeding of the specified mixes occurs in late spring/early summer. In areas dominated by nonnative cool season grasses, seeding in late spring/early summer offers several benefits. The cool season grasses are past their most active growth phase while many of the specified wildflowers and grasses are warm season species adapted to germinate and grow well during the warmer months. In the event of summer drought, the seed will remain dormant until rainfall resumes. Once the breeding season begins, seeded areas should be monitored for nesting birds by a local bird expert.

Fall seeding of the specified mixes is not recommended for it would require two years of disturbance to the bird breeding period. The necessary site preparation during the
growing season would disturb breeding in the first year. In the subsequent year, following seeding of the specified mixes, the monthly mowings required would disturb breeding for yet another year. In contrast, the program outlined here disturbs breeding habitat in target areas for just one growing season rather than two.

For Herbaceous Weed Cover

1. On August 15 after the end of the bird breeding season, delineate the target area using 5' rebar with the top 12" painted a designated color so that field personnel do not confuse management and seeding zones. Delineation stakes should be as far apart as possible without compromising perimeter legibility.

2. Flag any existing warm season grasses.

3. Broadcast apply appropriate herbicide per label to eradicate existing growth, avoiding any flagged desirable warm season grasses. If existing vegetation is over 36" in height, mow with a brushhog or other appropriate equipment and allow re-growth to attain a height of 12" before applying herbicide.

4. Calculate the square footage/acreage for the target area and procure cover crop seed. For cover crop options see cover crops listed in Seed Mix Specifications in Section VII.C.

5. Determine crew and equipment requirements for seeding of cover crop and make appropriate arrangements. For equipment and materials list, see Seeding Specifications in Section VII.G.

6. Two weeks after the initial herbicide application, mow treated growth and any regrowth, avoiding any flagged desirable warm season grasses.

7. Immediately sow temporary cover crop for erosion control and to provide a managed, "cared for" look.

8. In October, while green growth is still available to translocate herbicide, broadcast apply appropriate herbicide per label to cover crop and weeds that have germinated. Avoid treating any flagged desirable warm season grasses. Thatch of the treated growth will help prevent erosion over the winter.

9. Between March 1 and March 22 of the following year, scalp mow the target area to 2-3", avoiding any flagged desirable warm season grasses from the prior year.

10. String trim any flagged warm season grass specimens to 6" and checking flagging so that this desirable vegetation is not targeted in any subsequent herbicide applications.

11. In early May procure seed for selected mixes using Seed Procurement Specifications in Section VII.E. Determine crew and equipment requirements for seeding and make appropriate arrangements. For equipment and materials list, see Seeding Specifications in Section VII.G.

12. In late May work with a local birder to monitor for the presence of nests and breeding pairs in the target area. To the extent possible, emphasize distant observations and call identification over walking the area, which risks trampling nests and disturbing nesting birds. If nests are observed, flag location to within fifteen feet (15') and avoid any further activity within the flagged area for the remainder of the breeding season. Schedule the flagged zone for weed control
Section VII: Installation Specifications

13. On June 1, broadcast apply herbicide to newly emergent growth in target area, avoiding any flagged nesting zones or flagged desirable warm season grasses.

14. Two weeks later, inspect target area to ensure that no further herbicide treatments are necessary. Conduct an additional broadcast herbicide application if necessary. If existing growth is completely exterminated, mow treated stubble to approximately 1–2".

15. Rake off excess cut plant refuse if necessary, leaving roots and crowns to help stabilize the soil prior to establishment of seeded vegetation.


17. Manage seeded areas according to Specifications for Seeded Areas in Section VI.E.

18. Remove any nest zone flagging so that predators do not associate flags with the presence of nests.

19. If desired in order to increase forb species diversity, install live plants in the fall after the seeding’s first season of growth. See Live Plant Combinations in Section VII.D and Planting Specifications in Section VII.H.

For Turf-Like Conditions

NOTE – Although the specifications below for preparing sites in turf-like conditions are not likely to be needed in the Croton grassland, they are provided here for reference purposes. They could prove useful if turf areas outside the current project zone are slated for conversion to native grassland habitat.

Eight (8) Weeks Prior to the Selected Seeding Date

1. Delineate seeding area using appropriate marking equipment.
2. Flag any desired plants.
3. Broadcast apply appropriate herbicide per label to eradicate existing growth, avoiding any flagged desirable plants.

Two (2) Weeks Prior to Selected Seeding Date

1. Broadcast a second application of herbicide to eradicate any newly emergent growth. Apply as directed on the herbicide label.

Two-to-Three (2–3) Days Prior to Selected Seeding Date

1. Inspect seeding area to ensure that no further herbicide treatments are necessary.
2. If existing growth is completely exterminated, mow treated stubble to approximately 1–2".
3. Rake off excess cut plant refuse if necessary, leaving roots and crowns to help stabilize the soil prior to establishment of seeded vegetation.
C. SEEDING SPECIFICATIONS

Seeding Method 1 – Hand Broadcast No-Till for Small Areas or Areas Inaccessible to Seeding Equipment

RATIONALE – No-till seeding avoids disturbing the soil, which provides opportunities for existing weed seeds in the soil to germinate and risks erosion.

1. Scalp mow all remaining dead growth to expose the soil to sunlight.
2. Scarify the soil to approximately ½” using appropriate equipment. Repeat as needed to create a seedbed with approximately 50% of the soil exposed. Do not till as this leads to increased weed presence due to the release of dormant weed seeds in the soil seed bank.
3. Segregate the seeds according to mix and seed size. For the hand broadcast method, “Fluffy,” “Small,” and “Grain” seed can be combined with the exception of leguminous species. This combination is referred to henceforth as “Large” seed. “Very Fine” seed, which cannot be picked up individually by hand, should remain separate.
4. Inoculate seed of leguminous species (if included in the mix). Place the seed in a container and add a small amount of sand, sawdust, or other fine textured bulking material. Moisten the mixture until slightly damp. Add inoculum (provided by seed house) and mix thoroughly. Mix into “Large” or “Very Fine” seed as appropriate.
5. Bulk up the "Large" seed mixture by mixing with an inert bulking material such as sawdust, sand, kitty litter, or vermiculite. Seed and bulking material can be mixed on tarps spread on the ground. Slightly dampening the bulking material will help the seed be more evenly distributed through the bulking material. Use enough bulking material to allow seed to be evenly distributed over the entire target area.
6. Divide the project area into sections and mark accordingly so as to facilitate even dispersal of seed over the site. Divide mixed, bulked-up seed into relevant quantities for each area.
7. Hand broadcast the "Large" seed mix evenly over the prepared surface of target area. Use a dispersal pattern that reduces the chances of using up the mix prematurely.
8. Rake or cut seed lightly into the soil to a depth of approximately ¼” using appropriate equipment.
9. Bulk up the "Very Fine" seed in the manner described above and broadcast evenly over the prepared surface. Do not incorporate into the soil as these species need light to germinate and will

Equipment & Materials for Hand Broadcast No-Till

- Bulking material (sand, sawdust, kitty litter, vermiculite)
- Five-gallon buckets for distributing seed
- Gloves
- Marking materials (flagging, marking paint, etc.)
- Mower
- Scarifying/tamping equipment (York Rake, walk-behind dethatcher, etc.)
- Seed as specified
- Shovels for mixing seed with bulking material
- Tarps for seed mixing surface
- Water for wetting bulking material
not do so if buried in the soil.

10. Tamp or roll the soil surface to ensure good soil-to-seed contact.

11. Apply a cover of 50% PennMulch at a rate that ensures light can penetrate to the soil surface and allow seed germination.

12. Mark seeded areas for receiving first year management procedures as specified in Year 1/Short Term Management Procedures (see Section V.E).

13. Watering the seeding is not required. If rain does not fall for an extended period after the planting and if a source of water is readily available, application of up to 1” per week (including any rainfall received) for a period of six (6) weeks will facilitate establishment.

**Seeding Method 2: No Till Drill Seeder For Large Areas**

_RATIONALE – A no till drill seeder (example brand: Truax) is specifically adapted for the seeds of native grasses and wildflowers, which typical agricultural drills cannot adequately accommodate due to the seeds’ varying sizes and textures. When conducting a no till drill seeding, steps 2, 7, and 10 from Seeding Method 1 can be eliminated as the no till drill seeder will accomplish these procedures in one pass of the project area. No-till seeding avoids disturbing the soil, which provides opportunities for existing weed seeds in the soil to germinate and risks erosion._

1. Scalp mow all remaining dead growth to expose soil to sunlight.

2. Calibrate the no-till drill seeder.
   a. Put a small amount of seeds in the seeder. Segregate species in each seed mix and handle as follows (see Seed Procurement Specifications – Section VIII.E for definitions of seed sizes):
      - **FLUFFY**: Place in the fluffy seed box.
      - **SMALL**: Place in alternate sections of the small flower box.
      - **VERY FINE**: Bulk up seed with sand, vermiculite or any available inert material to the same volume as the "Small" seed (do not use sawdust as it may jam the seeder). Place in remaining sections of the small flower box.
      - **GRAIN**: Place in the grain box.

   _Note: Never load all the seed at once. Divide the seeding area into sections and divide the seed accordingly, thereby eliminating the possibility of accidentally running out of seed part way through the seeding process._

   b. Remove feeder tubes from Equipment & Materials for No Till Drill Seeding
      - Bulking material (sand, vermiculite, or other non-jamming material)
      - Marking materials (flagging, marking paint, etc.)
      - Mower
      - No-till drill seeder (example brand: Truax)
      - Seed as specified
      - Shovels for mixing seed with bulking material
      - Tarps or buckets for mixing Very Fine seed with bulking material
      - Walk-behind dethatcher for use in areas inaccessible to the no till drill seeder
      - Water for wetting bulking material
the small flower box containing "Very Fine" seed. This allows the seed to fall directly only the soil surface without being cut in by the machine (Very Fine seed requires light to germinate). Do not remove the feeder tubes for the sections containing "Small" seed.

c. Conduct test runs to see how quickly the machine deposits seed and adjust accordingly (every seeder calibrates slightly differently).

d. Ensure the drill seeder is not depositing seed too deeply in the soil. The disks should be cutting in approximately ¼-⅜” deep. During the trial calibration run, examine the soil slits to ensure proper depth. Some seed should be evident on the soil surface and some will be tucked into the slits.

3. Sow seed, checking for even distribution of seed across the seeding area.

4. For any areas inaccessible to the Truax (steep slopes, wet areas, etc.), use Seeding Method 1: Hand Broadcast No-Till.

D. PLANTING SPECIFICATIONS

Installation of live plants is recommended for September 15 through November 15, typically one full growing season following seeding. All planting specifications pertain to live plant material in plug and quart form. Recommended spacing is as indicated on Live Plant Lists.

1. Water plants prior to removing from containers.

2. Apply Liquid Fence (deer deterrent product) per label, if desired.

3. Remove plants from containers.

4. Dip plant roots in Agrigel slurry per label if desired in order to reduce transplant shock and assist with root establishment.

5. Position the plant in the center of planting hole and backfill half way with site soil. If planting plugs late in the season, planting on an angle can reduce chances of frost heave and make it harder for deer to pull plugs out of the ground.

6. Tamp soil around the plant and water in until water fills the planting hole completely. Let the water seep into the soil around the plant.

7. Once the water has drained, place the remaining backfill into the planting hole and tamp lightly.

8. If possible, generously water the plant after backfilling. If not possible, plant in cool weather or on overcast days.

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Planting Equipment & Materials

- □ Agrigel (if desired)
- □ Gloves (if desired)
- □ Liquid Fence (or other deer browse deterrent if desired)
- □ Planting tools (trowels, drills, etc.)
- □ Water for initial watering-in
VIII. MANAGEMENT SPECIFICATIONS

A. APPROACH

Long Range Vision Phased In Over Time

Over the long term, management specifications for the Croton grassland are designed to achieve a patchy matrix of native grassland habitats that meet the diverse needs of the target grassland birds while resisting weed invasion. To prevent woody vegetation and buildup of thatch, one third to one half of the grassland will need to be mowed in late winter. Leaving some residual growth standing for another year meets the nesting requirements of certain species and provides forage and cover in the spring and early summer prior to the emergence of new growth. The entire area will need yearly monitoring for problem weeds.

In the short-term, however, management requirements are more intensive and some will need to be phased in over time so as to minimize habitat disturbances. As desired existing growth and seeded/planted vegetation become dense, weed suppressive, and more stable, management needs will decrease. Management personnel will also become more familiar with yearly tasks and vegetation management strategies such that managing the grassland will seem to require less effort. Throughout this process, however, the grassland will require monitoring and adapting management protocols and timings as necessary. This is best done in coordination with a grassland consultant and avian experts.

Integrated Vegetation Management

Management tasks involve a series of practical techniques timed to give desired vegetation (whether existing or proposed) a competitive advantage over undesired vegetation. These techniques include timed sequential cuttings to specified heights and targeted herbicide treatments. Combining control methods results in more successful weed control and can restore suppressed desired native species such that there is less need to replant. For each management procedure or recommendation, a supporting rationale is provided to help managers and field personnel understand how a task will achieve desired results.

Year-Round Sensitivity to Grassland Birds

Management recommendations are designed with sensitivity to the specific habitat requirements of target grassland birds and all periods in which they use or might use the Croton grassland. Accommodating for migration and overwintering habitat needs as well as during the breeding season is important since survival of adults is critical to population growth rates (Fletcher et al, 2006). The Croton grassland also likely functions as an important migration stopover (Buckley, personal communication, 2015).
The majority of recommended management tasks are timed to avoid the grassland bird breeding period in New York: April 22 through August 15 (Morgan and Burger, 2008). While migrating grassland birds begin returning to the lower Hudson Valley around March 15, territorial boundaries and locations remain dynamic into April. July 15 is sometimes given as the end of bird breeding, but as nesting can have a relatively high failure rate and with five of the eleven target species having double broods or a protracted breeding season, August 15 represents a safer end date to the breeding season. If management actions are necessary during the breeding period in order to manage for or against particular vegetation, procedures for minimizing impacts have been developed.

In instances of severely degraded habitat where invasive exotic species dominate and are threatening to jeopardize the quality of nearby areas and the grassland overall, management actions are specified that temporarily forgo providing undisturbed breeding sites in favor of restoring more suitable habitat conditions. The assumption is that the long-term habitat benefits outweigh temporary habitat loss, an approach also recommended in A Plan for Conserving Grassland Birds in New York (Morgan and Burger, 2008). Monitoring by volunteers for birds present in target patches will indicate whether any priority species are present and could be impacted by management actions taken during the breeding season. The phased restoration approach will also help to ensure some habitat always remains in available in patches in the grassland.

Adaptive Management & Volunteer Bird Monitoring

Designing and managing for a particular habitat is no guarantee that certain species will use that habitat. Outcomes depend on the kind, amount, and relative density of vegetation as well as a broad range of complex, interrelated factors, such as insect densities, predation, amount of human disturbance, and surrounding land use patterns, all of which can have varying levels of impact depending on the region and species involved. In the future, models may exist to give precise predictions for habitat use and nesting success (or at least probabilities for different outcomes), but research has not advanced to this stage. In the meantime, management decisions can be made based on the best available "on the ground" information and then adjusted as necessary.

This trial and error approach will require help from experienced birders willing to monitor the site during breeding, migration, and overwintering. Developing a network of such volunteers is feasible given Croton’s prominence as a birding spot. A possible monitoring program is detailed further in Section VIII.
B. BEST MANAGEMENT PRACTICES

Best management practices for managing native plant species and Croton’s target grassland birds are described below.

Best Mowing Practices

The mowing practices described below should be used whenever mowing is recommended unless reasons for using alternative techniques are provided. The practices described below, in addition to benefitting the desired native plant species and target bird species, will also benefit many invertebrates, including butterflies, pollinators, grasshoppers, and spiders, all of which can serve as food sources for target bird species feeding their young. Practices relevant to mowing access paths to monitoring wells and along the rock-lined swales are marked with a star *.

Do Not Mow During the Breeding Season (April 22–August 15 in New York)

Unless required in order to control pernicious weeds that jeopardize habitat overall, mowing during the breeding season should be avoided as it can destroy nests and eggs and mortally wound adults, chicks, and fledging birds, which are sensitive to disturbance and generally reluctant to leave their nests.

Wait to Mow Residual Top Growth until Late Winter (March 1–22)

Mowing the prior year’s residual vegetation is required to prevent it from inhibiting emerging growth; this late winter cutback also discourages woody plants. Waiting to cut residual top growth until late winter enables it to provide forage, shelter, and perches for overwintering and migrating birds. Residual growth also supports overwintering insects that then serve as food sources for breeding birds and their young. Allowing the growth to remain during fall and winter supplies aesthetic interest as well. Growth must be cut before returning birds begin nesting.

Use Rotary Style Equipment for Cutting Dead Top Growth

Use flail or rotary style equipment to cut back the prior year’s growth. Sickle or cutting bar type mowers that cut at the base of vegetation and drop plant material intact should not be

Fig. 30: Snow Buntings in the Croton grassland. Courtesy Jim Bourdon.
used since the intact cut plant material can inhibit new growth. See caveat later in this section regarding use of sickle-bar type mowers when remediation mowing is necessary during the bird breeding period.

Leave Unmown Areas That Are Mowed Every Other Year or Every Third Year
Prior to the emergence of new vegetative growth in the spring, grassland nesting birds still require cover, forage opportunities, and perches. This is especially important for overwintering and early arriving birds, including Eastern Meadowlark, Horned Lark, Northern Harrier, Savannah Sparrow, Short Eared Owl, and Vesper Sparrow (Morgan and Burger, 2008). For such early arriving birds, leave unmown patches that are mowed every other year or every third year instead of annually. Note: once weeds are adequately controlled, long-term specifications recommend mowing one-third of the grassland annually on a rotating basis.

Do Not Mow at Night or in the Early Morning *
Do not mow at night or in the early morning as birds that forage or roost on the ground are less likely to flush and successfully escape and find refuge.

Mow "Inside Out"
Do not mow starting at the perimeter and move in a circle towards the center since this pattern forces birds into a continually smaller space in their attempt to simultaneously avoid the mower and exposure to predation. Mow instead from the center outwards in an "inside out" pattern that encourages birds to scatter outward through cover rather than into an ever decreasing space. The "inside out" pattern is particularly important in the post-breeding season when juvenile birds may still be inexperienced at flying.

Mow Toward Areas That Are to Remain Uncut
When possible, orient the mowing route to mow towards adjacent areas that will remain uncut, allowing birds to disperse into protective cover.

Mow at a Reduced Speed *
Mowing at reduced speeds is believed to reduce bird mortality. (Unfortunately, specific m.p.h. rates could not be located at the time this manual was prepared.)

Leave Cut Material *
Unless managing for target bird species (such as the Grasshopper Sparrow and
the Horned Lark) that prefer limited to no thatch, leave cut material as it returns organic matter and nutrients to the soil and helps sustain invertebrate populations that in turn serve as a food source for target bird species. Any thick accumulations that remain to the point where soil cannot be observed through the cut material should be dispersed evenly over the area or removed. Leaving litter will also help attract small mammals like voles, which serve as prey for raptors and owls associated with open habitats like the Croton grassland.

**Best Practices When Mowing Is Necessary During the Breeding Period**

Adhere to the practices below when targeted mowing is necessary to control weeds during the designated breeding period (April 22-August 15). Practices relevant to mowing monitoring well access paths and along the stone-lined swales are marked with a star *.

*Work with Volunteers to Monitor for Nests and to Flag Nest Buffer Zones* *
Work with local birders to monitor for nests and breeding pairs in the target area. To the extent possible, emphasize distant observations and call identification over walking the area, which risks disturbing nesting birds and their young and trampling nests. If nests are observed, record location and flag to within fifteen (15) feet to provide cover around the nest. Avoid all activity within the 15' buffer zone. Remove nesting zone flags once mowing is complete so that predators do not begin to associate flagging with nests.

*String Trim Instead of Mowing When Appropriate* *
When target areas are small, a hand held string trimmer allows fine-tuned cutting around nesting sites and non-target vegetation.

*Use a Cutting Bar Mower with the Bar Angled Upwards for Spring Mowings of Cool Season Grasses Less than 12" Tall* *
Cutting bar mowers have lower bird mortality rates than rotary style mowers (Green, n.d). Angling the cutting bar upwards instead of horizontally or downward may also help push birds that do not flush away from the blade.

**Mow High**
Mowing to a minimum height of 10" has been shown to leave many nests unharmed and reduce bird wounds and mortality (Peters and Allen, 2011). This is particularly important when using rotary style mowers, which cause higher mortality at low heights than bar-type equipment (Humbert et al, 2009). Depending on the target vegetation, it may be possible to mow higher than 10".

*Use a Flushing Bar and Volunteer Flushers* *
Flushing bars designed to flush out birds in advance of the mower blades may help, although their efficacy appears to vary based on bird species and vegetation height and density (Green, n.d.). Flushing bars may help move large birds but have no effect on smaller birds. Volunteer flushers who walk in advance of the mower and flush out birds by sweeping a long pole in an arc pattern may be more
effective. As a refinement on flushing, thermal imaging devices attached to mowers are being researched in Europe.

Avoid Auditory Flushers
Auditory flushers or alarms intended to frighten grassland birds from their nests have been shown to be ineffective (Green, n.d.).

Key Weed Control Principles
Monitor routinely, particularly early on in the planting's growth and in more vulnerable areas, such as the edges of the planting where invasion is more likely to occur. Control is easiest and the most economical with early detection since it is easier to treat a weed as soon as it appears than to wait until it is established and reproducing.

Maintain a healthy cover of desired vegetation.
In robust, mature, well-managed plantings, weeds rarely present a significant problem because the desired plantings outcompete undesired species for water, sunlight, and soil nutrients.

Thoroughly clean all tools and equipment prior to performing work in the grassland to avoid spreading seeds of undesired plants from one area to another.

Monitor following treatments to assess treatment efficacy and to ensure new undesired species do not fill the void of eradicated species.

Disturbance Protocols
Avoid disturbance to the soil and established cover.

When disturbance to soil and established cover occurs or is required for landfill management purposes, monitor the area for sign of problem species emerging. Plant the disturbed area with a cover crop and treat any weeds that have emerged. Treat weeds and mow the cover crop as necessary to keep it from going to seed; after a full growing season, reseed with the relevant seed mix and manage as recommended in Section VIII.E.

Do not move soils where Mugwort or other rhizomatous species are established as root fragments in transported soils can establish new satellite populations. Importing soils from offsite brings the same risk of introducing or spreading weeds.
C. MANAGEMENT CALENDAR & CHECKLISTS

Year At-a-Glance Calendar Checklists

The calendars provided here show management tasks at-a-glance for each vegetation zone over the course of one growing season (March-October), starting with March 2015. As the tasks are listed in abbreviated format, managers should review detailed specifications, whether for management tasks, site preparation, or seeding, prior to proceeding. Calendars can be revised as management procedures are adapted in response to vegetation changes and/or bird habitat requirements. The color-coded boxes are intended to be checked off as the task is completed. Completed records can then be retained as a history of management actions. Lists of weeds treated, the control time, and the relative abundance of these weeds (e.g., rare, scattered, abundant) could also be kept.

Color Coded Tasks and Symbology

Tasks in each calendar/checklist are color-coded by type of action (mowing, monitoring, etc.) The color coding is as follows:

- Live plant sourcing/installation
- Mowing/string trimming
- Nest monitoring/flagging
- Seed procurement or seed sowing
- Weed monitoring/control
- Zone delineation

Tasks that require assistance from experienced local birders to determine nest presence within a target area are marked with a star (*).

The color-coded boxes are intended to be checked off as the task is completed. Completed records can then be retained as a history of management actions. Lists of weeds treated, the control time, and the relative abundance of these weeds (e.g., rare, scattered, abundant) could also be kept.

Copyable Templates and Recordkeeping

Once areas are stabilized, the long-term calendar/checklist can serve as a template that can be copied for each new year of management as relevant.

Decreasing Management as Stable Compositions Are Achieved

As noted throughout this manual, management is most intensive in the early years of the restoration process. As desired existing vegetation and any seeded/planted growth become dense and weed suppressive, management requirements will decrease due to establishment of more stable overall compositions. Areas where any disturbance occurs can expect to have increased management until desired growth is successfully reestablished.
D. MANAGEMENT OF EXISTING VEGETATION

HIGH PRIORITY 1 – Native Warm Season Grass Areas (approx. 9.4 acres)

Recommendation: Favor existing warm season grasses while suppressing weeds and cool season grasses.

1. In late winter when ground is no longer frozen, delineate the perimeter of native warm season grass areas using 5' rebar stakes with the top 12" painted yellow to correspond to the Existing Vegetation Zones Map (Fig. 33). Residual growth of Little Bluestem (*Schizachyrium scoparium*) and Indian Grass (*Sorghastrum nutans*) can be used to identify the area's extent. Space rebar as widely apart as possible while still maintaining readability of the area's perimeter.

RATIONALE – Warm season grass areas should be delineated so they are not confused with adjacent zones that may require different management procedures. As field personnel become familiar with exotic and native grasses, area delineation may not be necessary. Stakes should be moved outward as native warm season grass areas expand.

2. Between March 1 and March 22, cut back residual top growth in target area to 4" using a rotary style mower. Adhere to Best Mowing Practices. In locations inaccessible to a mower (around delineation rebar, on steep slopes, etc.), string trim vegetation to the specified height.

RATIONALE – See Best Mowing Practices for the rationale behind late winter mowing.

3. To set back intermingled exotic cool season grasses, mow target area with a cutting bar type mower on approximately May 15 and again on June 15. If only one mowing is possible, conduct the June mowing. In the event of a warm, wet spring when native warm season species emerge early, target areas should be mowed no later than June 1.

RATIONALE – Sequential spring cuttings disadvantage intermingled, actively growing cool season grasses and weeds over warm season grasses, which are just beginning their growth cycle. See Best Mowing Practices for ways to minimize mowing impacts to ground-nesting birds during the breeding period.

NOTE – The necessity of sequential spring cuttings to set back cool season grasses should be assessed after year five (5), by which point the native warm season grasses should be well established and competitive. Spring mowings could then occur every other year or be discontinued.
a. Work with a local birder to monitor for the presence of nests and breeding pairs in the target area. To the extent possible, emphasize distant observations and call identification over walking the area, which risks trampling nests and disturbing nesting birds. If nests are observed, flag location to within fifteen feet (15') and avoid any further activity within the flagged area until the end of the bird breeding season.

b. Using a cutting bar type mower, cut target area to approximately 4". Adhere to Best Mowing Practices.

   RATIONALE – See Best Mowing Practices for reasons to use a cutting bar type mower.

c. Remove nest zone flagging so that predators do not associate flags with the presence of nests.

4. In late June or early July, if approved for use in New York, distribute flea beetles (Aphthona spp.) in target areas to control exotic Spurge species. See Spurge species entries in Section X for additional information on Spurge biocontrol.

   RATIONALE – Release of Aphthona spp. flea beetle combined with targeted spot herbicide applications can be used to control Spurge species. At the time this manual was produced, however, it has not been determined whether Spurge biocontrols are approved for use in New York.

5. On August 15 after bird breeding ends, monitor for weeds and treat as necessary.

   RATIONALE – Delaying weed control until August 15 avoids disturbing ground nesting birds and their young. Field personnel should remain sensitive to the presence of ground-foraging birds, however, particularly juveniles which may still be inexperienced flyers.

   NOTE – As warm season grasses achieve denser, weed-suppressive cover, need for weed control should decrease.

   a. Monitor for weeds, identify species and select appropriate control method in Section X. Be sure to check for Mugwort around monitoring wells in the target areas and treat as necessary.

   b. Schedule and conduct control treatments as needed. Spot treatment is preferable but in cases of widespread infestation, affected areas should receive blanket applications as directed on the herbicide label. While treating, be alert to the presence of ground-foraging birds.

   c. To maintain a "cared for" appearance in visually prominent areas if desired, string trim expired treated vegetation two (2) weeks following any systemic herbicide applications. To ensure any systemic herbicides can translocate to the roots of desired vegetation, cutting treated top growth should not occur less than two weeks (2) after herbicide application.

   d. Monitor treated area(s) for ensure treatment effectiveness. If necessary, schedule and conduct follow-up treatment(s).

6. In mid-September, monitor for weeds, identify species, and treat as necessary in late September to early October per Specification 5. Check for Mugwort around monitoring wells in the target area and treat as necessary.
**Alternative Option for Native Warm Season Grass Areas:** Favor existing warm season grasses. Eradicate weed patches and seed with Shortgrass Upland Mix (SM1) and/or Midgrass Mix (SM2).

1. Follow Specifications 1, 2, 3, and 4 as detailed in the above Management Recommendation for Warm Season Grass areas. Adhere to Best Mowing Practices whenever mowing is required.

2. On August 15 after bird breeding ends, begin preparing target area(s) using Site Preparation Specifications in Section VII.B.

   NOTE – The proposed Site Preparation Specifications (fully detailed in Section VII.B) present the fewest possible impacts to the bird breeding period. The strategy is less optimal for weed control because it does not include an entire growing season in which weed seeds can germinate and then be targeted.

3. In the following year, seed target areas according to Seeding Specifications in Section VII.G.

4. Manage seeded areas per Management Specifications in Section VIII.E. Depending on the size of the seeded area(s), the required monthly cutting during the growing season in the first year of growth could be conducted with a string trimmer, thereby avoiding driving through bird habitat during the breeding season.
HIGH PRIORITY 2 – Phragmites Stand(s) (approx. 5,000 sq. ft.)

Recommendation: Eradicate and seed with tall, vigorous native grasses and forbs.

RATIONALE – The existing Phragmites patch is relatively small and can be readily controlled. Recommended seed mixes to replace this growth consist of tall, vigorous native species able to establish quickly and compete with any Phragmites regrowth.

NOTE – The proposed Site Preparation Specifications (fully detailed in Section VII.F) present the fewest possible impacts to the bird breeding period. The strategy is less optimal for weed control because it does not include an entire growing season in which weed seeds can germinate and then be targeted.

1. In mid-to-late summer when Phragmites is flowering and clearly evident, delineate area as necessary using 5' rebar stakes with top 12" painted brown to match Existing Vegetation Zones Map (Fig. 34).
2. While Phragmites is still flowering, treat using selected control method listed in Phragmites entry in Section X.
3. On August 15 after bird breeding ends, prepare the target area using Site Preparation Specifications in Section VII.B.
4. In the following year, seed target areas according to Seeding Specifications in Section VII.C. Use Tall Lowland Mix SM3 and/or Tall Lowland Mix SM4 (see Seed Mix Specifications in Section VI.E).
5. Manage seeded areas per Management Specifications in Section VIII.F. Depending on the size of the seeded areas, the required monthly cutting during the growing season in the first year of growth could be conducted with a string trimmer, thereby avoiding driving through bird habitat during the breeding season.
6. Add live plants if desired in the fall after the first season of growth. Use Tall Lowland Combinations LP4 and LP5 (see Section VI.F).
**Recommendation:** Eradicate existing weeds and maintain as free of vegetation per landfill requirements.

**RATIONALE** – Small weed patches in stone-lined swales can be controlled with minimal effort unless allowed to spread further. Since swales must remain free of vegetation due to landfill maintenance requirements, the swales can act as clearly delineated buffers helping to limit the spread of rhizomatous weeds and cool season grasses.

**NOTE** – Many of the target bird species appear to use the stone-lined swales and adjacent mown strips for foraging and perching. Field personnel should be alert to the presence of birds during all procedures.

1. In late May monitor for weeds and treat as necessary.

   **RATIONALE** – A late May weed control targets early seed-setting cool season species. In subsequent years, the May weed control may not be necessary and only post-breeding season spot weed control as detailed in Specification 2 below will be required.

   **NOTE** – As none of the target bird species are believed to use the stone-lined swales for nesting, localized weed control in late May should not directly impact nests. Field personnel should remain alert to the presence of birds, however.

   a. Monitor for weeds and identify species.

   b. Schedule and conduct treatment as needed with appropriate herbicide. Spot treatment is preferable but in cases of widespread infestation, affected areas should receive blanket applications as directed on the herbicide label.

   c. Monitor treated area(s) for ensure treatment effectiveness. If necessary, schedule and conduct follow-up treatment(s).

2. In late June or early July, if approved for use in New York, distribute flea beetles (*Aphthona* spp.) in target areas to control exotic Spurge species. See Spurge species entries in Section X for additional information on Spurge biocontrol.

   **RATIONALE** – Release of *Aphthona* spp. flea beetle combined with targeted spot herbicide applications can be used to control Spurge species. At the time this manual was produced, however, it has not been determined whether Spurge biocontrols are approved for use in New York.

3. Monitor for weeds on August 15 at the end of the bird breeding season, repeating weed control procedures detailed in Specification 1 above. If growth exceeds 36" string trim and treat regrowth once it reaches 12". Be sure to check for Mugwort around any monitoring wells in the target area and treat with recommended herbicide as necessary.
MID-LEVEL PRIORITY – Non-Native Cool Season Grass Areas (approx. 40 acres)

NOTE – In addition to a main recommendation, two alternative management options are provided. The three strategies are not mutually exclusive. The main recommendation can be used in one area while Alternatives B and/or C can be used elsewhere. If multiples strategies are used, they should be clearly delineated on the site and on site maps so as to avoid confusion in the field and in management records. To reduce bird habitat disturbance, management options are best phased in (for example, conversion of the cool season grass area on the east side could be followed later by conversion of cool season grasses on the west side.)

Recommendation: Maintain cool season grass areas as is while eradicating problem weeds.

RATIONALE – Non-native cool-season grasses do not always negatively impact obligate grassland birds. Several studies have shown higher abundance of certain grassland birds in non-native cool season rhizomatous grasslands than in conservation plantings of native warm season grasses (Madden et al., 2000, McCoy et al, 2001, Davis et al., 2013). This may have more to do with habitat structure than plant origin, however. Some exotic cool season grasses may be structurally similar enough to the original habitat associations of certain birds that these birds have adopted introduced vegetation as breeding habitat in the absence of their closest preferred native equivalent. Restoration actions must therefore balance the habitat benefits of some non-native species with the potential for these species to spread and compromise habitat quality overall. At Croton, where the goal is a patchy matrix of grassland habitats, efforts should be made to prevent further spread of cool season grasses while assessing which of these areas can best be converted to native grasses and forbs.

1. In late winter when the ground is no longer frozen, delineate the perimeter of cool season grass areas using semi-green growth to identify the approximate extent. If it is too difficult to delineate the area at this time, delineate in April prior to the start of bird nesting on April 22. Mark the perimeters using 5’ rebar stakes with the top 12” painted green to correspond to the Existing Vegetation Zones Map (Fig. 36) Space rebar as widely apart as possible while still maintaining readability of the area’s perimeter.

RATIONALE – The cool season grass areas should be delineated so they are not confused with adjacent zones that require different management procedures. As field personnel become familiar with introduced and native grasses, area delineation may prove less necessary.

2. Between March 1 and March 22, cut back residual top growth to 4”, adhering to Best Mowing Practices. Mow in entirety or, if no residual growth is to remain elsewhere in the grassland, mow in swatches such that 300’-wide strips of prior growth remain for another growing season to provide bird cover until emergence of new growth. In locations inaccessible to a mower (around delineation rebar, on steep slopes, etc.), string trim vegetation to the specified height.

RATIONALE – See Best Mowing Practices for rationale for late winter mowing and swathe mowing.
3. In late June or early July, if approved for use in New York, distribute flea beetles (*Aphthona* spp.) in target area(s) to control Leafy Spurge. See Spurge species entries in Section X for additional information on biocontrol.

**RATIONALE** – Release of *Aphthona* spp. flea beetle combined with targeted spot herbicide applications can be used to control Spurge species. At the time this manual was produced, however, it has not been determined whether Spurge biocontrols are approved for use in New York.

4. On August 15 after bird breeding ends, monitor for weeds and treat as necessary.

**RATIONALE** – Delaying weed control until August 15 avoids disturbing ground nesting birds and their young. Field personnel should remain sensitive to the presence of ground-foraging birds, however, particularly juveniles which may still be inexperienced flyers.

a. Monitor for weeds, identify species and select appropriate control method in Section X. Be sure to check for Mugwort around any monitoring wells in target areas and treat as necessary.

b. Schedule and conduct control treatment(s) as needed. Spot treatment is preferable but in cases of widespread infestation, affected areas should receive blanket applications as directed on the herbicide label. While treating, be alert for the presence of ground-foraging birds, both juveniles and migrants.

c. To maintain a "cared for" appearance in visually prominent areas if desired, string trim dead treated vegetation two (2) weeks following any systemic herbicide applications. To ensure any systemic herbicides can translocate to the roots of desired vegetation, cutting treated top growth should not occur less than two weeks (2) after herbicide application.

d. Monitor treated area(s) for ensure treatment efficacy. If necessary, schedule and conduct follow-up treatment(s).

5. In mid September, monitor for weeds, identify species, and treat as necessary as detailed in Specification 4 above.

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**Alternative A for Non-native Cool Season Grass Areas**: Convert to native warm season grasses over time by recruiting intermingled suppressed warm season grasses.

**RATIONALE** – Upland areas and areas adjacent to existing warm season grass zones should be prioritized for implementing this strategy. After year five (5) of commencing the conversion process, evaluate target area(s) to determine whether they can be managed as warm season grass communities as detailed in Native Warm Season Grass Areas Management.

1. In March when the ground is no longer frozen, delineate target area(s) according to Specification 1 in the main recommendation for cool season grass areas. If necessary, develop a color coding system for perimeter stakes so that field personnel do not confuse cool season grass management zones.

2. Follow mowing specification 2 in main recommendation for cool season grass areas. Adhere to Best Mowing Practices.

3. To set back cool season grasses during their most active growth, mow target area with a cutting bar type mower on May 15 and again on June 15. If only one mowing is possible, conduct the June mowing. In the event of a warm, wet spring when native warm season species emerge early, target areas should be mowed no later than June 1.
RATIONALE – Sequential spring cuttings disadvantage actively growing cool season grasses and weeds over intermingled warm season grasses, which are just beginning their growth cycle. See Best Mowing Practices for ways to minimize impacts to ground-nesting birds.

NOTE – The need for sequential spring cuttings to set back cool season grasses should be assessed after year five (5) of implementing sequential spring cuttings, by which point the native warm season grasses should be well established and competitive. Spring mowings could then occur every other year or be discontinued.

a. Work with a local birder to monitor for the presence of nests and breeding pairs in the target area. To the extent possible, emphasize distant observations and call identification over walking the area, which risks trampling nests and disturbing nesting birds. If nests are observed, flag location to within fifteen feet (15’) and avoid any further activity within the flagged area for the remainder of the breeding season.

b. Using a cutting bar type mower, cut target area to approximately 4”. Adhere to Best Mowing Practices.

RATIONALE – See Best Mowing Practices for reasons to use a cutting bar type mower.

c. Remove nest zone flagging so that predators do not associate flags with the presence of nests.

4. In late June or early July, if approved for use in New York, distribute flea beetles (*Aphthona* spp.) in target area(s) to control Spurge species. See Spurge species entries in Section X for additional information on Spurge biocontrol.

RATIONALE – Release of *Aphthona* spp. flea beetle combined with targeted spot herbicide applications can be used to control Spurge species. At the time this manual was produced, however, it has not been determined whether Spurge biocontrols are approved for use in New York.

5. On August 15 after bird breeding ends, monitor for weeds following Specification 4 procedures in main recommendation for cool season grass areas.

6. In mid-September, monitor for weeds, following procedures in Specification 4 in main recommendation for cool season grass areas.

7. Apply Sulphur to target areas.

RATIONALE – Sulphur applications reduce the soil pH to levels that favor the growth of desired warm season grass species over the growth of exotic cool season grasses and many weeds, which cannot tolerate lower soil pH.

< Specification on sulphur application rates, timing, and methods can be provided following provision of soil samples for target area.>
Alternative B for Non-native Cool Season Grass Areas: Eradicate existing cool season grasses and seed a mosaic of native grasses and forbs.

RATIONALE – Eradicating cool season grasses and any weeds followed by seeding native species enables optimal habitat diversity. For example, short grass communities used by Killdeer and Vesper Sparrows could be seeded in drier, hotter areas while tall grass plant communities used by Eastern Meadowlarks could be seeded in wetter areas suited to taller growth.

1. In March when the ground is no longer frozen, delineate target area(s) according to Specification 1 in main recommendation for cool season grass areas. If necessary, develop a color coding system for perimeter stakes so that field personnel do not confuse cool season grass management zones.

2. Between March 1 and March 22 cut back the prior year’s residual top growth in entirety or in swathes according to Specification 1 in the main recommendation for cool season grass areas. Adhere to Best Mowing Practices.

3. In late June or early July, if approved for use in New York, distribute flea beetles (*Aphthona* spp.) in target area(s) to control Spurge species. See Spurge species entries in Section X for additional information on Spurge biocontrol.

RATIONALE – Release of *Aphthona* spp. flea beetle combined with targeted spot herbicide applications can be used to control Spurge species. At the time this manual was produced, however, it has not been determined whether Spurge biocontrols are approved for use in New York.

4. On August 15 after bird breeding ends, begin preparing the target area(s) using Site Preparation Specifications in Section VII.B.

NOTE – The proposed Site Preparation Specifications (fully detailed in Section VIII.F) present the fewest possible short-term impacts to the bird breeding period. The strategy is less optimal for weed control because it does not include an entire growing season in which weed seeds can germinate and then be targeted.

5. In the following year, seed target area(s) using Seeding Specifications in Section VII.C. For seed mix options, see Seed Mix Specifications in Section VI.E.

6. Manage seeded areas according to Specifications for Seeded Areas in Section VI.F.

7. If desired in order to increase forb species diversity, install live plants in the fall after the seeding’s first season of growth. See Live Plant Combinations in Section VI.F and Planting Specifications in Section VII.D.
LOWER PRIORITY – Mugwort Areas (approx. 45 acres)

NOTE – While other zones are being stabilized, Mugwort must be suppressed and prevented from setting seed or otherwise spreading. Adhering to Best Mowing Practices and other strategies as specified will help reduce impacts whenever mowing is required during the bird breeding season. Small patches of Mugwort occur around some monitoring wells in other vegetation zones, likely due to soil imports containing Mugwort fragments. Weed control in these zones should treat Mugwort to prevent further spread.

Interim Management of Monotypic Mugwort Stands

Mow sequentially as necessary to suppress growth throughout the growing season and prevent seed set. Mowing should ideally occur after bird breeding ends but before Mugwort can form seed.

RATIONALE – Interim suppression of Mugwort dominated zones is critical while management efforts are focused on stabilizing higher quality areas. Mowing Mugwort repeatedly during the growing season has been shown to reduce its growth rate and biomass, although the degree of reduction may vary by habitat and presence of other vegetation (Barney et al, 2005). Note that sequential mowing can suppress but not eradicate Mugwort and is most effective along invasion fronts and on satellite populations than on well-established stands. Mowing on August 15 at the end of bird breeding is recommended, but if the growing season is particularly wet and vegetative growth vigorous, mowing prior to August 15 may be necessary in order to prevent seed formation.

1. In March when the ground is no longer frozen, delineate the perimeter of Mugwort monotypic stands using evidence of the prior year’s growth to identify the approximate extent. If it is too difficult to delineate the area at this time, delineate in April prior to the start of bird nesting on April 22. Mark the perimeter of the target area using 5’ rebar stakes with the top 12” painted orange to correspond to the Existing Vegetation Zones Map in Fig. 37. Space rebar as widely apart as possible while still maintaining readability of the area’s perimeter.

RATIONALE – Target areas should be delineated so they are not confused with adjacent areas requiring different management actions. As field personnel become more familiar with problem weed species, area delineation may no longer be necessary.

2. Between March 1 and March 22, mow residual growth (if not already cut back from the previous years) in target areas to 2-3”. Adhere to Best Mowing Practices. In locations inaccessible to a mower (around delineation rebar, on steep slopes, etc.), string trim vegetation to the specified height.

3. In early August, check Mugwort stands to ensure Mugwort is not flowering. In the event of a warm, wet spring, monitor Mugwort for early flowering.

4. On August 15 after bird breeding ends, mow target areas adhering to Best Mowing Practices. If flowers are forming in early August and mowing is required before
August 15 to avoid Mugwort setting seed, work with a local bird expert to monitor for the presence of nests and breeding pairs in the target area (although avian use of Mugwort for breeding is unlikely). If nests are observed, flag location to within fifteen feet (15') and avoid all activity within the 15' buffer for the remainder of the breeding period.

a. Mow growth with a rotary-style mower to 2-3” or to a stubble height in which no foliage remains (much of the foliage on late summer growth is high along the stem).

b. In locations inaccessible to a mower (steep slopes, etc.), string trim vegetation to the specified height. String trim Mugwort shoots that have extended beyond the perimeter of the main stand. (Mugwort is rhizomatous with below-ground runners that produce new above-ground stems beyond the main colony.)

5. Once regrowth reaches 12”, mow Mugwort stands again, adhering to Best Mowing Practices. Check beyond the perimeter of target areas for emergence of new Mugwort growth and string trim emergent growth, avoiding intermingled desirable vegetation.

Interim Management of Mugwort Areas with Bedstraw, Leafy Spurge, and Other Weeds

Suppress existing growth and prevent from forming seed or otherwise spreading.

RATIONALE – Interim suppression of Mugwort dominated zones is critical while management efforts are focused on stabilizing higher quality areas. Sequential mowing and spot herbicide applications as necessary will keep these zones from expanding further until management resources can focus on eradicating Mugwort dominated zones and reseeding with desired vegetation.

1. In March when the ground is no longer frozen, delineate area using 5' rebar stakes with the top 12" painted tan to correspond to the Existing Vegetation Zones Map in Fig. 32. Use delineation procedures as outlined in Specification 1 in Montotyic Mugwort Stands.

2. Between March 1 and March 22, mow residual growth (if not already cut back from the previous years) in target areas to 2-3". Adhere to Best Mowing Practices. In locations inaccessible to a mower (around delineation rebar, on steep slopes, etc.), string trim vegetation to the specified height.

3. In late June or early July, if approved for use in New York, distribute flea beetles (Aphthona spp.) in target areas to control Spurge species. See Spurge species entries in Section X for additional information on Spurge biocontrol.

RATIONALE – Release of Aphthona spp. flea beetle combined with targeted spot herbicide applications can be used to control Spurge species. At the time this manual was produced, however, it has not been determined whether Spurge biocontrols are approved for use in New York.

4. In early August, check Mugwort stands to ensure Mugwort is not flowering. In the event of a warm, wet spring, monitor Mugwort for early flowering.

5. On August 15 after bird breeding ends, mow Mugwort dominated zones according to Specifications 4 in Monotypic Mugwort Stands above.

6. Once regrowth reaches 12”, mow Mugwort dominated zones again adhering to Best Mowing Practices. Check beyond the perimeter of target areas for emergence of new Mugwort growth and string trim emergent growth, avoiding intermingled desirable vegetation.
Recommendation for All Mugwort Areas

Eradicate all vegetation in existing Mugwort dominated areas and seed with native grasses and wildflowers resistant to the selective herbicides for targeting Mugwort.

RATIONALE – Seed mixes consist of tall, vigorous native species able to establish quickly, compete with Mugwort regrowth, and resist the herbicide used to target Mugwort. Desirable species can thus be establishing while any persistent Mugwort is controlled. Species that are not resistant to the herbicide used for targeting Mugwort can be added in live plant form once Mugwort is under control.

NOTE – The eradication and seeding strategy proposed presents the fewest impacts to the bird breeding period. It is less optimal for weed control because it does not include an entire growing season in which weed seeds can germinate and then be treated with herbicide.

1. In March when the ground is no longer frozen, check delineation stakes in relevant target area(s), assuming delineation stakes were installed in prior years during interim suppression.

2. Between March 1 and March 22, mow residual growth in target area(s) to 2-3". Adhere to Best Mowing Practices. In locations inaccessible to a mower (around delineation rebar, on steep slopes, etc.), string trim vegetation to the specified height.

3. In late June or early July, if approved for use in New York, distribute flea beetles (Aphthona spp.) in target area(s) to control Spurge species. See Spurge species entries in Section X for additional information on Spurge biocontrol.

RATIONALE – Release of Aphthona spp. flea beetle combined with targeted spot herbicide applications can be used to control Spurge species. At the time this manual was produced, however, it has not been determined whether Spurge biocontrols are approved for use in New York.

4. On August 15 after bird breeding ends, begin preparing the target area(s) using Site Preparation Specifications in Section VII.B.

NOTE – The proposed Site Preparation Specifications (fully detailed in Section VII.B) present the fewest short-term impacts to the bird breeding period. The strategy is less optimal for weed control because it does not include an entire growing season in which weed seeds can germinate and then be targeted.

5. The following year seed target area(s) using Seeding Specifications in Section VII.C. Use Tallgrass Lowland Mix SM3 and/or SM4 (see Seed Mix Specifications in Section VI.C).

6. Manage seeded areas according to Specifications for Seeded Areas in Section VIII.E.

7. If desired in order to increase forb species diversity, install live plants in the fall after the seeding’s first season of growth and assuming Mugwort is appropriately under control. See Live Plant Combinations in Section VI.D and Planting Specifications in Section VII.D.
E. MANAGEMENT OF SEEDED AREAS

SHORT TERM (YEAR 1) PROCEDURES FOR SEEDED AREAS

1. Year 1 for a spring seeding represents that season’s growth.

1. If not already delineated, mark the perimeter of the target area to ensure it is not confused with other vegetation zones. Use 5' rebar stakes with the top 12'' color coded. Use small diameter rebar to discourage raptors from perching. Space rebar as widely apart as possible while still maintaining readability of the area perimeter.

2. During the growing season whenever growth reaches 12-14", mow all seeded areas monthly to approximately 4" using a cutting bar mower. Adhere to Best Mowing Practices. In locations inaccessible to a mower (around delineation stakes, wet areas, steep slopes, around planted trees, etc.), string trim vegetation to the specified height.

RATIONALE – Monthly cuttings allow the seedlings of seeded species, which do not grow more than a few inches in height in the first year of growth, to receive necessary sunlight. Monthly cuttings also help prevent herbaceous weeds from maturing to the point where they can form and disperse seeds.

NOTE – Sequential cuttings during the bird breeding season will disturb ground nesting birds but in order to restore more suitable habitat, temporarily forgoing breeding site disturbance in favor of restoring quality habitat is recommended under the assumption that the long-term benefits outweigh temporary habitat loss. Cutting strategies have also been developed to minimize adverse impacts.

Fig. 38: Monthly mowing of cover crop and weeds in the first year of growth.

3. Monitor monthly for weeds during the growing season and treat as necessary.

RATIONALE – Timely weed control is critical during the establishment phase since weed competition can have the largest inhibitory effect on establish in the first year, overwhelming developing seedlings and compromising long-term grassland development. Also, the earlier
problem species are detected, the easier the control. In subsequent years, as seeded species achieve dense, weed-suppressive cover, need for weed control will decrease.

NOTE – Like the sequential cuttings during the bird breeding season, monthly weed control during the growing season risks disturbing nesting and fledging birds but is necessary in order to successfully establish quality warm season grass habitat. To minimize impacts, spot weed control with a backpack sprayer is recommended over use of tractor or ATV mounted applicators.

a. Monitor for weeds and identify species. Select appropriate control in Section X.

b. Schedule and conduct control treatment(s) as needed. Spot treatment with backpack sprayer is preferable but in cases of widespread infestation, affected areas should receive blanket applications as directed on the herbicide label. Check target vegetation for the presence of nests. Field personnel should remain alert to the presence of ground foraging birds or juvenile birds less experienced at flying.

RATIONALE – An applicator wearing a backpack sprayer conducting spot weed control can avoid adverse impacts to nesting birds better than tractor or ATV mounted applicators.

c. Monitor treated area(s) to ensure treatment effectiveness. Schedule and conduct follow-up treatment(s) as necessary.

4. In November, monitor for any bare or disturbed soil caused by physical damage to plantings or poor germination of the original seeding and spot reseed as necessary. Areas with a greater than 33% slope should be scheduled for spot reseeded in June to avoid erosion during the winter.

RATIONALE – Reseeding bare and disturbed areas helps prevent weed populations from becoming established.

a. Remove any existing weeds using physical means and/or spot herbicide applications.

b. Allow three to four (3-4) weeks for weed seedlings to emerge and then treat prior to beginning the seeding process

c. Scarify the soil surface.

d. Mix the original seed mix with sawdust or woodshavings, which serve as a carrier and indicate where seeding has occurred.

e. Hand broadcast seed evenly.

f. Cut seed into the soil ⅛-¼".

g. Tamp or roll the soil surface to ensure good soil-to-seed contact.

h. Apply a cover of 50% PennMulch at a rate that ensures light can penetrate to the soil surface and allow seed germination.

i. Mark reseeded areas for receiving first year management procedures as specified in Short Term/Year 1 Procedures.
LONG TERM (YEAR 2+) PROCEDURES FOR SEEDED AND CONVERTED AREAS

1. Between March 1 and March 22, cut back the prior year's residual growth in entirety or in 300'-wide swathes such that strips of prior growth are allowed to remain for another growing season to provide cover and forage for birds until emergence of new growth. If residual growth is to remain in another section of the grassland, mow in entirety.

   RATIONALE – See Best Mowing Practices.

   a. Determine if mowing area in entirety or in swathes leaving 300'-wide strips of standing residual vegetation.
   b. Assess whether stakes delineating the area perimeter are still necessary and if so, adjust as needed.
   c. Mow the previous year's growth to approximately 4". Adhere to Best Mowing Practices.
   d. In locations inaccessible to a mower (around area delineation stakes, on steep slopes, etc.), string trim vegetation to the specified height.

2. In early June, spot mow if necessary to set back cool season grasses.

   RATIONALE – Although a late spring mowing disturbs breeding ground nesting birds, cutting in late spring disadvantages intermingled, actively growing cool season grasses and weeds over warm season grasses, which are just beginning their growth cycle. The techniques recommended below are designed to limit disturbance to breeding birds.

   NOTE – Need for sequential spring cuttings to set back cool season grasses should be assessed after year five (5), by which point the native warm season grasses should be well established and competitive. Spring mowings could then occur every other year or be discontinued.

   a. Work with a local bird expert to monitor for the presence of nests and breeding pairs in the target area. Emphasize distant observations and call identification over walking the target area, which risks trampling nests and disturbing nesting birds. If nests are observed, record location, and flag location to within 15 feet and avoid all activity within that 15' buffer for the remainder of the bird breeding season.
   b. Using a cutting bar type mower, mow target area once to approximately 4". Adhere to Best Mowing Practices.

   RATIONALE – For rationale on use of a cutting bar-type mower during the breeding season, see Best Mowing Practices.
   c. Remove nest zone flagging so that predators do not associate flags with nests.

3. If necessary, in late June or early July, if approved for use in New York, distribute flea beetles (Aphthona spp.) in target area(s) to control Spurge species. See Spurge species entries in Section X for additional information on Spurge biocontrol.

   RATIONALE – Release of Aphthona spp. flea beetle combined with targeted spot herbicide applications can be used to control Spurge species. At the time this manual was produced, however, it has not been determined whether Spurge biocontrols are approved for use in New York.
4. On August 15 after bird breeding ends, monitor for weeds and treat as necessary per standard weed control practices detailed in Short Term/Year 1 Procedures. To maintain a "cared for" appearance in visually prominent areas if desired, schedule string trimming of dead treated vegetation two (2) weeks following any systemic herbicide applications. To ensure herbicide can translocate to the roots of treated vegetation, cutting treated top growth should not occur less than two (2) weeks after systemic herbicide application.

5. On August 15 after bird breeding ends, delineate the Shortgrass Upland Zone (if not already delineated) and cut back with a rotary-style mower to twelve inches (12"). This will set back any non-shortgrass species, thereby maintaining the integrity of this zone. Adhere to Best Mowing Practices.

RATIONALE – If not suppressed, non-shortgrass species from surrounding zones will invade seeded Shortgrass zones. Topcutting the Shortgrass zone to 12" will not harm the seeded shortgrass species as all of the species included in the Shortgrass Upland mix (SM1) have been selected for growing to less than 12" (excluding some species that seed heads above 12"). Mower operators should remain alert to the presence of ground foraging birds, particularly juveniles which may still be inexperienced flyers.

6. In mid-September, monitor for weeds and treat as necessary per standard weed control practices detailed in Short Term/Year 1 Procedures.

7. Spot reseed as necessary in November (see Reseeding Specifications as detailed in Year 1 specifications).
F. MANAGEMENT OF PATHWAY VEGETATION

Width of Monitoring Well Access Paths
To reduce disturbance to bird habitat, pathways should be one mower-width wide or the minimum required for maintenance access.

Adhere to Best Mowing Practices
In maintaining pathways, adhere to Best Mowing Practices to the extent possible. Mower operators should also remain alert for the presence of birds, some of which may use the shorter growth in mown paths for foraging and nesting. Note that juvenile birds during the breeding season and migration season may also be inexperienced fliers and so may fly erratically or may be slow to fly out of the way of moving mowers.

Optimum Mowing Path Configuration
Section VI.D of this manual presents a monitoring well access path configuration that significantly reduces the overall footprint of routine mowing and the habitat disturbances associated with routine mowing of paths. The proposed configuration expressly aims to avoid path layout that cuts through larger grassland sections and aligns with a mowing configuration proposed by the Department of Parks, Recreation, and Conservation, with a few exceptions as noted in Section VI.D. The new configuration should be marked out with spray paint at the first time mowing of paths is required in the growing season. Thereafter, vegetation height differentials should make the path route evident.

If Reseeding
If reseeding an area, the path can be seeded with the mix being used for that area and the path mowed as normal.

Path Mowing Specifications
1. Use a rotary-style mower during the growing season to mow pathways to approximately 4" whenever growth reaches 8". In locations inaccessible to a mower (wet areas, steep slopes, etc.), string trim vegetation to the specified height. Adhere to Best Mowing Practices.

2. Include pathways in post-breeding season weed control. Monitor for weeds, identify species, and control as necessary. Be sure to monitor for Mugwort, which is located around many monitoring wells throughout the grassland. Even if suppressed by mowing, Mugwort could continue to spread vegetatively and so should be controlled as necessary.
Section IX: Additional Habitat Enhancement Recommendations

VIII. ADDITIONAL HABITAT ENHANCEMENT MEASURES

A. VOLUNTEER BIRD MONITORING PROGRAM

Bird Monitoring Is Key to Project Success

Monitoring how target bird species respond to implementation of vegetation management and design specifications will enable management actions to be refined and improved as necessary. Effectively monitoring bird populations in the Croton grassland will require help, however, from experienced birders able to monitor the grassland in different seasons, namely the breeding period (April 22–August 15) and during fall and winter migrations (March–May, August–November). Fortunately, the Park is already a popular regional birding spot with regular, often daily visitations, and the Croton Point Discussion Group includes knowledgeable birders who could form the nucleus for a monitoring group. Local birding groups and National Audubon Society chapters could also be sources for interested, engaged volunteers, some of whom might have the skills and resources to track and interpret collected data. Some of this data is already available through eBird (see Section X.J References and Resources for the link to Croton Park sightings on eBird).

A Practical Approach to Volunteer Monitoring

Volunteers cannot be expected to engage in the kind of research that scientists consider ideal for assessing habitat restoration projects. Volunteers have neither the expertise nor the time or resources to band birds, monitor nests, set up artificial nest experiments, or calculate survival and reproduction rates. While academic researchers could do this, they typically select study sites suited to their research questions, and the Croton grassland is unlikely to be selected as a study site at this time. That stated, bird responses to restoration of the Croton grassland might be of interest to graduate student-level researchers (Buckley, personal communication, 2015).

Imperfect monitoring parameters need not preclude the gathering of useful information, however. Volunteers could walk the site and identify the location of target species using handheld GPS devices or spot locate them on a map using monitorings wells as reference points. Eight to ten visits during the breeding season with corresponding spot mapping could delineate approximate breeding territories (Robbins, 1970). Data collected by volunteers could be further enhanced by eBird listings. If this effort is too intensive, fewer visits would likely be sufficient to produce a general index of abundance, particularly if sustained for ten or twenty visits. Visits during July and August could gauge the abundance of family groups, thereby giving an indication of whether target species are reproducing successfully.

Fig. 39: Birders in the Croton grassland, June 2013. Photo by Joe Larese.
Source: http://gardening.lohudblogs.com/2013/06/24/in-the-news-20/
Spring and fall migration data is an equally valid habitat quality metric to breeding and overwintering population statistics (Buckley, personal communication, 2015). Monitoring efforts during spring and fall migration (March-May and August-November) should attempt to quantify how many of which target species along with additional species if possible use the Croton grassland and for how long they remain and in what areas.

Mapping bird locations could also reveal what vegetation communities and types are attracting what species so that the management personnel can then expand or reduce an area depending on monitoring results. Volunteers trained in use of the Visual Obstruction Method with the the Robel Pole could also measure vegetation height density in areas where target species are occurring (see Appendix H in Section X for a description of the Robel Pole Method and directions on its use).

**Volunteer Monitorers Can Provide Important Outreach**

Volunteer monitorers could also provide an informal but critical face to the Croton grassland restoration and the Park's grassland bird habitat protection measures. The presence of volunteers and their interactions with Park users could help explain the Park's efforts in a way that signs and other forms of outreach cannot. Assuming volunteers are informed about the Park's overall approach, they could help to dispel misunderstandings about management actions that might need to occur during the bird breeding period in order to improve grassland habitat conditions over the long term.

**Future Possibilities for More Intensive Monitoring**

More intensive monitoring programs could be initiated if funds become available. Moreover, should large numbers of grassland birds be attracted to Croton, academic researchers might prove interested in studying the site. Population growth rates, which are more prudent measures of habitat fitness than species abundance or density, could then be studied. Ultimately, understanding factors that contribute to population growth rates and implementing strategies that enhance these rates are critical to sustaining viable populations in grasslands like Croton.
B. PARK MAINTENANCE & INFRASTRUCTURE

Below are recommendations for Park maintenance practices and infrastructure that could further enhance habitat for target grassland bird species (some of these measures may already be in place):

- Ensure trash is removed promptly as it attracts predators such as raccoons and skunks that then prey on ground nesting birds and their eggs.
- Reduce or eliminate insecticide use on the Park's ornamental plantings. This will help to enhance insect forage for breeding birds and their young (insects serve as the primary food source for rapidly growing chicks and fledglings).
- Where possible, create 100-foot shrub buffers along woodland perimeters to soften abrupt habitat edges. Predation rates from crows, jays, skunks, raccoons, opposums, foxes, and cats are higher near abrupt edges, as is brood parasitism by brown headed cowbirds.
- Avoid use of recorded call playbacks for the purposes of simulating occupancy and encouraging residency by conspecifics. Call playbacks should be used only where habitat is of very high quality and associated with extremely high priority species.

C. EDUCATION & OUTREACH

Below are recommendations for reaching out to and educating Park users about ongoing efforts to maintain and improve grassland bird habitat.

- Post dog leashing requirements and educate dog walkers about the importance of leashing dogs to protect nesting birds and their young.
- It has also been recommended that jogging, dog walking, and all pets should be interdicted from the grassland area year-round, although success with this approach would only be as good as it is possible to enforce (Buckley, personal communication, 2015).
- Limit non-essential access to the grassland minimally during the breeding season (April 22–August 15) and possibly during the migration periods as well (March–May, August–November). Post "Grassland Bird Habitat Area - Do Not Disturb" signs along the perimeter and at relevant access points. Note that the grassland area should remain open to birders.
year-round provided they remain on pathways. Maintaining the goodwill of the grassland's supporters and best source of important volunteer data should not be underestimated.

- Use the proposed Volunteer Bird Monitoring group to serve as on-the-ground ambassadors for the grassland restoration initiative and its importance to grassland nesting bird species.

- Provide habitat observation areas with educational signage to increase public awareness and appreciation of the unique habitat type provided by large grasslands. Habitat observation areas should be low profile and to the extent possible located along the grassland periphery in order to avoid disturbing interior habitat.
X. WEED CONTROL GUIDE

A. OVERVIEW

Definitions of weeds and invasive species are not always straightforward and sometimes cause heated debate. For the purposes of this document, the terms problem weed or invasive species refer to species that, if not managed, could jeopardize the function, habitat value, and aesthetic integrity of the Croton grassland, particularly during the early years of growth in newly planted areas.

Weeds and invasive species share certain traits: they are regionally widespread and disturbance-adapted, have high relative growth rates, can thrive in a wide range of habitats, often have multiple means of vigorous reproduction, and can adapt easily to changing conditions, including altering flowering times or resource allocation. These traits are not limited to exotic (a.k.a., nonnative or nonindigenous) species. Some native plants (such as Canada Goldenrod \([\text{Solidago canadensis}]\) are highly aggressive and can become so abundant that unless controlled they will degrade species diversity over time. It is also important to remember that invasion success (or failure) typically results from a series of interacting factors, including invader traits, habitat characteristics, and the nature and timing of disturbance.

Control strategies for weeds and invasive species have complicated ecological, social, and economic dimensions. Methods recommended in this manual take into account local and state regulations, the semi-urban context of Croton Point Park, and the characteristics of species found onsite and nearby. All of the methods recommended are designed to exploit strategic differences between weeds and desirable species, including growth period, growth height, and herbicide tolerance. Control methods consist of timed cuttings and targeted spot applications of organic and/or synthetic herbicides, with spot applications being preferable to broadcast treatments. The amount of control required will depend on when the problem is addressed, the nature of the invading species, and the degree to which it displaces seeded or desirable existing species.

Most people understandably prefer to avoid herbicides, but when properly applied, targeted herbicides often have fewer adverse impacts on soils and surrounding vegetation than mechanical controls, in addition to being less labor and time intensive than most physical control methods. Herbicides are also sometimes the only effective means of controlling particularly pernicious species without massive site disturbance, which has its own set of maintenance and ecological costs.

**Key Control Practices**

1. Monitor routinely, particularly early on in the planting's growth and in more vulnerable areas, such as the edges of the planting where invasion is more likely to occur. Control is the easiest and the most economical with early detection since it is easier to treat a weed as soon as it is appears than to wait until it is established and reproducing.

2. Maintain a healthy cover of desired vegetation. In robust, mature, well-managed plantings, weeds rarely present a significant problem because the desired plantings outcompete undesired species for water, sunlight, and soil nutrients.

3. Thoroughly clean all tools and equipment prior to performing work in the grassland.
to avoid spreading seeds of undesired plants from one area to another.

4. Monitor following any treatments to assess treatment efficacy and to ensure new undesired species do not fill the void of eradicated species.

Profiled Weed Species

Weeds and invasive plant species observed in the Croton grassland or nearby are profiled by vegetation type (e.g., forbs, grasses, trees, shrubs, and vines) and in alphabetical order by botanical name. Species that could occur based on regional invasive plant populations are also profiled, although the species profiled are not intended to represent all possible problem weeds. If a species is observed that is not included here, consult LWLA for assistance with identification and appropriate controls or consult the resources listed in Section X.J.

Perniciousness Ratings

The entry for each weed begins with a rating of perniciousness for presence in a grassland community. Degree of perniciousness is affected by a range of factors including site location and conditions and so this rating should be considered an approximation only.

<table>
<thead>
<tr>
<th>Perniciousness Rating in Grasslands</th>
</tr>
</thead>
<tbody>
<tr>
<td>mildly</td>
</tr>
<tr>
<td>moderately</td>
</tr>
<tr>
<td>very</td>
</tr>
<tr>
<td>0 1 2 3 4 5 6 7 8 9 10</td>
</tr>
</tbody>
</table>

Control Options

Each weed profile includes control options as shown in the example below. Definitions of the control techniques and herbicides listed appear in Sections X.D and X.E.

<table>
<thead>
<tr>
<th>CONTROL OPTIONS</th>
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<tbody>
<tr>
<td>Herbicide:</td>
</tr>
<tr>
<td>Synthetic:</td>
</tr>
<tr>
<td>Organic:</td>
</tr>
<tr>
<td>Timing:</td>
</tr>
<tr>
<td>Mechanical:</td>
</tr>
<tr>
<td>Timing:</td>
</tr>
</tbody>
</table>

Each entry also includes an impact description, habitat information, geographic range, information on regenerative ability, and identifying characteristics with corresponding photographs. Unless noted otherwise, information on seed viability comes from *Weeds of North America* (Dickinson and Royer, 2014).
Recordkeeping

Space for recordkeeping is included in each weed profile. Recording the abundance and treatments times for problem weeds can aid the tracking of treatment results and may prove helpful to future site managers trying to understand site history and its impact on vegetative compositions and site trajectories.
**Equisetum arvense**

**Field Horsetail (Horsetail Fern, Bottle Brush)**

Equisetaceae Family (Equisetum Family)

**Perniciousness Rating** (for grasslands)

<table>
<thead>
<tr>
<th>Rating</th>
<th>Description</th>
</tr>
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<tbody>
<tr>
<td>0</td>
<td>mildly</td>
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<tr>
<td>1</td>
<td>moderately</td>
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<tr>
<td>2</td>
<td>very</td>
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</table>

**CONTROL OPTIONS**

**Herbicide:** Spot, wick, or broadcast application to non-fruiting stems

- **Synthetic:** Sedgehammer® in uplands
- **Timing:** Spring (most effective when non-fruiting stems are < 6” tall).
  Herbicide will suppress but not eradicate growth when > 6” tall.
- **Note:** This species is difficult to treat with herbicide. Lack of leaf area and silica in the stem may reduce herbicide uptake and translocation.

**Mechanical:** Cutting non-fruiting stems at the base

- **Timing:** As soon as observed. Recut regrowth before it reaches 8-10” as necessary until the root system is exhausted.
- **Note:** Tillage and digging can encourage the spread of established stands by dispersing rhizomes and tubers.

**Impacts**

Disturbance-adapted native colonizer of bare ground that forms large stands, increasing in size via branched and creeping rhizomes that can reach depths of 6’. Likely allelopathic due to high level of alkaloids in the roots.

**Habitat**

Roadsides, ditches, railroad tracks, pastures, and old fields. Grows in many soil types but thrives on sandy, neutral to slightly basic soils in areas with a high water table and poor drainage. Generally intolerant of drought.

**Range**

Native throughout the United States and Canada.

**Regeneration**

Reproduces primarily via extensive rhizomes that bear small tubers. Can also reproduce via wind dispersed spores released in the early spring.

**Identification**

Small terminal cone (strobilis) atop unbranched brownish-to-pale-pink succulent fruiting stalk emerge to produce spores in mid-April through May. Fruiting stalks are up to 1’ tall. Stiff, hollow, jointed vegetative stems emerge in late May after the fertile stems have withered. The green vegetative stems, which grow up to 2’ tall, produce whorls of secondary branches (hence the common name “bottle brush”). These vegetative stems, which are rough to the touch, turn black and die back in the fall.
**Equisetum arvense in the Croton grassland**
(e.g., dates observed, abundance, treatments, etc.)

Not listed in July 2000 plant survey.  
May 2014: Rare-to-scattered populations observed in drainage ditches.

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**Look Alikes**

*Equisetum hyemale* (Scouring Rush) has an evergreen green and greenish-brown stem that, unlike *Equisetum arvense*, lacks or has very few secondary branches.

**Caution**

Soils where *E. arvense* have been growing should not be transferred to other sites as it could allow for dispersal of the species through regeneration of rhizomes and tubers remaining in the transported soil.

IMAGE CREDITS: wikipedia.org
**Alliaria petiolata**  
Garlic Mustard  
Brassicaceae Family (Mustard Family)

**Perniciousness Rating** (for grasslands)  
mildly------------moderately-----------------very

<table>
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<tr>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
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<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
</tr>
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</table>

**CONTROL OPTIONS**

**Herbicide:** Spot, wick, or broadcast application

**Synthetic:** Garlon® in uplands  
Renovate® in wetlands

**Organic:** Scythe® in wetlands (use only when non-target vegetation is dormant)

**Timing:** November – March when temperatures are above freezing. Best control occurs before the first hard freeze of the season. Missed plants can be string trimmed to the ground in the spring (achieves approx. 90% mortality).

**Mechanical 1:** Cutting at base

**Timing:** May, prior to second year plants flowering

**Note:** Regrowth may occur on cut first year specimens but seed production in the subsequent year will be lessened. Second year plants cut at flowering should bagged and disposed of as seeds can still develop and disperse on cut plants.

**Mechanical 2:** Physical removal by the roots

**Timing:** As soon as observed or before second year plants set seed in May and June.

**Note:** Best for small populations since soil disturbance may disturb soil pathogens that naturally reduce garlic mustard populations over time.

**Biocontrol:** Under research and not available at this time

**Impacts**
Rapidly growing exotic biennial that can form large colonies. Allelopathic chemical exuded by the roots suppresses the growth of other plants. Also inhibits mycorrhizal fungi important to the functioning of many native plants (Stinson et al, 2006). Ecological trap and population sink for the native Pieris butterfly species, which rely on plants in the same family (adults lay eggs on garlic mustard but when eggs hatch larvae cannot feed on the foliage due to the plant’s chemistry) (Chew, 1980). One study suggests garlic mustard did not have a measurable impact on plant species richness (Blossey, 2005) and that the vigor of garlic mustard populations decline over time due to soil pathogens (Blossey and Nuzzo, unpublished data).

**Range**
Native to Europe. Introduced and widespread in the eastern and midwestern United States. Also found in the Pacific Northwest and southern Alaska.

**Habitat**
Woodlands, woodland edges, riparian areas, roadsides, and disturbed environments, then spreading into less-disturbed areas.

**Regeneration**
Insect and self pollinated. Seeds disperse via water, animals, people, vehicles, and movement of soil. Soil trampling by white tailed deer may also contribute to spread (Blossey, 2003). Seeds germinate in the early spring or the subsequent fall after the necessary winter chilling period. Seed viability is thought to be short lived (approximately 5 years), although survival of only a few specimens can quickly lead to repopulation of an area since a single plant can produce thousands of seeds. Seedling densities are high but approximately 50% seedling mortality is typical by the end of May.

**Identification**
Seedlings emerge in the early spring and by early summer form a rosette of kidney shaped leaves with scalloped edges. First-year plants overwinter as basal rosettes. A second year plant sends up a single 1-to-3’ tall flowering stalk in mid spring with small clusters of white, 4-petaled flowers. Alternately arranged leaves along the flowering stalk are more toothed and triangular shaped than those in the rosette. Whitish taproot with a slight S-curve just below the soil surface. Plants die after forming seed, which occur in thin, 1 to 2.5” long seed pods (siliques) that turn tan by midsummer.

**Look Alikes**
Basal leaves resemble native Senecio, Viola, and Zizia spp. as well as nonnative ground ivy (Glechoma hederacea). Garlic mustard is distinguished by the garlicky odor of the crushed foliage. Fruiting structure resembles several other mustards.
**Alliaria petiolata** – seedlings, dense cover (first year plants)

**Alliaria petiolata** – basal rosettes (first year plant)

**Alliaria petiolata** – flowers (second year plant)

**Alliaria petiolata** – form in flower (second year plants)

**Alliaria petiolata** – fruit (second year plant, turns tan)

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**Alliaria petiolata in the Croton grassland** (e.g., dates observed, abundance, treatments, etc.)

July 2000: Listed in Croton grassland plant survey.


**IMAGE CREDITS:** www.ipane.org
Artemisia vulgaris
Mugwort
Asteraceae Family (Aster Family)

Perniciousness Rating (for grasslands)
mildly--------------moderately--------------very
0     1     2     3     4     5     6     7     8     9     10

CONTROL OPTIONS

Herbicide: Spot, wick, or broadcast application
Synthetic: Stinger® in uplands
Renovate® in wetlands
Timing: Late spring – fall, retreating as necessary. When feasible, treating post-bird breeding season (Aug. 15 or after) is recommended.

Mechanical: Repeated cutting at base
Timing: Late spring – fall, recutting regrowth as necessary. Will suppress growth but not eradicate. Handpulling is difficult as root fragments will resprout.

Biocontrol: None available at this time.

Impacts
Exotic herbaceous perennial that forms dense colonies in open areas. Allelopathic production in both leaf and rhizome tissue suppresses growth of other plants, causing a decline in species diversity. Residual effect of allelopathic chemicals may last for more than one season, making establishment of desired vegetation difficult.

Range
Common in the eastern United States and spreading to the West Coast.

Habitat
Found in meadows, old fields, roadsides, urban areas, and in agricultural areas in sun to part-shade conditions. Tolerant of high soil pH, compacted areas, and road salt.

Regeneration
Established populations spread prolifically by rhizomes, fragments of which can give rise to new plants. Seeds are dispersed by wind and water. There is little published data on seed production since most research has focused on vegetative reproduction. However, some reports document up to 200,000 seeds produced per plant depending on the growing environment (Barney and DiTommaso, 2003). Seed viability, which may vary by region but, is believed to be long. Seedlings and new vegetative shoots emerge throughout the growing season but are typically first observed in early May and beginning rhizome production about four weeks later. In the U.S., flower heads mature during the late summer months into early autumn (August to October).

Identification
Heavily lobed, pointed foliage resembles that of cultivated chrysanthemums. Leaves are alternately arranged along the stem. Undersides
Artemisia vulgaris

—are covered with white hairs, smooth to somewhat hairy above. Crushed foliage smells like sage. Flowers appear at the end of stems on a spike in late summer to early fall. Develops thick, woody stems by late in the growing season. Suckering white and tan roots. Can grow to 6’ tall. Exhibits extreme variation in morphology.

**Look Alikes**
Mature foliage can resemble Common Ragweed (*Ambrosia artemisiifolia*), although Ragweed lacks Mugwort’s silvery-white wooly hairs.

---

**Artemisia vulgaris in the Croton grassland**
(e.g., dates observed, abundance, treatments, etc.)

Not listed in July 2000 Croton grassland plant survey. May 2014: Abundant monotypic and mixed stands. (For approximate locations see Section IV.D, Fig. 12.).

---

**Caution**
Wind-born pollen in the late summer can be allergenic. Vegetation also uptakes heavy metals (zinc, copper, lead, and cadmium) such that cut vegetation should be disposed of appropriately in the event such metals exist in site soils.

IMAGE CREDITS: www.invasive.org, www.escience.com (top left)
**Centaurea biebersteinii (Centaurea maculosa)**

**Spotted Knapweed**

Asteraceae Family (Aster Family)

**Perniciousness Rating** (for grasslands)

mildly--------------moderately--------------very

0     1     2     3     4     5     6     7     8     9     10

---

**CONTROL OPTIONS**

**Herbicide:** Spot, wick, or broadcast application

**Synthetic:** *Stinger*® in uplands

*Renovate*® in wetlands

**Note:** Aminopyralid (alone or mixed with 2,4-D or Metsulfuron-methyl) and Picloram are registered for use on Spotted Knapweed

**Timing:** Early spring or fall, retreating as necessary

**Mechanical:** Cutting at base or root cutting

**Timing:** Soon after flowers open and before seeds mature.

**Biocontrol:** Multiple biocontrols have been released in the northwestern U.S. and southern British Columbia.

---

**Impacts**

Fast growing introduced allelopathic biennial or short-lived perennial. Can form monocultures that reduce plant species diversity and increase chances of erosion, surface runoff, and stream sedimentation due to lack of fibrous roots. Poisons would-be competitors by releasing catechins, which induce harmful reactive oxygen in neighboring plant roots. Chemical can persist in the soil long after eradication, making restoration difficult.

**Habitat**

Establishes in disturbed areas, rmeadows, open woodlands, and along roadsides.

**Range**

Introduced from Eurasia in the late nineteenth century and now found throughout most of the continental United States and eastern and western Canada. A particular problem on range and pasture in the western United States.

**Regeneration**

Reproduces by seed. One plant can produce thousands of seeds, which have a hard seed coat and a viability of approximately 5-10 years.

---

**Identification**

In the first year of growth, forms a basal rosette of 8”-long deeply lobed leaves on short stalks. In the second year, flowering stalks, which grow up to 3’, have alternate leaves deeply lobed toward the base and with fewer, smaller lobes toward the top. Short hairs on the surface with tough hairs on the leaf margins. Bachelor’s-button like flowers are pink to purple and sometimes white and appear in summer. Extensive taproot.

**Caution**

Plants irritate the skin on some individuals. Clean tools, footwear, clothing, tires, etc. after proceeding through infested areas where plants have set seed.

Centaurea biebersteinii in the Croton grassland
(e.g., dates observed, abundance, treatments, etc.)
Cirsium arvense
Canadian Thistle
Asteraceae Family (Aster Family)

Perniciousness Rating (for grasslands)
mildly--------------moderately--------------very
0     1     2     3     4     5     6     7     8     9     10

CONTROL OPTIONS

Herbicide: Spot, wick, or broadcast application
Synthetic: Stinger® in uplands
           Renovate® in wetlands
Organic: Scythe® in wetlands (to be used only when non target vegetation is dormant)
Timing: May, June, or fall when temperatures are above freezing (best control occurs prior to the first hard freeze). Retreat as necessary. When feasible, treating post-bird breeding season (Aug. 15 or after) is recommended.

Mechanical: Cutting at base or root cutting
Timing: Throughout growing season. Recut regrowth as necessary. May require 4+ years of repeat cuttings on a near monthly basis.

Impacts
Exotic herbaceous perennial capable of rapidly suppressing and displacing native vegetation. Produces vigorous new shoots from deep, creeping roots to form large colonies that outcompete desired vegetation. Allelopathic roots.

Habitat
Disturbed areas such as roadsides, pastures, drainage ditches and open, sunny, wet to moist areas.

Range
Native to Europe. Occurs throughout most of the northern United States.

Regeneration
Although a single plant can produce up thousands of seeds annually, the primary means of reproduction is the lateral allelopathic roots, which can grow up to 18’ in one growing season with new shoots every 3 to 6”. Seeds are reported to have extended viability of approximately 20 years.

Look Alikes
C. arvense resembles some native thistles, although these are unlikely to appear in the Croton grassland.

IMAGE CREDITS: www.ipane.org
Cirsium arvense in the Croton grassland
(e.g., dates observed, abundance, treatments, etc.)

July 2000: Listed in Croton grassland plant survey.
**Cirsium vulgare**

**Bull Thistle (Spear Thistle)**

Asteraceae Family (Aster Family)

**Perniciousness Rating** (for grasslands)

\[
\begin{array}{ccccccccc}
0 & 1 & 2 & 3 & 4 & 5 & 6 & 7 & 8 & 9 & 10 \\
\end{array}
\]

**CONTROL OPTIONS**

**Herbicide:** Spot, wick, or broadcast application

Synthetic: *Stinger*® in uplands

*Renovate*® in wetlands

Organic: *Scythe*® in wetlands (to be used only when non target vegetation is dormant)

Timing: May, June, or fall when temperatures are above freezing (best control occurs prior to the first hard freeze). Retreat as necessary. When feasible, treating post-bird breeding season (Aug. 15 or after) is recommended.

**Mechanical 1:** Cutting at base or root cutting

Timing: Throughout growing season as necessary, recutting regrowth as necessary.

**Mechanical 2:** Physical removal by the roots

(most effective at the seedling stage in moist soil).

Timing: Throughout the growing season as necessary.

**Impacts**

Exotic evergreen biennial that establishes readily on bare soil. Can be unattractive in flower.

**Habitat**

Vacant lots, pastures, grasslands, old fields, railroad and highway embankments, median strips, and margins of streams, ponds, and freshwater wetlands. Prefers moist, rich soil in full sun.

**Range**

Native Europe, Asia, and North Africa. Now widespread throughout the United States and southern Canada.

**Regeneration**

Wind dispersed seeds germinate in a variety of sunny habitats and soil types, including under lower moisture conditions. Does not regenerate vegetatively like *Cirsium arvense*. Plants growing in nitrogen-poor soils may take more than two years to flower. Seeds are reported to remain viable for up to five years.

**Identification**

Forms a rosette of spiny, dark green leaves about 8" long that remain evergreen through the winter. Taproot forms in the first year with secondary fibrous root system. Produces a tall, upright, branched flowering stalk in the following spring. Reddish purple flower heads appear from June to October and are about 1½". Spiny capsule forms following pollination and contains small seeds topped with a downy white apparatus to aid wind and animal dispersal. Alternate leaves covered with coarse to cobweb-like hairs and sharp spines on their lobes and bases. Up to 6' tall.

**Look Alikes**

*Cirsium arvense* (Canada Thistle) is a rhizomatous perennial with foliage that is smooth above and smooth or hairy below, in contrast to *C. vulgare* leaves, which are prickly hairy above and woolly-like below. *C. arvense* also occurs in clumps and does not have a basal rosette.

IMAGE CREDITS: wikipedia.org (top left), USDA-NRCS PLANTS Database / Britton, N.L., and A. Brown. 1913. An
Cirsium vulgare in the Croton grassland
(e.g., dates observed, abundance, treatments, etc.)

July 2000: Listed in Croton grassland plant survey.

Cirsium vulgare – flower, foliage, and seed form

**Conyza canadensis** (a.k.a. *Erigeron canadensis*)
**Marestail** (Canadian Horseweed)
Asteraceae Family (Aster Family)

**Perniciousness Rating** (for grasslands)
mildly-------------------moderately-------------------very
0 1 2 3 4 5 6 7 8 9 10

## CONTROL OPTIONS

**Herbicide:** Spot, wick, or broadcast application  
Synthetic: *Stinger®* in uplands  
*Renovate®* in wetlands  
Organic: *Scythe®* in wetlands (to be used only when non-target vegetation is dormant)  
Timing: May, June, or fall when temperatures are above freezing (best control occurs prior to the first hard freeze). Retreat as necessary. When feasible, treating post-bird breeding season (Aug. 15 or after) is recommended.  
Note: Plants not killed by chemical burn down will re-grow, be less susceptible to subsequent herbicide applications, and sprout multiple stems resulting in increased seed production.

**Mechanical 1:** Cutting at base or root cutting  
Timing: Throughout growing season as necessary. Recut regrowth as necessary.

**Mechanical 2:** Physical removal by the roots  
Timing: Late fall and early spring when plants are young (most effective when seedlings are < 2")

## Impacts
Native annual with wind-dispersed seed germinates in a wide variety of disturbed conditions. Often considered unattractive.

## Habitat
Meadows, grasslands, urban lots, fallow fields, fence rows, orchards, rock outcrops, railroad rights-of-way, and road embankments and medians. Thrives in dry, exposed sites.

## Range
Widespread throughout the United States and Canada.

## Regeneration
Reproduction occurs by seed. Seeds that germinate in the fall produce a rosette that overwinters and flowers in mid to late summer. Spring germinating seeds produce a rosette that quickly bolts to form flowers.

## Identification
Basal rosette produces an erect central stem with a terminal panicle of tiny white flowers. Linear to oblanceolate foliage is arranged alternately along the stem and is approximately 4" long by ½" wide. Stems, which are hairy and can be up to 6’ tall, typically do not branch until flowering begins in July or August. Branching on the stem may occur
if apical growing points have been damaged. Inflorescence consists of a loose panicle of small flower heads. Flowers occur from July through October in the form of white to pale purple "petals" (rays) that surround the yellow disk florets. Basal foliage often deteriorates as the stem elongates.

**Look Alikes**

*Erigeron annuus* (Annual Fleabane) has more prominent toothing on the leaves and the flowers are larger.

**Conyza canadensis** in the Croton grassland (e.g., dates observed, abundance, treatments, etc.)

Not listed in July 2000 Croton grassland plant survey. May 2014: Rare-to-scattered populations observed in drainage ditches.

---

**IMAGE CREDITS:** wikipedia.org (photos), USDA-NRCS PLANTS Database / USDA NRCS. *Wetland flora: Field office illustrated guide to plant species*. USDA Natural Resources Conservation Service (drawing).
**Coronilla varia**  
**Crown Vetch**  
Fabaceae Family (Bean Family)

**Perniciousness Rating** (for grasslands)  
mildly-------------moderately-------------very

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**CONTROL OPTIONS**

**Herbicide:** Spot, wick, or broadcast application  
Synthetic: Stinger® in uplands  
Renovate® in wetlands  
**Timing:** As soon as detected. Best control occurs when flowering (typically begins in June). Retreat as necessary.

**Mechanical:** Physical removal by the roots  
**Timing:** As soon as detected, repeating as necessary

**Impacts**  
Exotic leguminous herbaceous perennial capable of overrunning tall grasses and even shrubs in a dense tangle of short vines. Seeds may remain viable in the soil seed bank for hundreds of years so infestations must be dealt with immediately for best control. Fixes nitrogen, altering soil chemistry that favors other weeds. Spreads by seed and underground shoots.

**Habitat**  
Woodland edges, pastures, streambanks and disturbed areas such as roadsides. Prefers full sun. Will grow in most soil types.

**Range**  
Native to Europe and Asia. Now found throughout most of the continental United States.

**Regeneration**  
Spreads by seed and underground shoots. Seeds typically produced in the second year of growth and mature 6-10 weeks after flower pollination. Large plants can produce up to 1,000 seeds, which are reported to remain viable for five years or more.

**Identification**  
White-pink to lavender cloverlike flowers arranged in 1” clusters on long stalks that emerge from the leaf axils. Flowers throughout the summer. Alternately arranged leaves are divided, 2-6” long, and consist of 15-25 pairs of ¾” oval leaflets with one leaflet on the end. Slender, 2”-long, crownlike seedpods mature in late summer and contain 3-12 brown seeds. Stems, which grow to approximately 6’ long and die back in the winter, trail along the ground and over other vegetation. Mounded habit.

**Look Alikes**  
The vegetative state of *C. varia* resembles many native and nonnative vetches (*Vicia* spp.) but the flower form of *C. varia* is distinctive. True vetches also have tendrils for climbing.

**IMAGE CREDITS:** commons.wikipedia.org

(100) Section X: Weed Control Guide
Coronilla varia in the Croton grassland
(e.g., dates observed, abundance, treatments, etc.)

July 2000: Listed in plant survey.
May 2014: Rare-to-scattered populations observed.
Euphorbia cyparissias
Cypress Spurge
Euphorbiaceae Family (Euphorb Family)

Perniciousness Rating (for grasslands)
mildly---------moderately----------very
0     1     2     3     4     5     6     7     8     9     10

CONTROL OPTIONS

Herbicide: Spot, wick, or broadcast application
Synthetic: Accord® in uplands and seasonally dry wetlands
          Rodeo® in wetlands
Timing: May-June and fall. When feasible, treating post-bird breeding season (Aug. 15 or after) is recommended.

Biocontrol: Flea beetle (Aphthona spp.)
Timing: Release in late June-early July. May require multiple releases until populations become established, particularly if spring and summer are hot and dry. Take longer to establish on north-facing slopes.
Note: Best used in combination with herbicide applications until established. TBD whether biocontrols are approved in New York. Special permission may be required, although the Croton grassland is a good candidate given its specialized habitat value.

Mechanical: Likely ineffective due to extensive root system. Mowing can spread seeds and increase density.

Impacts
This exotic herbaceous perennial can invade open disturbed areas and displace desired vegetation by establishing large colonies through extensive root systems.

Habitat
Pastures, grasslands, and riparian areas.

Range
Native to Europe and western Asia. Introduced in Maine south to North Carolina and west to Washington and northern California.

Regeneration
Reproduces both by seed and vegetatively through lateral root buds that form extensive root systems. Diploid plants are sterile while tetraploids are fertile. Seed viability is not known.

Identification
Grows up to 12" tall with small, up to 1" bright green linear leaves, which are numerous, alternate or whorled. Yellow-green flowers are in a cyme at the top of the plant and mature to a
Euphorbia cyparissias – foliage and habit. Photo: Todd Pfeiffer, Klamath County Weed Control, Bugwood.org

Euphorbia cyparissias – fruit and form. Photo: Leslie J. Mehrhoff, University of Connecticut, Bugwood.org

reddish color. Seeds are three-lobed and contain 1-3 egg shaped smooth gray seeds.

**Look Alikes**
Resembles *Euphorbia esula* (Leafy Spurge), which has larger flower bracts and larger foliage, in addition to being larger overall. Euphorbia hybrids are common.

**Caution**
Wear gloves when handling as the milky sap is a skin irritant.

---

**Euphorbia cyparissias in the Croton grassland**
(e.g., dates observed, abundance, treatments, etc.)

July 2000: Listed in Croton grassland plant survey.
May 2014: Presence not confirmed.
**Euphorbia esula**

**Leafy Spurge**

Euphorbiaceae (Euphorb Family)

**Perniciousness Rating** (for grasslands)

mildly---------------moderately-----------------very
0 1 2 3 4 5 6 7 8 9 10

### CONTROL OPTIONS

<table>
<thead>
<tr>
<th><strong>Herbicide:</strong></th>
<th>Spot, wick, or broadcast application</th>
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<tr>
<td><strong>Synthetic:</strong></td>
<td>Perspective® in uplands</td>
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<tr>
<td><strong>Timing:</strong></td>
<td>May-June and fall. When feasible, treating post-bird breeding season (Aug. 15 or after) is recommended.</td>
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</tbody>
</table>

**Biocontrol:** Flea beetles (*Aphthona* spp.)

**Timing:** Release in late June-early July. May require multiple releases until populations become established, particularly if spring and summer are hot and dry. Take longer to establish on north-facing slopes.

**Note:** Best used in combination with herbicide applications until established. TBD whether approved in New York. Special permission may be required, although the Croton grassland is a good candidate given its specialized habitat value.

**Mechanical:** Handpulling likely ineffective due to extensive surface and tap root system. Mowing can spread seeds and increase density.

### Impacts

This exotic perennial spreads rapidly via a vigorous root system and has buds at both the crown and root that enable it to create dense stands. Allelopathic roots exude chemicals that deter growth of nearby plants. In the Great Plains, sites with moderate to high densities of Leafy Spurge have shown population declines in native grassland bird species (Nowierski and Pemberton, 2002). Flowers, which produce large amounts of nectar and pollen, attract many types of insects.

### Habitat

Pastures, grasslands, riparian areas, and open woodlands.

### Range

Native to the Caucasus region of western Asia. Now occurring throughout North America, from the plains of southern Canada to Texas and east to Virginia.

### Regeneration

Reproduces both vegetatively and by seed. Lateral vegetative shoots typically develop in late May after flowering is initiated. Seeds mature in late June. The three-lobed seed capsule containing three seeds explodes when dry,
**Euphorbia esula** in the Croton grassland
(e.g., dates observed, abundance, treatments, etc.)

July 2000: Listed in Croton grassland plant survey.  
May 2014: Abundant populations throughout cool season grass zones and Mugwort-dominated zones.

---

**Identification**
Alternate, linear 1-4" leaves containing a milky sap. Stems are bluish-green and appear in early spring to form dense clusters approximately 3' in height. Flowers in late spring and sometime again in late summer. Yellow-green 3/4" bracts projecting seeds up to 15 feet from the parent plant. Seeds float and disperse readily via water. Seeds germinate in mid to late spring. Seeds are reported to have a viability of 5-8 years. Species has both sterile diploids and fertile diploids and tetraploids.

**Look Alikes**
Resembles *Euphorbia cyparissias* (Cypress Spurge), which has smaller flower bracts and narrower, more closely spaced leaves, in addition to being smaller overall. Also resembles *Euphorbia pseudovirgata*. Euphorbia hybrids are common.

**Caution**
Wear gloves when handling as the milky sap is a skin irritant.
**Galium mollugo**

Smooth Bedstraw
Rubiaceae Family (Madder Family)

**Perniciousness Rating** (for grasslands)
mildly---------------moderately---------------very
0     1     2     3     4     5     6     7     8     9     10

**CONTROL OPTIONS**

**Herbicide:** Spot, wick, or broadcast application

*Synthetic:* Milestone® in uplands
**Timing:** Prior to bud stage or early flowering.

**Mechanical:** Cutting at base or root cutting

**Timing:** Early summer to midsummer, just before flowering when root carbohydrates are lowest. Requires multiple years of treatment until the root system is exhausted.

**Note:** Cutting will reduce the plant’s vigor and if repeated, will keep it from spreading but it will most likely not eradicate the plant completely. May also prove difficult due to prostrate growth habit. Hand pulling/removal by the roots for large infestations is generally ineffective because of the plant’s extensive root system.

**Impacts**
Exotic perennial that establishes large colonies displacing desired vegetation.

**Habitat**
Meadows, prairies, roadsides, pastures, open woodlands, woodland edges, open disturbed areas, and shrub thickets. Most vigorous in nutrient-rich soils but tolerates dry sandy conditions. Tolerates low pH levels.

**Range**
Eurasian origin. Established in eastern and central United States and Canada as well as western United States and Canada.

**Regeneration**
Seeds, which disperse via animals, equipment, wind, and rain, germinate readily under a variety of conditions. Seeds are reported to be viable for about a year. Established plants spread via rhizomes to form extensive colonies.

**Identification**
Weakly upright, sprawling habit, 1-3’ tall. Smooth, square stems. Narrow, lance-shaped leaves are ½” to 1½” long, lack petioles and are six- or eight-leaf whorls at each stem node. Tiny white flowers with four petals appear at the end of branches in late spring and summer. Masses of the flowers have a wispy, hazy look. Branching taproot in addition to woody rhizomes.

**Look Alikes**
Catchweed bedstraw (*Galium aparine*), a native annual, has square stems but short, downward-pointing barbs or hooks. Perennial northern bedstraw (*Galium boreale*) has four longer (1-2”) leaves to each whorl.

Galium mollugo in the Croton grassland
(e.g., dates observed, abundance, treatments, etc.)

May 2014: Abundant throughout cool season grass areas (for approximate locations see Section IV.D.)
Lespedeza cuneata

Chinese Lespedeza (Himalayan bush clover, sericea lespedeza)
Fabaceae Family (Legume Family)

Perniciousness Rating (for grasslands)
mildly---------moderately-----------very
0 1 2 3 4 5 6 7 8 9 10

CONTROL OPTIONS

**Herbicide:** Spot, wick, or broadcast application
Synthetic: Stinger® in uplands
Renovate® in wetlands
Timing: Early summer to midsummer, just before flowering when root carbohydrates are lowest. Retreat as necessary.

**Mechanical:** Cutting at base or root cutting
Timing: Early summer to midsummer, just before flowering when root carbohydrates are lowest. Requires multiple years of treatment until the root system is exhausted.
Note: Cutting will reduce the plant’s vigor and if repeated, will keep it from spreading but it will most likely not eradicate the plant completely. Hand pulling is generally ineffective because of the plant’s extensive root system.

**Impacts**
Shrubby, aggressive exotic perennial that can develop large stands via vigorous spreading roots. Displaces native vegetation. A single plant can live for 20 years or more (Kaufman, 2007). Highly tolerant of drought due to deep woody taproot. Allelopathic. Seeds are often produced in the first year of growth and can be viable for many years.

**Habitat**
Meadows, prairies, roadsides, pastures, open woodlands, woodland edges, and shrub thickets. Prefers full sun but tolerates shade, poor soil conditions, and a wide range of pH levels. Has been frequently planted to stabilize roadsides.

**Range**
Native to eastern Asia and now occurring throughout much of the eastern United States, from Minnesota to Texas east to New York and Florida.

**Regeneration**
Individual plants are very long-lived and have very long-lived seed. Also reproduces vegetatively.

**Identification**
Forms a bushy clump 1 - 5½’ tall with increasing number of stems formed each year of growth. Alternately arranged leaves divided into 3 leaflets, ½ - 1” long with dense hairs giving leaflets a gray-green color. Has two flower types: showier, creamy white insect-pollinated flowers with purple throats in clusters of 2 to 4 among the leaves along the upper parts of branches; the second flower type lacks petals and are self-pollinated. Flowers from midsummer to fall. Fruit is a legume pod containing one seed. Stems die back in winter, and new stems emerge from root stem buds in early spring.

**Look Alikes**
Distinguished from all other lespedezas by the wedge-shaped base of the leaflets. Lespedeza bicolor (Bicolor Lespedeza) and Lespedeza thunbergii (Thunberg’s Bush Clover) are both
*Lespedeza cuneata* in the Croton grassland
(e.g., dates observed, abundance, treatments, etc.)

July 2000 Croton grassland plant survey: not listed.

---

*L. cuneata* – foliage

*L. cuneata* – form

larger, have woodier stems, and the flowers occur
in an elongated clouster.

IMAGE CREDITS: wikipedia.org
**Lotus corniculatus**  
**Bird’s Foot Trefoil**  
Fabaceae Family (Pea Family)

**Perniciousness Rating** (for grasslands)  
mildly-------------moderately-------------very  
0 1 2 3 4 5 6 7 8 9 10

### CONTROL OPTIONS

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<th>Herbicide:</th>
<th>Spot, wick, or broadcast application</th>
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| Synthetic: | Stinger® in uplands  
Renovate® in wetlands |
| Timing:    | Spring (most active growth period) or as soon as observed. |
| Note:      | Some plants have shown resistance to glyphosate (Kaplan, 2007). |

**Mechanical:** Cutting at base or root cutting  
Timing: Early summer to midsummer, just before flowering when root carbohydrates are lowest. Requires multiple years of treatment until the root system is exhausted.  
Note: Cutting will reduce the plant’s vigor and if repeated, will keep it from spreading but it will most likely not eradicate the plant completely. Hand pulling is generally ineffective because of the plant’s extensive root system and ability to regenerate from root fragments.

### Impacts
Mat forming perennial from Eurasia that outshades and outcompetes other plants. Fixes nitrogen, thereby changing soil conditions that favor other weed species. Tolerates roadway salt and compacted soils.

### Habitat
Moist, open areas such as meadows, pastures, riparian areas, and roadsides.

### Range
Canada and the United States with the exception of southern states. Frequently planted for erosion control, soil enrichment, and a forage crop.

### Regeneration
Regenerates by seed and stems that run along the ground and root at the nodes. Seeds are reported to remain viable for up to 11 years.

### Identification
Bright yellow pealike flowers in rounded clusters on low-growing perennial plants from spring until frost. Grows to nearly 2 ft, often sprawling along the ground. Alternately arranged clover-like leaves are compound, made up of 3 leaflets ½ inch long and less than ⅛ inch wide. Two leaflike stipules at the base of each leafstalk. Flowers grow in clusters of 2-8 and are up to ⅔” long. Seed pods are brown to black, ½ to 1¼ inches long, form from mid summer into fall, and fan out like a bird’s foot. Extensive taproots (3 feet’) with branched roots. Stems that run along the ground root at the nodes, enabling the plan to form circular clumps that can reach 2 foot-diameter clumps or larger.

### Look Alikes
Trefoil (*Lespedeza pedunculatus*) has hairy sepals, flowers appearing in clusters of 6-12, and hollow stoloniferous stems.
Lotus corniculatus in the Croton grassland
(e.g., dates observed, abundance, treatments, etc.)

Included in the original seed mix (Kester’s Upland Game Bird Mix (see Appendix B in Section XI).
May 2014: Scattered to abundant populations observed.
**Lythrum salicaria**

**Purple Loosestrife**

Lythraceae Family (Loosestrife Family)

**Perniciousness Rating** *(for grasslands)*

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**CONTROL OPTIONS**

**Herbicide:** Spot, wick, or broadcast application

Synthetic: Accord®, Garlon® in uplands

Rodeo®, Renovate® in wetlands

Timing: Late May through September or as soon as plants are easily identifiable.

**Mechanical:** Cutting at base

Timing: Just prior to flowering, repeating as necessary (resprouting is likely)

Note: Cutting stems underwater at various times in the summer has been shown to be ineffective. Hand pulling or removal by the roots for large infestations is generally ineffective because of the plant’s extensive root system and ability to regenerate from root fragments. Cut stems should be disposed of as they can sprout and create new plants.

**Biocontrol:** Four host specific insects are approved by the USDA. Includes root mining weevil (*Hylobius transversovittatus*), leaf eating beetles (*Galerucella calamiensis and G. pusilla*), and the flower-feeding weevil (*Nanophyes marmoratus*). *Galerucella* beetles appear most effective at this time.

Note: One or more of these species is likely already present in the Hudson Valley. Research examining a pathogenic fungi as biocontrol is ongoing.

Note: *Lythrum salicaria* can occasionally remain dormant for an entire growing season and then exhibit normal growth from the same rootstock in subsequent years.

**Impacts**

This exotic perennial displaces native vegetation through its vigorous growth and formation of extensive monocultures, which reduce wildlife habitat by eliminating foods and cover. Can also affect water flow.

**Habitat**

Open wetlands, ditches, brackish marshes, and edges of ponds, streams, and rivers. Tolerates salinity and a high soil pH.

**Range**

Native to Europe and Asia. Now found in all of the Canadian provinces and all of the continental United States with the exception of Florida. Most common in northeastern North America, particularly New England.

**Regeneration**

Seeds prolifically (just one seed capsule can...
**Lythrium salicaria**

contain approximately 100 seeds), and seeds are reported to remain viable for to 20 years. Can also reproduce from broken root fragments and damaged growth vigorously produces new shoots and root buds.

**Identification**

Conspicuous pink-purple flowers (occasionally pink or white) with 5 to 7 petals form in summer in whorls on terminal spikes that can reach 16 inches. Flowering can continue into the fall. Narrow, lance-shaped or linear foliage is 1-4 inches long and an inch wide, has smooth edges and is oppositely arranged or in whorls of three along angular stems. Foliage turns bright red in autumn.

**Look Alikes**

The native Swamp Loosestrife (*Decodon verticillatus*) is distinguished by 5-7 short sepals, 5 pink petals and 10 stamens (5 short and 5 long). The leaves are opposite or in whorls of three or four.

**Caution**

Soils where *Lythrum salicaria* have been growing should not be transferred to other sites as this enables dispersal of the species through the regeneration of cut stems or other vegetative parts remaining in the transported soil.

**Lythrium salicaria in the Croton grassland**

(e.g., dates observed, abundance, treatments, etc.)

**Polygonum cuspidatum (Fallopia japonica)**

**Japanese Knotweed**

Polygonaceae Family (Buckwheat Family)

**Perniciousness Rating** (for grasslands)

mildly-----moderately------very

0 1 2 3 4 5 6 7 8 9 10

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**CONTROL OPTIONS**

**Herbicide:** Cut plants to the ground and treat regrowth with spot, wick, or broadcast application

**Synthetic:** Garlon® in uplands

Renovate® in wetlands

**Timing:** Cut stems in early to midsummer. Treat regrowth with herbicide in August to early September when topgrowth is most actively feeding roots.

**Note:** Total eradication may require several years of consecutive treatment.

**Mechanical:** Physical removal by the roots or cutting at the base

**Timing:** As soon as observed. Repeat multiple times throughout the growing season to exhaust rhizomes.

**Note:** May take up to 10 years of physical removal to eradicate an established population. Any cuttings should be removed and thoroughly dried or burned to prevent spread to other areas.

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**Impacts**

Fast growing, thicket-forming exotic herbaceous perennial that displaces native vegetation. Extremely persistent once established. Thickly layered decomposing stems and leaves mulch out other species.

**Habitat**

Waterways, low-lying areas, roadsides, utility rights-of-way, and former homesites. Tolerant of high temperatures, high salinity, and drought. Prefers full sun but also grows in shade.

**Range**

Common from Maine to Wisconsin, south to the Gulf Coast and in several midwestern and western states.

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**Regeneration**

Although individual specimens can produce copious amounts of seed able to germinate under diverse conditions (with the exception of dense shade), reproduction occurs primarily through vegetative means, including rooting of cut stems and rhizomes, which must be thoroughly dried or burned prior to disposal to avoid regeneration. Often spreads when the plant is cut by maintenance crews and the cut stems and rhizomes regenerate and put down new roots. Seeds are reported to remain viable under dry storage for at least four years.

**Identification**

Smooth, stout, hollow 4-10’ reddish stems with swollen joints where the leaf joins the stem. A membranous sheath surrounds the stem above each joint as is characteristic of the Buckwheat/Polygonaceae family. Juvenile stems and leaves have a purplish caste. Wide, broad oval-shaped leaves with a pointed tip are alternately arranged along the stem. Greenish-white flowers appear in summer on arching stems. Small white fruits contain shiny, triangular seeds, which develop two weeks after pollination.

**Look Alikes**

Native and introduced Polygonum species may look similar at the seedling stage but *P. cuspidatum* grows much taller with stouter rhizomes.

**Caution**

Soils where *P. cuspidatum* have been growing should not be transferred to other sites as this enables dispersal of the species through the regeneration of cut stems or rhizomes remaining in the transported soil.

**Image Credits:** www.ipane.org (upper left, bottom left), www.invasive.org
Polygonatum cuspidatum – foliage

Polygonatum cuspidatum – flower

Polygonatum cuspidatum – seed

Polygonatum cuspidatum – infestation

*P. cuspidatum in the Croton grassland*
(e.g., dates observed, abundance, treatments)

July 2000: Croton grassland plant survey
May 2014: Not observed
February 2015: Local experts reported that has not been observed in the Croton Grassland
(Phillips)
**Rumex crispus**  
Curly Dock (Yellow Dock)  
Polygonaceae Family (Buckwheat Family)

**Perniciousness Rating** (for grasslands)  
*mildly*---------*moderately*---------*very*  
0 1 2 3 4 5 6 7 8 9 10

**CONTROL OPTIONS**

**Herbicide:** Spot, wick, or broadcast application  
Synthetic: Stinger® in uplands  
Renovate® in wetlands  
**Timing:** Spring treatment for seedlings, retreating as necessary. Fall treatment for established plants, retreating as necessary.

**Mechanical:** Cutting plant at base  
**Timing:** As soon as observed, repeating removal efforts as necessary

**Impacts**  
Exotic perennial that colonizes bare ground. A single plant can produce large numbers of extremely long-lived seed. Common in newly established plantings but usually not a serious presence in competitive, established, properly managed plantings. Often regarded as unattractive.

**Habitat**  
Neglected gardens, pastures, and old agricultural fields, vacant lots, roadways, and drainage ditches. Prefers moist areas.

**Range**  
Native to Europe and now occurring throughout most of the continental United States.

**Regeneration**  
Disturbance adapted colonizer of bare ground. A large plant can produce over 60,000 seeds. Winged structures on long-lived seeds enable dispersal by wind and water. Seeds germinate readily on bare soil from late spring through early fall. Established plant regenerates from a perennial crown. Tenacious, deep taproot. Root fragments can give rise to new plants.

**Identification**  
Begins the growing season as a rosette of shiny narrow leaves approximately 1” long and 2” wide with wavy, somewhat crumpled margins when mature. A solitary, sometimes grouped, sparsely leaved and unbranched, approximately 5’ tall reddish flowering stalk emerges from the rosette in June and July and is topped by small, greenish, wind-pollinated flowers. Fruits turn chestnut brown at maturity and can persist on the visually distinctive seed stalk throughout the winter. Taproot is a thick, fleshy yellow.

**Look Alikes**  
*Rumex obtusifolius* (Curly Dock) has heart-shaped lobes at the leaf base. Foliage on this plant is also wider and less wavy than those on *R. crispus*.

**Caution**  
Seeds can readily stick to clothing and be transported to other areas.

IMAGE CREDITS: wikipedia.org (top left), Robert H. Mohlenbrock @ USDA-NRCS PLANTS Database / USDA SCS. 1989. Midwest wetland flora: Field office illustrated guide to plant species. Midwest National Technical Center, Lincoln (top right)
Rumex crispus in the Croton grassland
(e.g., dates observed, abundance, treatments, etc.)

July 2000: listed in Croton grassland plant survey.
**Rumex obtusifolius**  
**Broadleaf Dock** *(Bitter Dock)*  
Polygonaceae Family *(Buckwheat Family)*

**Perniciousness Rating** *(for grasslands)*

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**CONTROL OPTIONS**

**Herbicide:** Spot, wick, or broadcast application  
Synthetic: *Stinger®* in uplands  
*Renovate®* in wetlands  
Timing: Treat prior to forming seed or whenever observed, retreating as necessary.

**Mechanical:** Cutting plant at base  
Timing: As soon as observed, repeating removal efforts as necessary.

**Impacts**
Exotic perennial that colonizes bare ground. First-year plants can flower and produce seed. A single plant can produce large numbers of extremely long-lived seed. Can colonize newly established plantings but usually not a serious presence in competitive, established, properly managed plantings. Generally regarded as unattractive.

**Habitat**
Neglected gardens, pastures and old agricultural fields, vacant lots, road sides, and drainage ditches. Prefers moist areas but widely adaptable.

**Range**
Throughout most of the continental United States, Alaska, British Columbia, Ontario, and Quebec.

**Germination and Regeneration**
Disturbance adapted colonizer of bare ground. Winged structures on long-lived seeds enable dispersal by wind and water. Seeds germinate readily on bare soil from late spring through early fall. Established plant regenerates from a perennial crown. Tenacious, deep taproot. Root fragments can give rise to new plants.

**Identification**
Heart-shaped lobes at the base of the foliage, which can be 18” in length. Foliage edges are slightly wavy. Some of the lower leaves have red stems. Single stalk grows above the leaves and forms large clusters of racemes that feature green flowers, which turn to red as they mature. Blooms June through September. Seeds are reddish-brown. Toothed margins on the calyx lobes that develop into the wings of the fruit. Seedlings have oval leaves with red stems that sprout from the center of the plant.

**Look Alikes**
*Rumex crispus* *(Curly Dock)* has wavier and more narrow foliage. Calyx lobes that develop into the wings of the fruit have entire margins on *R. crispus*.

**Caution**
Seeds can readily stick to clothing and be transported to other areas. Foliage is considered to be slightly poisonous and the sap in the leaves has been known to cause mild dermatitis.

**IMAGE CREDITS:** wikipedia.org (all photos), Robert H. Mohlenbrock @ USDA-NRCS PLANTS Database / USDA SCS. 1989. Midwest wetland flora: Field office illustrated guide to plant species. Midwest National Technical Center, Lincoln (drawing)
Rumex obtusifolius – foliage, flower, and fruit

Rumex obtusifolius – seed

**R. obtusifolius** in the Croton grassland
(e.g., dates observed, abundance, treatments)

Not listed in July 2000 Croton grassland plant survey.

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**Solidago canadensis**  
Canada Goldenrod  
Asteraceae Family (Aster Family)

**Perniciousness Rating**  
(for dry grasslands)  
mildly---------moderately------------very  
0  1  2  3  4  5  6  7  8  9  10

**Perniciousness Rating**  
(for moist-wettish grasslands)  
mildly---------moderately------------very  
0  1  2  3  4  5  6  7  8  9  10

**CONTROL OPTIONS**

**Herbicide:** Spot, wick, or broadcast application  
Synthetic: Stinger® in uplands  
Renovate® in wetlands  
Timing: Treat prior to forming seed or whenever observed, retreating as necessary.

**Mechanical:** Cutting plant at base  
Timing: As soon as observed, repeating removal efforts as necessary. If only one cutting is possible, cut in the midsummer prior to flowering. Works best when surrounded by competitive vegetation able to limit regrowth of cut stems.

**Impacts**
Common native perennial that can form monocultures in favorable conditions (moist, medium-textured to muck soils in part-shade to full sun). Allelopathic.

**Habitat**
Neglected gardens, pastures and old agricultural fields, vacant lots, roadsides, and drainage ditches. Prefers moist areas but widely adaptable.

**Range**
Throughout most of the continental United States, Alaska, and Canada.

**Germination and Regeneration**
Disturbance adapted colonizer. Reproduces via wind-dispersed seed and creeping rhizomes. Shoots from rhizomes appear in mid-April while seedlings emerge in June or early July. Flower and rhizome production begins following the first year of growth.

**Identification**
Rosettes produce erect, slender, mostly unbranched 1-5’ stems, which are generally smooth with small, soft hairs from the middle upwards. Leaves, which become gradually smaller up the stem, are alternate, sessile, lanceolate to lanceolate-elliptic in shape, have mostly toothed margins, and taper to the base and apex. Leaf blades are smooth on top and hairy on the underside. Rhizomes occur primarily at the base of aerial stems and frequently have reddish pigmentation. Yellow flowers, which appear from August through October and consist of yellow ray flowers surrounding 2-8 yellow disk flowers, occur in composite heads on panicle-like clusters. Inflorescence branches form a central axis with the flower heads occurring only on one side of the axis. A pappus of white hairs is attached to the fruit (achene) enclosing the seed; these white hairs facilitate wind dispersal. Erect stems remain rigid throughout the winter, with remains of the branching flower making large clumps of the stems highly visible.

**Look Alikes**
Some goldenrod species (Solidago spp.) are similar in structure and flower to Solidago canadensis. Differences exist in overall stature, leaf blade width, hairiness of leaves and stems, and flower cluster shape.

**Faunal Associations**
The pollen and nectar of Solidago canadensis serve as an important late-summer food
Solidago canadensis—panicle like flower clusters

source for long- and short-tongued bees, wasps, flies, beetles, and a few butterflies and moths. Also host to the Goldenrod Gall Fly (Eurosta solidaginis), which forms spherical galls on the stems. A number of beetles, leafhoppers, and other insects feed on the foliage.

IMAGE CREDITS: USDA-NRCS PLANTS Database / USDA NRCS. Wetland flora: Field office illustrated guide to plant species. USDA Natural Resources Conservation Service (top left); “Solidago canadensis 20050815 248,” wikimedia.org (top right).

S. canadensis in the Croton grassland
(e.g., dates observed, abundance, treatments)

Not listed in July 2000 Croton grassland plant survey.
Scattered individuals observed Sept. 2015. In dry locations, it appears to be far less competitive and not a threat to desired growth. It could, however, present a challenge to seeded/planted vegetation in moister areas with medium-textured soil.
Microstegium vimineum
Japanese Stiltgrass
Poaceae Family (Grass Family)

Perniciousness Rating (for grasslands)
mildly-----------moderately-----------very
0 1 2 3 4 5 6 7 8 9 10

DO NOT DELAY CONTROL OF THIS PLANT ONCE IT BEGINS TO FLOWER OR SUBSTANTIAL SEED WILL BE PRODUCED, INCLUDING FROM CUT PLANTS. MONITOR FOLLOWING TREATMENT TO CATCH ANY MISSED PLANTS.

CONTROL OPTIONS

**Herbicide:** Spot, wick, or broadcast application
Synthetic: Assure® in uplands (for severe isolated infestations only since it will affect seeded grasses) Rodeo® at .5% solution in wetlands
Timing: Prior to flowering (Aug. – Sept.). Retreat as necessary.

**Mechanical 1: Cutting plant at base**
Timing: August (prior to flowering), repeat as necessary. Cutting too early in the growing season gives plants time to produce new flower spikelets at the axils.
Note: Plants with fruits should be bagged and removed to the extent possible.

**Mechanical 2: Physical removal by the roots (for small infestations)**
Timing: As soon as detected (larger plants are easier to pull than seedlings)
Note: To the extent possible, plants with fruits should be bagged and removed. According to some studies, pulling this species encourages Microstegium seeds in the soil to germinate. This may be desirable if the intent is to exhaust the seed bank and undesirable if amidst desirable growth.

**Impacts**
Exotic annual warm-season grass with allelopathic roots and leaves that suppress the growth of other plants to form monoculture stands. Affects soil pH, nutrient cycling, and soil microfaunal composition. Grows rapidly with significant seed set. Unlike most warm season grasses, able to survive and produce seed in very low light levels. Reduces native woody species regeneration in forests. White-tailed deer avoid browsing on stiltgrass, contributing to its spread.

**Habitat**
Forests, stream banks, fields, roadsides, utility lines, and lawns. Tolerant of a variety of sun and moisture level conditions.

**Range**
Native to Japan, Korea, China, Malaysia, Indian and the Caucasus Mountain. Now sporadically occurring throughout most of the eastern United States. Roads and waterways may be primary corridors for distribution.

**Regeneration**
A single plant can produce up to 1,000 seeds that germinate quickly in warm spring weather and continue to germinate until late spring-early summer. Seeds, which remain viable for up to five years under favorable conditions (Gibson et al., 2002), are small, light, and can float, facilitating water dispersal and transmission by human and vehicular traffic. High amounts of leaf litter appear to inhibit germination (Tardy). Also increases vegetatively by tillering and by stolons, resulting in dense monospecific stands. Can flower and produce stolons under a wide range of light and fertility conditions. Late-season drought appears to reduce seed production.

**Identification**
Alternate, lance shaped lime green foliage on slender stems up to 3.5' tall, often bent over. Distinctive off-center midrib with minute shiny silvery hairs. Flower spikes resemble those of crab grass with fruit that can vary from yellow to red in color.

**Look Alikes**
Easily distinguished from other grasses by the silver midrib on the lance shaped leaf. Sometimes confused with and cooccurring with white grass (Leersia virginica)—a morphologically similar native perennial. Japanese stiltgrass can be distinguished by its silvery midrib on the upper leaf blade and smooth nodes versus the hairy nodes and lack
Microstegium vimineum – incursion

Microstegium vimineum – fall color

M. vimineum in the Croton grassland
(e.g., dates observed, abundance, treatments)

Not listed in the July 2000 Croton grassland plant survey. Residual growth not observed in a May 2014 visit but an exhaustive search was not made.

of a silvery midrib on white grass. Other native look-a-likes include sweet woodreed (Cinna arundinacea), drooping woodreed (Cinna latifolia), and Brachyelytrum grasses.

Caution
Seeds can readily stick to clothing, tools, and equipment and be transported to other areas.

IMAGE CREDITS: www.ipane.com
**Phragmites australis**

Common Reed  
Poaceae Family (Grass Family)

**Perniciousness Rating** (for grasslands)  
mildly--------------moderately--------------very  
0     1     2     3     4     5     6     7     8     9     10

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**CONTROL OPTIONS**

**Herbicide:** Spot, wick, or broadcast application  
**Synthetic:** Habitat® in wetlands (will affect non-target vegetation)  
**Timing:** Mid to late summer during flowering or seed production, retreating as necessary. When feasible, timing control post-bird breeding season is recommended.  
**Note:** Selective herbicides are ineffective against this species.

**Mechanical 1:** Cutting at base or root cutting  
**Timing:** Mid to late summer when in flower, repeating as necessary

**Mechanical 2:** Physical removal by the roots (for small infestations), repeating as necessary  
**Timing:** Mid to late summer when in flower (repeat as necessary)  
**Note:** Mechanical control of this species is difficult, expensive, and time consuming. Any pulled roots should be removed and solarized or otherwise killed to prevent spread to other areas.

---

**Impacts**

Long lived perennial grass that forms dense monocultures of genetically uniform stems, particularly in disturbed wetlands, detention ponds, and other waterways. The dried stalks, leaves, and seed heads can be a fire hazard during times of drought.

**Habitat**

Marshes, floodplains, drainage ditches, detention ponds, lake edges, and other wet open areas. Also very drought tolerant and capable of establishing in cracks in asphalt or concrete.

**Range**

Introduced from Europe and Asia and now found throughout the continental United States.

---

**Regeneration**

Spreads primarily by root fragments dispersed by water. Seeds, which disperse by wind and germinate under variable light and moisture conditions, are reported to have viability of less than three years.

**Identification**

Up to 20’ tall with 50 to 100” yellowish-green leaves that are 1 to 4” wide on finely ribbed and dull stems. Leaves have rough margins and a prominent midrib. Tan fall-winter color. Inflorescence is a conspicuous 6-15” plumelike panicle that starts out purple and turns tawny brown as the seeds mature.

**Look Alikes**

*P. australis* includes more than 20 genetic strains, 11 of which are considered to be native to the United States, primarily in Southeast, intermountain West, and Midwest. The exotic lineages tend to form dome shaped monocultures while native populations are more scattered and less aggressive. *P. australis* found at Croton Point are unlikely to be of a native strain and more likely to be of exotic lineage. See Kaufman and Kaufman for additional identifying characteristics of native strains.

**Caution**

Soils where *P. australis* have been growing should not be transferred to other sites as this enables dispersal through the regeneration of cut stems or rhizomes remaining in the transported soil.

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IMAGE CREDITS: www.ipane.org
**Phragmites australis** in the Croton grassland (e.g., dates observed, abundance, treatments, etc.)

May 2014: Small populations observed at the northern tip of the grassland (see Fig 12, Section IV.D for approximate locations). Large monotypic stands also located along Croton Bay.
Cool Season European Grasses
(Fescues, Bluegrass, Orchard Grass, Smooth Brome, Timothy, etc.)

Perniciousness Rating (for grasslands)
mildly---------moderately----------------very

0 1 2 3 4 5 6 7 8 9 10

CONTROL OPTIONS

Herbicide: Spot, wick, or broadcast herbicide application
Synthetic: Plateau® (uplands only)
Timing: June, retreating as necessary.
Note: Only apply when warm season grasses have a significant presence.

Mechanical: Cutting to 4" in late spring
Timing: May 15 and June 15 in target areas. If only one mowing is possible, conduct the June mowing. If the spring is particularly warm and wet such that native warm season grasses emerge early, mow no later than June 1.

IMPORTANT: Mowings should only occur when absolutely necessary. See Best Mowing Practices for ways to minimize impacts on ground-nesting birds.

Note: Sequential spring cuttings disfavor actively growing cool season grasses over intermingled warm season grasses, which are just beginning their growth cycle. The need for sequential spring cuttings should be assessed after several years to determine whether warm season grasses are established well enough such that spring mowings are no longer required.

Impacts
Cool season grasses provide some cover for certain types of wildlife, but they will out-compete the majority of native grasses and wildflowers if not managed effectively.

Habitat
Lawns, pastures, abandoned farm fields, roadsides, and other open sunny areas.

Range
Introduced from Europe and now found throughout North America.

Identification
Foliage emerges green, and the plant flowers much earlier in the spring than warm season grasses. Turns brown and “mats down” in the summer.
Cool Season European Grasses in Croton Point Park grassland
(e.g., dates observed, abundance, treatments, etc.)

May 2014: Abundant throughout the Croton grassland (see Fig 12 – Existing Vegetation Zones Map in Section IV.D for approximate locations).
**Rosa multiflora**
**Multiflora Rose**
Rosaceae Family (Rose Family)

**Perniciousness Rating** (for grasslands)
*mildly*---------*moderately*---------*very*

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**CONTROL OPTIONS**

**Herbicide:** Cut canes to base, allow 2-3 weeks of regrowth and spot, wick, or broadcast treat as necessary

Synthetic: Garlon® in uplands
Renovate® in wetlands

Timing: Late spring after flower buds form through fall, retreating as necessary

**Mechanical:** Physical removal by the roots

Timing: Throughout the growing season, repeating removal efforts as necessary

**Impacts**
Exotic shrub with densely spreading habit, forming impenetrable thickets. Sometimes a preferred nesting site for some native song birds.

**Habitat**
Fields, hedgerows, meadows, woodland edges, and forest gaps.

**Range**
Introduced from Asia and now found throughout most of the continental United States.

**Regeneration**
A single plant can produce a million seeds a year that remain viable in the soil for up to 20 years (Kaufman & Kaufman). Birds, ants, chipmunks, deer, and squirrels feed on and readily spread the fruit, which can germinate under diverse conditions. Water also serves as a means of seed dispersal. Can spread by layering when cane tips touch the ground and root.

**Identification**
Multistemmed shrub. Stout reddish thorns on canes, which are green when young and brownish gray when older. White-to-pinkish, 5-petaled, fragrant flowers in mid-spring mature into pea-sized brownish red fruits (hips) that are often residual into the winter and following spring. Leaves consist of 5 to 11 oblong, serrated 1-1½” leaflets that retain their bright green coloration until late into the fall, eventually turning a pale yellow.

**Look Alikes**
Multiflora Rose resembles many native and nonnative roses, which can be distinguished by flower, fruit color, and fruit size. Multiflora Rose also has fringed petioles (leaf stalks).

**IMAGE CREDITS:** www.ipane.org
*Rosa multiflora* in the Croton grassland
(e.g., dates observed, abundance, treatments, etc.)

July 2000: listed in the Croton grassland plant survey (in the "Wildflowers" category).
May 2014: not observed, although an exhaustive search was not conducted.
**Ailanthus altissima**  
Tree-of-Heaven  
Simaroubaceae Family (Quassia Family)

**Perniciousness Rating** (for grasslands)  
mildly-----moderately---------very

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**CONTROL OPTIONS**

**Herbicide:** Spot or wick application  
Synthetic: Garlon® in uplands  
Renovate® in wetlands  
Timing: Late summer through fall, repeating as necessary

**Mechanical:** Physical removal by the roots (saplings only)  
Timing: Any point in the growing season, repeating as necessary  
Note: Cutting this species is counterproductive as it causes the plant to sucker heavily, increasing the number of specimens to be treated.

**Impacts**

Fast growing exotic tree that forms dense thickets. Allelopathic toxins in foliage, bark, and roots suppress the growth of other plants; toxins remain in the soil for many years after removal. Toxin concentration is greatest in the roots, with the highest levels in the spring (Voigt).

**Habitat**

Abandoned urban lots, highway embankments, field edges, disturbed woodlands, and railroad beds. Highly tolerant of disturbance.

**Range**

Introduced from Asia and now widespread through the continental United States and southern Canada.

**Regeneration**

Wind-spread prolific seeder (a single female specimen can produce more than 300,000 seeds in one season). Flowers at an early age and on resprouts, with seed production highest on trees aged 12-20 years old. Seeds, which are reported to have soil viability of less than one year, germinate easily on bare ground in sun and shade. Capable of extensive root suckering, particularly when cut.

**Identification**

Alternately arranged 1-4’ leaf with 11-41 lance shaped, oppositely arranged leaflets that have a long pointed tip and 1-5 teeth at base. Stout twigs are covered with fine hairs when young and have yellowish pith. Bark on older trees is smooth and light brown or striped gray-brown. Foliage appears very late in the spring. Yellowish flowers at the end of the branches appear in early summer. Unpleasant odor to crushed foliage and broken stems. Branches break readily.

**Look Alikes**

Sumac, walnut, and pecan trees, which unlike A. altissima, have toothed margins along the entire leaflet instead of just at the base. Foliage and cut/broken stems of Ailanthus are ill-scented.

**Cautions**

Sap contains quassinoids, which can cause heart problems, headaches, and nausea.

*IMAGE CREDITS: www.ipane.org*
**Ailanthus altissima**

- *A. altissima* – staminate inflorescence above foliage
- *A. altissima* – leaflets
- *A. altissima* – seedlings
- *A. altissima* – fruit (samaras)

**Ailanthus altissima in the Croton grassland**

(e.g., dates observed, abundance, treatments, etc.)

July 2000 Croton grassland plant survey: not listed
**Ampelopsis brevipedunculata**  
Porcelainberry  
Vitaceae Family (Grape Family)

**Perniciousness Rating** (for grasslands)  
*mildly*---------*moderately*---------*very*  
0   1   2   3   4   5   6   7   8   9   10

### CONTROL OPTIONS

| **Herbicide:** | Spot application to cut stems.  
| **Synthetic:** | Accord® in uplands  
| | Renovate® in wetlands  
| **Timing:** | Cut vines back in summer then treat new growth in early autumn before leaves drop off. |

| **Mechanical:** | Cutting at the base  
| **Timing:** | Any point in the growing season, repeating as necessary.  
| **Note:** | Requires multiple treatments. |

**Impacts**  
Exotic woody vine whose vigorous growth shades out other plants by growing up and over them. Growth habit also inhibits germination of other species.

**Habitat**  
Riparian areas and moist thickets as well as roadsides, railroad beds, shorelines, fields, hedges, and woodland edges. Prefers sun to part shade.

**Range**  
Native to Asia and now occurring in New England south to North Carolina and west to Michigan.

**Regeneration**  
Seeds are spread via fruit consumed by birds and small animals. Fruit can also float and disperse via water. Still commonly sold as an ornamental plant by the nursery industry.

**Identification**  
Alternate leaves are slight 3-5 lobes or deeply dissected with heart shaped base and coarsely toothed margins. Delicate hairs along the veins on the undersides of the leaves. Clusters of small greenish white flowers appear in midsummer, followed by multicolor fruits in the fall that resemble porcelain balls, ranging in color from white to yellow to pastel shades of blue, green, and purple. Each fruit carries 2-4 seeds. Deciduous.

**Look Alikes**  
Grape vines can look similar but have a brown pith (versus the white pith of porcelainberry). Porcelainberry bark has lenticels and will not peel, unlike grapevine bark.

IMAGE CREDITS: www.ipane.org
Ampelopsis brevipedunculata – fruit

_A. brevipedunculata_ in the Croton grassland
(e.g., dates observed, abundance, treatments, etc.)

July 2000 Croton grassland survey: not listed.
May 2014: Scattered presence in stone-lined swales.
**Celastrus orbiculatus**  
**Oriental Bittersweet**  
Celastraceae Family (Stafftree Family)

**Perniciousness Rating** (for grasslands)  
*mildly*---------*moderately*---------*very*

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<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
</tr>
</thead>
</table>

**CONTROL OPTIONS**

**Herbicide:**  
Cut to the ground. Allow 3-4 weeks of regrowth and then spot, wick, or broadcast treat regrowth as necessary.

**Synthetic:**  
*Garlon®* in uplands  
*Renovate®* in wetlands  

**Timing:**  
June, retreating as necessary

**Mechanical:**  
Physical removal by the roots  
Timing:  
Any point in the growing season, repeating as necessary

**Impacts**

Rapid growing deciduous exotic woody vine capable of climbing herbaceous and woody vegetation, including into the tree canopy. Runs along the ground in search of climbing opportunities, forming shrubby thickets. Seedlings can establish even in dense shade and then grow rapidly once they have gained exposure to sunlight following a disturbance. Can also hybridize with the relatively obscure American bittersweet (*Celastrus scandens*).

**Habitat**

Fencerows, old agricultural fields, open areas, and forest edges.

**Range**

Native to Asia and now common in the eastern United States, west to Iowa.

**Regeneration**

Birds consume and widely disperse the seeds, which germinate readily under diverse conditions, including shade. Stems root where they touch soil. Roots produce new shoots (suckers) prolifically when aerial parts of the plant are cut or otherwise damaged.

**Identification**

Rounded, 2-5” long foliage with wavy, slightly toothed edges, alternately arranged on light brown twigs and branches with tan lenticels. Greenish yellow, 5 petaled dioecious flowers appear in spring in small clusters in the leaf axils. Round green fruits turn yellow in the fall and split open to reveal distinctive bright red-orange seed coatings. Foliage turns a clear, bright yellow in the fall. Roots are a distinctive bright orange.

**Caution**

Fruit is toxic.

**Look Alikes**

Very similar to the relatively rare American bittersweet (*Celastrus scandens*). The flowers and fruit of *C. scandens* occur only at the ends of branches and typically have more than 7 flowers and fruits per cluster in comparison to the 3-7 flowers of *C. orbiculatus*.

**IMAGE CREDITS:** www.ipane.org
Celastrus orbiculatis – staminate flowers

Celastrus orbiculatis – fruit

C. orbiculatus in Croton Point Park grassland
(e.g., dates observed, abundance, treatments)

July 2000: listed in Croton grassland plant survey
**Lonicera japonica**  
Japanese Honeysuckle  
Caprifoliaceae Family (Honeysuckle Family)

**Perniciousness Rating** (for grasslands)  
mildly-------------moderately-------------------very

0   1   2   3   4   5   6   7   8   9   10

### CONTROL OPTIONS

**Herbicide:** Spot, wick, or broadcast application to overwintering growth  
Synthetic: *Garlon®* in uplands  
*Renovate®* in wetlands  
Timing: Late fall through early spring, retreating as necessary. Best control occurs prior to the first hard freeze.

**Mechanical:** Physical removal by the roots  
Timing: Any point in the growing season, repeating as necessary  
Note: Root fragments that remain in the soil will resprout. Mowing and cutting is an ineffective means of control as it stimulates stem production.

### Impacts
Exotic vine with twining habit capable of rapidly covering herbaceous plants, shrubs, and trees to form dense monocultures. Semi-evergreen/evergreen leaves enable photosynthesis longer than many native species, thereby giving it a competitive advantage.

### Habitat
Roadsides, field edges, floodplains, disturbed woodlands and woodland openings.

### Range
Native to Japan and now found in the eastern, southern-central, and western United States. Also found in parts of Canada.

### Regeneration
Spreads by seed, rhizomes, and above ground runners, which are most prolific in open sun and will resprout when touching exposed soil to form mats of new plants. Seeds can germinate under a wide variety of sun and moisture conditions.

### Identification
Sweetly scented, tubular, white to pink flowers fade to yellow. Flowers late spring and into the summer and fall. Black fruits mature in the fall. Leaves at the vine’s base are often lobed somewhat like an oak leaf while upper leaves are simple, oval, and opposite, 1½ to 3½” long. Stems are reddish brown and hairy when immature while older stems have flaky bark that peels off in strips.

### Look Alikes
The native vining honeysuckles (including *Lonicera sempervirens* in the east) have red to orange fruits and uppermost pairs of fused leaves while the leaves of *L. japonica* are...
Lonicera japonica in the Croton grassland
(e.g., dates observed, abundance, treatments, etc.)

May 2014: Scattered presence in stone-lined swales

Lonicera japonica – fall color and fruit

distinctly separate.

IMAGE CREDITS: www.ipane.org
Polygonum perfoliatum  
Mile-a-Minute Vine  
Polygonaceae Family (Buckwheat Family)  

Perniciousness Rating (for grasslands)  
mildly-------------moderately------------------very  
0 1 2 3 4 5 6 7 8 9 10  

CONTROL OPTIONS  

NOTE: ANY MISSED PLANTS THAT HAVE FORMED SEED SHOULD BE BAGGED AND REMOVED FROM THE SITE TO PREVENT SEED DISPERSAL.  

Herbicide: Spot, wick, or broadcast application  
Synthetic: Stinger® in uplands  
Renovate® in wetlands  
Timing: As soon as detected, ideally before growth climbs up and over seeded species.  
Note: Total eradication may require several years of consecutive treatment.  

Mechanical: Physical removal by the roots  
Timing: As soon as detected (thorn-like spines are still soft in the spring, facilitating removal).  

Biocontrol: Weevil (Rhinoncomimus latipes)  
Note: Likely already present in the Hudson Valley.  

Impacts  
Fast spreading annual exotic vine capable of overrunning shrubs and small trees, growing up to 6” daily. Vines have small downward pointing thorn-like spines that make access to overrun areas difficult.  

Habitat  
Road embankments, riparian areas, old fields, open areas, and disturbed woodlands and woodland edges.  

Range  
Introduced from Asia and now widespread throughout the Mid-Atlantic and northeastern United States.  

Regeneration  
Birds, ants, chipmunks, deer, and squirrels feed on and readily spread the fruit. Water also serves as a means of seed dispersal.  

Identification  
Distinctive triangular shaped 1–3” wide leaves alternately arranged on slender reddish stems. Thorn-like spines on both leaves and stems. Small white flowers emerge from cuplike leafy structures along the stem. Pea-sized fruit appears pale green and matures to purple and metallic blue. Vigorous vines can grow to 15’ or more in one season.  

Look Alikes  
Somewhat similar to native arrow-vine (Polygonum sagittatum) and halbeardleaved...
Polygonum perfoliatum in Croton Point Park grassland
(e.g., dates observed, abundance, treatments, etc.)

July 2000 Croton grassland plant survey: not listed
May 2014: not observed but it may have been too early to see evidence

tearthumb (Polygonum arifolium), neither of which have the distinctive flower structure of P. perfoliatum. Both native species are found in wet areas preferred by Mile-a-Minute Vine.

IMAGE CREDITS: www.invasive.org
C. NON THREATENING WEEDS

The weeds profiled here are considered non-threatening due to their lack of long-term competitiveness. No control is necessary when these species are intermingled with seeded or existing desired species since these species will outcompete the weeds over time. If no desirable species are present, however, or if eradication is desired for aesthetic reasons, treat the undesired species and reseed the treated area.

**Erigeron annuus**
Eastern Daisy Fleabane
Asteraceae Family (Aster Family)

**CONTROL OPTIONS** (to be used when plant is not intermingled with seeded species)

- **Herbicide:** Spot, wick, or broadcast application
- **Synthetic:** Garlon® in uplands
  Renovate® in wetlands
- **Timing:** Spring prior to seed formation or as soon as detected, repeating as necessary. Semi-evergreen foliage can also be treated in the fall.

- **Mechanical:** Physical removal by the roots
- **Timing:** As soon as detected, ideally before forming seed, repeating removal efforts as necessary

**Impacts**
Disturbance-adapted native herbaceous perennial that colonizes bare ground. Produce copious seed. Can tolerate a range of conditions and close mowing.

**IMAGE CREDIT:** http://de.wikipedia.org/wiki/Bild:Unbekannt-37.jpg

*Erigeron annuus*– foliage and flowers

---

**Erigeron annuus in the Croton grassland**
(e.g., dates observed, abundance, treatments, etc.)

July 2000: listed in the Croton grassland plant survey
**Plantago lanceolata** and **Plantago major**
Buckhorn Plantain and Broadleaf Plantain
Plantaginaceae Family (Plantain Family)

<table>
<thead>
<tr>
<th>CONTROL OPTIONS (to be used when plant is not intermingled with seeded species)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Herbicide:</strong></td>
</tr>
<tr>
<td><strong>Synthetic:</strong></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td><strong>Timing:</strong></td>
</tr>
<tr>
<td><strong>Mechanical:</strong></td>
</tr>
<tr>
<td><strong>Timing:</strong></td>
</tr>
</tbody>
</table>

**Impacts**
Disturbance-adapted exotic herbaceous perennial that colonizes bare ground. Produces copious seed. Can tolerate a range of conditions and close mowing.

**IMAGE CREDITS:** wikipedia.org

**Plantago** *spp.* in the Croton grassland
(e.g., dates observed, abundance, treatments, etc.)

July 2000 Croton grassland plant survey: not listed
**Taraxacum officinale**
Common Dandelion
Asteraceae Family (Aster Family)

**CONTROL OPTIONS (to be used when plant is not intermingled with seeded species)**

**Herbicide:** Spot, wick, or broadcast application

**Synthetic:** Garlon® in uplands
Renovate® in wetlands

**Timing:** Spring prior to flowering or as soon as detected, repeating as necessary.

**Mechanical:** Physical removal by the roots

**Timing:** As soon as detected, ideally before forming seed, repeating removal efforts as necessary

**Note:** Can resprout from root fragments

**Impacts**
Disturbance-adapted exotic herbaceous perennial that colonizes bare ground. Produces copious amounts of wind-dispersed seed. Can tolerate a range of conditions and close mowing.

IMAGE CREDIT: wikipedia.org (Köhler’s Medizinal Pflanzen)

**Taraxacum officinale in the Croton grassland**
(e.g., dates observed, abundance, treatments, etc.)

July 2000: listed in the Croton grassland plant survey
**Trifolium pratense**
**Red Clover** *(Purple Clover)*
Fabaceae Family *(Pea Family)*

| CONTROL OPTIONS (to be used when plant is not intermingled with seeded species) |
|---------------------------------|-------------------------------------------------|
| **Herbicide:** | Spot, wick, or broadcast application |
| **Synthetic:** | Garlon® in uplands
Renovate® in wetlands |
| **Timing:** | Late spring or early summer prior to seed formation or as soon as detected, repeating as necessary |
| **Mechanical:** | Physical removal by the roots |
| **Timing:** | As soon as detected, ideally before forming seed, repeating removal efforts as necessary |

**Impacts**
Exotic herbaceous biennial or perennial grown agriculturally for fodder and for its nitrogen fixing abilities. Moderately tolerant of mowing.

IMAGE CREDIT: wikipedia.org

---

**Trifolium pratense in the Croton grassland** *(e.g., dates observed, abundance, treatments, etc.)*

Included in one of the original Croton grassland seed mix (see "Wildflower/Butterfly Seed Mix" in Appendix B in Section XI).

July 2000: listed in the Croton grassland plant survey
**Trifolium repens**
**White Clover (Dutch Clover)**
Fabaceae Family (Pea Family)

**CONTROL OPTIONS** (to be used when not plant is not intermingled with seeded species)

- **Herbicide:** Spot, wick, or broadcast application
- **Synthetic:** Garlon® in uplands
  - Renovate® in wetlands
- **Timing:** Late spring or early summer prior to seed formation or as soon as detected, repeating as necessary.

- **Mechanical:** Physical removal by the roots
- **Timing:** As soon as detected, ideally before forming seed, repeating removal efforts as necessary

**Impacts**
A mat forming exotic perennial that spreads by creeping aboveground stems (stolons) that root at the nodes.
Seeds germinate in cool, moist conditions. Tolerates close mowing and a wide variety of growing conditions.

---

**Trifolium repens** in the Croton grassland
(e.g., dates observed, abundance, treatments, etc.)
July 2000: listed in the Croton grassland plant survey
D. SELECTED WEED CONTROL TECHNIQUES

Weed control techniques referred to in individual weed species profiles (Section X.B) are detailed below. Descriptions of herbicides appear in Section X.E.

Herbicide Controls

<table>
<thead>
<tr>
<th>TECHNIQUE</th>
<th>USE ON</th>
<th>HOW TO</th>
<th>EQUIPMENT &amp; MATERIALS NEEDED</th>
<th>COMMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Broadcast application of specified herbicide</td>
<td>All species (reserve for heavy infestations)</td>
<td>1. Spray until the leaves are wet but not dripping. Spray on calm days to avoid herbicide drift. 2. Allow 3-4 weeks for regrowth and retreat as necessary. For woody vegetation cut to the ground using desired equipment. Allow 3-4 weeks to pass for some regrowth to occur and then treat regrowth as specified above.</td>
<td>- Backpack sprayer for small areas  - Boom sprayer for larger areas (mounts on vehicle)  - Herbicide (<em>species-specific recommendations in Section X.B.</em>)</td>
<td>Reserve for heavy infestations. May affect non-target vegetation.</td>
</tr>
<tr>
<td>Spot spray application of specified herbicide</td>
<td>All species</td>
<td>1. Apply to target vegetation using a backpack or tank sprayer on a calm day with a narrowed application stream and low tank pressure. A spray guard attached to the nozzle end reduces collateral damage to adjacent desirable plants. 2. Allow 3-4 weeks for regrowth and retreat as necessary. For woody vegetation cut to the ground using desired equipment. Allow 3-4 weeks to pass for some regrowth to occur and then treat regrowth as specified above.</td>
<td>- Backpack/hand held sprayer  - Herbicide (<em>species-specific recommendations in Section X.B.</em>)</td>
<td>Reduced collateral damage to adjacent non-target species. Quality sprayers with a gun jet and interchangeable orifices reduce operator fatigue.</td>
</tr>
<tr>
<td>Wick application of specified herbicide</td>
<td>All species</td>
<td>1. Drag over or rub plants up and down foliage while plants are actively growing. Do not apply so heavily that herbicide drops off target vegetation. Provide sufficient agitation to maintain a uniform application. 2. Allow 3-4 weeks for regrowth and retreat as necessary. For woody vegetation cut to the ground using desired equipment. Allow 3-4 weeks to pass for some regrowth to occur and then treat regrowth as specified above.</td>
<td>- Wick applicator  - Herbicide (<em>species-specific recommendations in Section X.B.</em>)</td>
<td>Typically a more extensive application than spot spraying. Herbicide drift may affect non-target species.</td>
</tr>
</tbody>
</table>
## Mechanical Controls

<table>
<thead>
<tr>
<th>TECHNIQUE</th>
<th>USE ON</th>
<th>HOW TO</th>
<th>EQUIPMENT &amp; MATERIALS NEEDED</th>
<th>COMMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cutting sequentially in late spring (to height as specified)</strong></td>
<td>Non-native cool season grasses</td>
<td>Mow/string trim target areas in mid May and mid June to 4&quot;. If only one mowing is possible, prioritize the June mowing. If the spring is particularly warm and wet, mow no later than June 1. See Best Mowing Practices for ways to reduce impacts on target bird species.</td>
<td>Mower, String trimmer</td>
<td>Grassland consultant to assess after five years to determine whether still relevant.</td>
</tr>
<tr>
<td><strong>Cutting plant at the base</strong></td>
<td>All species, (particularly effective on annual species)</td>
<td>1. Cut plants at the base prior to setting of viable seeds, taking care to minimize any disturbance to desirable vegetation or soils. 3. Repeat monthly or as needed until the root system is exhausted.</td>
<td>Clippers, sharp knife, string trimmer, etc.</td>
<td>Annual species will not typically return the following season if prevented from producing viable seed. Best used with isolated specimens amidst established desired growth.</td>
</tr>
<tr>
<td><strong>Physical removal by the roots</strong></td>
<td>All species (most effective on annual and biennial weeds)</td>
<td>1. Remove plants and extricate as much of their root systems as possible, taking care to minimize soil disturbance and compaction. Moist soils facilitate ease of removal. 2. Tamp soil firmly to avoid bringing more seeds to the surface. 3. If existing soil cannot or should not be left behind, holes should be filled with clean soil and planted or seeded with a desired species. 4. Any root suckers that emerge must be removed as soon as they are evident. 5. Repeat above procedures until any remaining root system is exhausted.</td>
<td>Grubbing equipment as desired, Weed Wrench™ or comparable tool (for large specimens)</td>
<td>Adverse impacts include possible disturbance to adjacent non-target species and extensive soil disturbance/compaction. Some target species may also resprout prolifically.</td>
</tr>
<tr>
<td><strong>Root cutting</strong></td>
<td>Herbaceous species and woody species</td>
<td>1. Use a sharp knife to slice through the main root of the target plant several inches below the soil level. 2. Tamp soil firmly to avoid bringing more seeds to the surface. 3. Repeat monthly or as needed for any root suckers. Continue until the root system is exhausted.</td>
<td>Sharp knife</td>
<td>Reduces but does not completely avoid soil disturbance and disturbance to adjacent non-target vegetation.</td>
</tr>
</tbody>
</table>
E. SELECTED RECOMMENDED HERBICIDES

Herbicides recommended in weed profiles in Section X.B are detailed below. Note that this is not an exhaustive list of all possible herbicides.

<table>
<thead>
<tr>
<th>BRAND NAME</th>
<th>TYPE</th>
<th>ORGANIC or SYNTHETIC</th>
<th>EFFECTS</th>
<th>DOES NOT EFFECT</th>
<th>RATED FOR</th>
<th>COMMENTS</th>
<th>ACTIVE INGRED.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accord®</td>
<td>Non-selective post-emergent</td>
<td>Synthetic</td>
<td>All species</td>
<td>Upland Seasonally dry wetlands</td>
<td>Glyphosate</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Assure®</td>
<td>Selective systemic post-emergent</td>
<td>Synthetic</td>
<td>Grasses</td>
<td>Sedges or broadleaf herbaceous species</td>
<td>Upland only</td>
<td>Use only in severe isolated infestations of Japanese Stiltgrass when other controls are ineffective since Assure will kill seeded grasses.</td>
<td>Quizalofop</td>
</tr>
<tr>
<td>Garlon®</td>
<td>Selective systemic stump and brush herbicide</td>
<td>Synthetic</td>
<td>Broadleaf herbaceous species</td>
<td>Grasses</td>
<td>Upland only</td>
<td>Triclopyr</td>
<td></td>
</tr>
<tr>
<td>Habitat®</td>
<td>Non-selective systemic post-emergent</td>
<td>Synthetic</td>
<td>All species (particularly effective on Common Reed)</td>
<td>--</td>
<td>Wetland rated</td>
<td>Isopro-pylamine</td>
<td></td>
</tr>
<tr>
<td>Milestone®</td>
<td>Selective pre- and post-emergent</td>
<td>Synthetic</td>
<td>Broadleaf herbaceous species and some Brome grasses (Bromus spp.)</td>
<td>Most grasses</td>
<td>Upland only</td>
<td>Aminopyralid</td>
<td></td>
</tr>
<tr>
<td>Perspective®</td>
<td>Selective post-emergent</td>
<td>Synthetic</td>
<td>Broadleaf herbaceous species (particularly effective on Leafy Spurge)</td>
<td>Grasses</td>
<td>Upland only</td>
<td>Aminocyclo-pyraclor, Chlorsulfuron</td>
<td></td>
</tr>
<tr>
<td>Plateau®</td>
<td>Selective systemic pre- and post-emergent</td>
<td>Synthetic</td>
<td>Cool season grasses and some forbs</td>
<td>Warm season grasses</td>
<td>Upland only</td>
<td>Imazameth</td>
<td></td>
</tr>
<tr>
<td>Renovate®</td>
<td>Selective systemic stump and brush herbicide</td>
<td>Synthetic</td>
<td>Broadleaf herbaceous species (95% effective against Japanese Knotweed)</td>
<td>Grasses</td>
<td>Wetland rated</td>
<td>Triclopyr</td>
<td></td>
</tr>
</tbody>
</table>
### Croton Grassland Design & Management Specifications

#### Important Points to Remember

- Federal, state, and local laws stipulate that herbicides are to be applied only as directed per the labels and in some cases be applied only by certified or licensed applicators. For application rates of registered herbicides and the appropriate surfactants, consult the herbicide label and/or a qualified certified applicator. It is beyond the scope of this document to provide that information.

- For information on herbicides currently or previously registered in New York State with the New York State Department of Environmental Concern (NYSDEC), visit the Product, Ingredient, and Manufacturer System (PIMS) database at pims.psur.cornell.edu.

- Applications should be made using properly maintained and calibrated equipment at the rates specified on the herbicide label.

- LWLA has assembled the most reliable information available at the time this manual was prepared. Laws and regulations regarding herbicide use change regularly and LWLA cannot assume liability for any recommendations.

- Material Safety Data Sheets (MSDS) for all herbicides listed can be found online.

---

<table>
<thead>
<tr>
<th>BRAND NAME</th>
<th>TYPE</th>
<th>ORGANIC or SYNTHETIC</th>
<th>EFFECTS</th>
<th>DOES NOT EFFECT</th>
<th>RATED FOR</th>
<th>COMMENTS</th>
<th>ACTIVE INGRED.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rodeo®</td>
<td>Non-selective systemic post emergent</td>
<td>Synthetic</td>
<td>All species</td>
<td>--</td>
<td>Wetland rated</td>
<td></td>
<td>Glyphosate</td>
</tr>
<tr>
<td>Sedgehammer®</td>
<td>Selective systemic post emergent</td>
<td>Synthetic</td>
<td>Sedges, <em>Equisetum arvense</em></td>
<td>Grasses, broadleaf herbaceous species</td>
<td>Upland only</td>
<td>Affect on <em>Equisetum arvense</em> likely to show within 2 weeks as a necrotic ring at the base of the stem even though stems and foliage remain green.</td>
<td>Halosulfuron-methyl</td>
</tr>
</tbody>
</table>
XI. APPENDICES

A. MANAGEMENT EQUIPMENT & SUPPLIES

The following is a list of equipment and supplies for routine recommended management tasks. This list does not include equipment and supplies needed for seeding, planting, or site preparation (see relevant Section VII for installation equipment and supplies).

☐ Cutting bar or sickle-bar type mower
  
  *Cutting bar type mowers are recommended for use when mowing is necessary during the breeding season. When the cutting bar is angled upwards, it helps to push birds that do not flush up and away from the blade.*

☐ Field guides to supplement information provided in this manual (see Section X.J for recommendations)

☐ Flagging materials (spray paint, surveyor’s tape, flags on wire stakes, etc.)

☐ Flail or rotary style mower
  
  *Sickle bar type mowers that cut at the base of vegetation and drop plant material intact should not be used for cutting back the prior year’s residual growth as the intact cuttings can inhibit the growth of seedlings and newly emerging existing growth.*

☐ Flushing bar

☐ Hand pruners, loppers, sharp spade/knife, etc. for mechanical removal of undesired vegetation

☐ Herbicides (see Section X.E for recommended herbicides)

☐ Herbicide application tools (backpack sprayer, wicks, boom sprayer, etc.)

☐ Protective clothing for weed and invasive species removal (eye goggles, ear protectors, gloves, rubber boots, etc.)

☐ Rebar in 5’ lengths (or other length as desired/appropriate) for delineating vegetative zones. Wooden stakes can be used but they will split over time, can be harder to drive, are more likely to heave with frost, and are more difficult to store.

☐ Robel pole (1-2 metre pole with alternating horizontal bands and a 4 metre line of rope for assessing vegetation height and density)

☐ Spray paint for color coding the top 12” of rebar stakes

☐ String trimmer (i.e., weed wacker) for spot weed control


NOTE – Thoroughly clean all tools and equipment to avoid spreading seeds of weeds and invasive species to new areas.
B. SEED MIXES FROM 1993-1994

What are believed to be the original seed mixes for the Croton grassland are reproduced below. It is not clear whether the trees listed were planted. The document also included a list of "future shrub masses," which are not believed to have been planted and so are not reproduced here. Species observed by LWLA personnel in May 2014 are marked with a red dot (∗).

Source: Westchester County Department of Parks, Recreation, and Conservation.

<table>
<thead>
<tr>
<th>QTY</th>
<th>TREE</th>
<th>SIZE</th>
</tr>
</thead>
<tbody>
<tr>
<td>19</td>
<td>Acer rubrum</td>
<td>2 1/2&quot; - 3&quot; Cal.</td>
</tr>
<tr>
<td>17</td>
<td>Celtis occidentalis</td>
<td>2 1/2&quot; - 3&quot; Cal.</td>
</tr>
<tr>
<td>12</td>
<td>Pinus rigida</td>
<td>8' 10&quot; HT.</td>
</tr>
<tr>
<td>16</td>
<td>Quercus bicolor</td>
<td>2 1/2&quot; - 3&quot; Cal.</td>
</tr>
<tr>
<td>5</td>
<td>Quercus rubra</td>
<td>2 1/2&quot; - 3&quot; Cal.</td>
</tr>
</tbody>
</table>

GRASSES & CLOVER

- Andropogon gerardi
- Andropogon scoparius
- Panicum virgatum
- Sorghastrum nutans

Application Rate: 50 lbs. per acre

- Big Bluestem "Niagra" (Kester's Dwarf Corn)
- Little Bluestem "Aldous" or "Camper"
- Switch Grass "Blackwell"
- Indian Grass "Cheyenne"
- Red Clover
- Alsike Clover

KESTER'S UPLAND GAME BIRD MIX

<table>
<thead>
<tr>
<th>TREE</th>
<th>SIZE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Megari</td>
<td></td>
</tr>
<tr>
<td>Peas</td>
<td></td>
</tr>
<tr>
<td>Black Oil Sunflower</td>
<td></td>
</tr>
<tr>
<td>Sarcia Lespedeza</td>
<td></td>
</tr>
<tr>
<td>Kester's Trailing Soy Beans</td>
<td></td>
</tr>
<tr>
<td>Spring Wheat</td>
<td></td>
</tr>
<tr>
<td>Proso Millet</td>
<td></td>
</tr>
<tr>
<td>Sorghum</td>
<td></td>
</tr>
<tr>
<td>Lathco Flat Pea</td>
<td></td>
</tr>
<tr>
<td>Pearl Millet</td>
<td></td>
</tr>
</tbody>
</table>

Application Rate: 30 lbs per acre

- Small Burnett
- Alsike
- Canadian Peas
- Sweet Clover
- Red Clover
- Buckwheat
- Jap Millet
- Red Proso Millet
- Red Finch Millet

WILDFLOWER/BUTTERFLY MEADOW SEED MIX

<table>
<thead>
<tr>
<th>TREE</th>
<th>SIZE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Achillea millefolium</td>
<td></td>
</tr>
<tr>
<td>Daucus carota</td>
<td></td>
</tr>
<tr>
<td>Andropogon scoparius</td>
<td></td>
</tr>
<tr>
<td>Echinacea purpurea</td>
<td></td>
</tr>
<tr>
<td>Asclepias syriaca</td>
<td></td>
</tr>
<tr>
<td>Festuca scabrella</td>
<td></td>
</tr>
<tr>
<td>Echinochloa tuberosa</td>
<td></td>
</tr>
<tr>
<td>Galium triostigma</td>
<td></td>
</tr>
<tr>
<td>Aster nove-augiae</td>
<td></td>
</tr>
<tr>
<td>Liatris spicata</td>
<td></td>
</tr>
<tr>
<td>Centaurea cyanus</td>
<td></td>
</tr>
<tr>
<td>Onothera lamarkiana</td>
<td></td>
</tr>
<tr>
<td>Chrysanthemum leucanthemum</td>
<td></td>
</tr>
<tr>
<td>Redbeckia hirta</td>
<td></td>
</tr>
<tr>
<td>Solidago canadensis</td>
<td></td>
</tr>
<tr>
<td>Coreopsis lanceolata</td>
<td></td>
</tr>
<tr>
<td>Trifolium hybridum</td>
<td></td>
</tr>
<tr>
<td>Cosmos bipinnatus</td>
<td></td>
</tr>
<tr>
<td>Trifolium pratense</td>
<td></td>
</tr>
</tbody>
</table>

Application Rate: 30 lbs. per acre/3/4 lbs. per 1,000 SF

- Yarrow
- Queen Anne's Lace
- Little Bluestem
- Purple Coneflower
- Common Milkweed
- Sheep Fescue
- Butterfly Weed
- Blanket Flower
- New England Aster
- Gayfeather
- Bachelor's Button
- Evening Primrose
- Ox-eye Daisy
- Black-eyed Susan
- Goldenrod
- Coreopsis
- Alsike Clover
- Cosmos
- Red Clover

Fig. 42: Croton grassland, 2014. Courtesy Kathryn Lamb.
C. MANAGEMENT PLAN FROM 1997

A prior management plan (dated 1997) for the Croton grassland is reproduced below. While the plan appropriately recommends that the grassland be mowed in the late winter with sections left unmowed for up to three years, the plan did not appear to include a comprehensive weed control strategy. It is also unclear whether the recommended mowing strategy was consistently implemented.

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**DEPARTMENT OF PARKS RECREATION & CONSERVATION**

**MEMORANDUM**

April 16, 1997

**TO:** Joseph Stout  
Deputy Commissioner

**FROM:** Mary E. Davis  
Naturalist/Dir. Conservation

**RE:** Mowing at Croton Point Landfill

At your request, here is my recommendation for the mowing schedule of the Croton Point Landfill. It should be mowed once a year during the very early Spring. (March 15 - 30 would be ideal). It is important to mow once a year in order to prevent succession whereby field habitat reverts to forest habitat. Early Spring mowing is suggested because birds (such as Meadowlarks and Bobolinks) for example will start to come in after this. Since the landfill was planted with the idea of encouraging wildlife, this ecologically sound habitat management plan would further this objective. All the nature center parks have and follow habitat management plans to encourage wildlife in the existing habitats.

MBD/pm

**CC:** Commissioner DeSantis  
Deputy Commissioner Young

**Field Management:** The Meadow (capped landfill) at Croton Point Park should be mowed annually for numerous reasons: to protect the integrity of the cap, to prevent succession, to increase the diversity of bird species in Westchester County as Grassland Habitat in the County has decreased tremendously, to increase the overall biodiversity of plants, animals and insects, and to promote the growth of the native and planted species of plants. A further study of the plants on the Meadow will help determine a specific mowing schedule, in sections only, annually - leaving sections unmowed for up to three years or so, and/or doing experimental mowings of less ecologically sensitive areas and at different heights. The best time to mow the area is in the late Winter months - no later than March 30, as the grassland bird species begin arriving shortly after that to set up their nesting territories and also some early spring plants begin blooming. Mowing in the fall would be detrimental to the wintering birds as it reduces their ground cover substantially, and the plants are going to seed. Research is presently being done on the most appropriate long range way to manage the Meadow. The ultimate goal is to maintain it as a grassland habitat, to encourage native plants and discourage woody growth, and to provide the best habitat possible for the diversity of birds, animals and insects.
D. PLANT SURVEY FROM 2000

A July 2000 plant survey for the Croton grassland is reproduced below. (Source: Westchester County Department of Parks, Recreation, and Conservation.) Species observed by LWLA personnel in May 2015 are marked with a red dot (•).

**Wildflowers:**

- Alfalfa-Medicago sativa
- Bachelor's Button-Centauraea cyanus
- Birdfoot Trefoil-Lotus corniculatus
- Black-eyed Susan-Rudbeckia hirta
- Black Medick-Medicago lupulina
- Bladder Campion-Silene nivea
- Blue Vervain-Vervaina hastata
- Blue-Weed-Echium vulgare
- Bulbous Buttercup-Ranunculus bulbosus
- Bull Thistle-Cirsium vulgare
- Burnet-Sanguisorba sp.
- Butter-and-Eggs-Linaria vulgaris
- Buttercup-Ranunculus sp.
- Camphorweed-Heterotheca subaxillaris
- Canada Hawkweed-Hieracium canadense
- Canada Thistle-Cirsium arvense
- Chickory-Chicorium intybus
- Chickweed-Stellaria sp.
- Cinquefoil-Potentilla sp.
- Cohosh-Tussilago farfara
- Common Milkweed-Acilepis syriaca
- Common Mullein-Verbascum thapsus
- Common Wood-sorrel-Oxalis montana
- Coreopsis-Coreopsis sp.
- Cow Cress-Lepidium campestre
- Cow's Vetch-Vicia sativa
- Crown Vetch-Coronilla varia
- Curly Dock-Rumex crispus
- Cypress Spurge-Euphorbia paralias
- Daisy Fleabane-Erigeron annuus
- Dane's Rocket-Hesperis matronalis
- Dandelion- Taraxacum officinale
- Deptford Pink-Dianthus armeria
- Early Winter Cress-Barbarea verna
- Evening Lychins-Lychins alba
- Evening Primrose-Oenothera biennis
- Field Mustard-Brassica rapa
- Field Pansy-Viola tricolor
- Field Penny-cress-Thlaspi arvense
- Foxglove-Gerardia sp.
- Foxglove Beard tongue-Penstemon sp.
- Garlic Mustard-Alliaria officinalis
- Goldenrod-Solidago sp.
- Hedge Bindweed-Convolvulus sepium
- Hedge Mustard-Sisymbrium officinale
- Herb-Geranium robertianum
- Hoary Alyssum-Berteroa incana
- King Devil-Hieracium pratense
- Large Leaved Asters-Aster macrophyllus
- Leafy Spurge-Euphorbia esula
- Lesser Stitchwort-Stellaria graminea
- Moth Mullein-Verbascum blattaria
- Motherwort-Artemisia vulgaris
- Multiflora Rose-Rosa multiflora
- Nightshade-Solanum dulcamara
- Northern Bed Straw-Galium boreale
- Ox-Eye Daisy-Chrysanthemum leucanthemum
- Purple Coneflower-Echinacea purpurea
- Purple Dead-Nettle-Lamium purpureum
- Purple Loosestrife-Lythrum salicaria
- Queen Anne's Lace-Daucus carota
- Ragged Robin-Lychins flos-cuculi
- Red Clover-Trifolium pratense
- Rough Avens-Geum virginianum
- Rough Bedstraw-Galium asprellum
- Rough-fruited Cinquefoil-Potentilla recta
- Rose-Rosa sp.
- Shepards' Purse-Capsella bursa-pastoris
- Speedwell-Veronica sp.
- Spring Vetch-Vicia sativa
- Spotted Knapweed-Centaurea maculosa
- Strawberry-Fragaria sp.
- Sunflower-Helianthus sp.
- Thin Leaved Coneflower-Rudbeckia triloba
- Thyme-leaved Sandwort-Arenaria serpyllifolia
- Tower Mustard-Arabis glabra
- Tumble Mustard-Sisymbrium altissimum
- Violets-Viola sp.
- Vipers Bugloss-Echium vulgare
- Wild Madder-Galium mollugo
- Winter Cress-Barbarea vulgaris
- Yarrow-Achillea millefolium
- Yellow Sweet Clover-Mellilotus officinalis
- White-bracted Thoroughwort-Eupatorium pilosum

**Grasses:**

- Foxtail
- Sweet Vernal
- Switch
- Whitlow
- Winter Wheat
E. NEW YORK'S TARGET GRASSLAND BIRDS


<table>
<thead>
<tr>
<th>Species</th>
<th>Partners in Flight Ranking (Carter et al. 2000)</th>
<th>NE Concern†</th>
<th>NY SCCN‡</th>
<th>NY E.T.SC§</th>
<th>Tier</th>
</tr>
</thead>
<tbody>
<tr>
<td>Northern Harrier</td>
<td>High Regional Priority/High Regional Threats</td>
<td>Yes</td>
<td>Yes</td>
<td>T</td>
<td>1</td>
</tr>
<tr>
<td>Upland Sandpiper</td>
<td>High Continental Concern/High Regional Responsibility, High Regional Threats</td>
<td>Yes</td>
<td>Yes</td>
<td>T</td>
<td>1</td>
</tr>
<tr>
<td>Short-eared Owl</td>
<td>High Continental Concern/Low Regional Responsibility, High Regional Threats</td>
<td>Yes</td>
<td>Yes</td>
<td>E</td>
<td>1</td>
</tr>
<tr>
<td>Sedge Wren</td>
<td>High Regional Priority/High Regional Threats</td>
<td>Yes</td>
<td>Yes</td>
<td>T</td>
<td>1</td>
</tr>
<tr>
<td>Henslow's Sparrow</td>
<td>High Continental Concern/High Regional Priority; High Regional Priority/High Regional Concern, High Regional Threats</td>
<td>Yes</td>
<td>Yes</td>
<td>T</td>
<td>1</td>
</tr>
<tr>
<td>Grasshopper Sparrow</td>
<td>High Regional Priority/High Regional Threats</td>
<td>-</td>
<td>Yes</td>
<td>SC</td>
<td>1</td>
</tr>
<tr>
<td>Bsibolink</td>
<td>High Regional Priority/High Regional Concern, High Regional Responsibility</td>
<td>-</td>
<td>Yes</td>
<td>-</td>
<td>1</td>
</tr>
<tr>
<td>Loggerhead Shrike</td>
<td>High Regional Priority/High Regional Threats</td>
<td>Yes</td>
<td>Yes</td>
<td>E</td>
<td>1</td>
</tr>
<tr>
<td>Horned Lark</td>
<td>-</td>
<td>-</td>
<td>Yes</td>
<td>SC</td>
<td>2</td>
</tr>
<tr>
<td>Vesper Sparrow</td>
<td>-</td>
<td>-</td>
<td>Yes</td>
<td>SC</td>
<td>2</td>
</tr>
<tr>
<td>Eastern Meadowlark</td>
<td>High Regional Priority/High Regional Concern</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>2</td>
</tr>
<tr>
<td>Savannah Sparrows</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>2</td>
</tr>
<tr>
<td>Wintering Raptors  *</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>3</td>
</tr>
</tbody>
</table>

§ Species listed as Endangered, Threatened, or Special Concern in NY (New York State 1979).
* Including Northern Harrier, Short-eared Owl, Snowy Owl (*Bubo scandiacus*), Rough-legged Hawk (*Buteo lagopus*), Red-tailed Hawk (*Buteo jamaicensis*), American Kestrel (*Falco sparverius*), and Northern Shrike (*Lanius excubitor*).

Fig. 43: Grasshopper Sparrow in the Croton grassland. 
Courtesy Kevin Bolton.
**F. HABITAT CHARACTERISTICS OF NEW YORK’S BREEDING GRASSLAND BIRDS**

The tables reproduced below detail the habitat characteristics of New York’s grassland breeding birds as drawn from Morgan and Burger. *A Plan for Conserving Grassland Birds in New York* (Audubon New York, 2008). Target species occurring at Croton during the breeding period are highlighted in red.

<table>
<thead>
<tr>
<th>Species</th>
<th>Northern Harrier</th>
<th>Upland Sandpiper</th>
<th>Short-eared Owl</th>
<th>Sedge Wren</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Recommended Field Size (ha)</strong></td>
<td>30+</td>
<td>30+</td>
<td>Large (exact sizes not available)</td>
<td>10 – 20</td>
</tr>
<tr>
<td><strong>Shrub Tolerance (% cover)</strong></td>
<td>Medium to high (1-5%)</td>
<td>Low (1%)</td>
<td>None indicated</td>
<td>Medium to high (3-8%)</td>
</tr>
<tr>
<td><strong>Forb Component (% cover)</strong></td>
<td>Low (10%)</td>
<td>Low (10 - 15%)</td>
<td>Medium (20%)</td>
<td>Very Low (0 - 10%)</td>
</tr>
<tr>
<td><strong>Litter Depth (cm)</strong></td>
<td>No preference indicated</td>
<td>Low (1)</td>
<td>No preference indicated</td>
<td>Medium (1-4)</td>
</tr>
<tr>
<td><strong>Vegetation Height (cm)</strong></td>
<td>Tall (60+)</td>
<td>Mixed (&lt;15 &amp; 40+)</td>
<td>Medium (40 - 60)</td>
<td>Tall (80+)</td>
</tr>
<tr>
<td><strong>Vegetation Density</strong></td>
<td>High</td>
<td>Low</td>
<td>High</td>
<td>High</td>
</tr>
<tr>
<td><strong>Perches Important</strong></td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td><strong>Notes</strong></td>
<td>Nest success may be higher in wetter sites. Variable in vegetation preferences. Requires low, sparse vegetation for foraging, feeding, and brood-rearing. Maintenance of perches beneficial.</td>
<td>Requires sites with Northern Harrier, but avoids wetter areas.</td>
<td>Shares sites with Loggerhead Shrike.</td>
<td>Prefer wetter areas with tall, dense vegetation—often reed canarygrass, switchgrass, or sedges.</td>
</tr>
</tbody>
</table>

**Descriptions:**
- Recommended Field Size - based on estimates of 50% probability of occurrence for each species, commonly accepted as the standard for minimum size targets.
- Maximum Shrub Tolerance - estimates of the maximum percentage of total cover of a habitat patch that each species will tolerate as covered by woody vegetation.
- Preferred Forb Component - estimates of the percentage of total cover of a habitat patch that each species prefers as covered by herbaceous vegetation (non-grass).
- Preferred Litter Depth - estimates of the preferred litter depth (thickness) tolerated by each species. Continued in next section...

<table>
<thead>
<tr>
<th>Species</th>
<th>Henslow’s Sparrow</th>
<th>Grasshopper Sparrow</th>
<th>Bobolink</th>
<th>Loggerhead Shrike*</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Recommended Field Size (ha)</strong></td>
<td>60+</td>
<td>50 - 100+</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td><strong>Shrub Tolerance (% cover)</strong></td>
<td>High (3 - 4%)</td>
<td>Medium (1-3%)</td>
<td>Low (&lt;1%)</td>
<td>High (10-40+)</td>
</tr>
<tr>
<td><strong>Forb Component (% cover)</strong></td>
<td>High (25%)</td>
<td>Medium</td>
<td>High (50%)</td>
<td>No preference indicated</td>
</tr>
<tr>
<td><strong>Litter Depth (cm)</strong></td>
<td>High (26)</td>
<td>Low (&lt;1)</td>
<td>Medium (3 - 4)</td>
<td>Low</td>
</tr>
<tr>
<td><strong>Vegetation Height (cm)</strong></td>
<td>Tall (60)</td>
<td>Medium (30)</td>
<td>Medium (30 - 40)</td>
<td>Low to medium (15 - 40)</td>
</tr>
<tr>
<td><strong>Vegetation Density</strong></td>
<td>High</td>
<td>Low</td>
<td>Medium to Low</td>
<td>Low</td>
</tr>
<tr>
<td><strong>Perches Important</strong></td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td><strong>Notes</strong></td>
<td>Requires undisturbed fields (often &gt;10 years), with some standing dead vegetation.</td>
<td>Prefers little or no litter and &gt;20% bare soil (evenly distributed, not patchy).</td>
<td>Still fairly ubiquitous across New York, and may be found in habitat patches that are less than ideal.</td>
<td>Prefer short, patchy grassy fields (pastures), clumps of woody vegetation for nesting and perches.</td>
</tr>
</tbody>
</table>

**Descriptions (continued):** Preferred Vegetation Height/Density - Estimates of the vegetation height and approximate density preferred by each species (generally early in breeding season when establishing territories).

Perches - "Yes" when literature suggests that suitable perches may be an important habitat selection factor for that species.

---

1. Data pooled from various sources but weighted according to geographic representation: New York> Northeastern US> Range-wide.
<table>
<thead>
<tr>
<th>Species</th>
<th>Horned Lark</th>
<th>Vesper Sparrow</th>
<th>Eastern Meadowlark</th>
<th>Savannah Sparrow</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Recommended Field Size (ha)</strong></td>
<td>1 - 10</td>
<td>10</td>
<td>15</td>
<td>5 - 10</td>
</tr>
<tr>
<td><strong>Shrub Tolerance (% cover)</strong></td>
<td>None (0%)</td>
<td>Low (&lt;1%)</td>
<td>Medium (2-3%)</td>
<td>Medium (2-3%)</td>
</tr>
<tr>
<td><strong>Forb Component (% cover)</strong></td>
<td>High**</td>
<td>High**</td>
<td>High (20 - 30%)</td>
<td>&lt; 40%</td>
</tr>
<tr>
<td><strong>Litter Depth (cm)</strong></td>
<td>0</td>
<td>Low (&lt;1)</td>
<td>Medium (2 - 6)</td>
<td>4 (+)</td>
</tr>
<tr>
<td><strong>Vegetation Height (cm)</strong></td>
<td>Very Short (0 - 10)</td>
<td>Short (&lt; 20)</td>
<td>Medium (20 - 40)</td>
<td>Medium (30 - 40)</td>
</tr>
<tr>
<td><strong>Vegetation Density</strong></td>
<td>Minimal</td>
<td>Low</td>
<td>High</td>
<td>Medium</td>
</tr>
<tr>
<td><strong>Perches Important</strong></td>
<td>Yes</td>
<td>Yes</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Notes</strong></td>
<td>Prefer barren (or patchy) areas with exposed soil. Early disturbances on portion of habitat beneficial (before 15 March).</td>
<td>Prefer areas with exposed soil and little litter, such as newly planted grass or seed crops.</td>
<td>Accepts wide variety of habitat conditions.</td>
<td>May be found in small habitat patches, particularly when surrounded by open land.</td>
</tr>
</tbody>
</table>

*Likely extirpated.  **When overall vegetation density is low.


---

**Fig. 44: Northern Harrier, Croton grassland. Courtesy Jeff Seneca.**
G. BREEDING CALENDARS FOR NEW YORK'S GRASSLAND NESTING BIRDS

Breeding cycle dates for New York's grassland breeding birds appears below as drawn from Morgan and Burger. Target breeding species for the Croton grassland are highlighted in red.

<table>
<thead>
<tr>
<th>Species</th>
<th>Arrival</th>
<th>Nesting</th>
<th>Hatching</th>
<th>Fledging</th>
<th>Flighted</th>
<th>End of Cycle</th>
<th>Double-brooded*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Northern Harrier</td>
<td>-45**</td>
<td>-7</td>
<td>37</td>
<td>63</td>
<td>77</td>
<td>105</td>
<td>No</td>
</tr>
<tr>
<td>Upland Sandpiper</td>
<td>-5</td>
<td>10</td>
<td>44</td>
<td>44-45</td>
<td>74</td>
<td>94</td>
<td>No</td>
</tr>
<tr>
<td>Short-eared Owl</td>
<td>N/A**</td>
<td>-15</td>
<td>17</td>
<td>32</td>
<td>53</td>
<td>96</td>
<td>Possible</td>
</tr>
<tr>
<td>Sedge Wren</td>
<td>10</td>
<td>25+</td>
<td>48</td>
<td>61</td>
<td>Unk (+14?)</td>
<td>111+</td>
<td>Yes</td>
</tr>
<tr>
<td>Henslow's Sparrow</td>
<td>8</td>
<td>15</td>
<td>37</td>
<td>46</td>
<td>Unk (+14?)</td>
<td>109</td>
<td>Yes</td>
</tr>
<tr>
<td>Grasshopper Sparrow</td>
<td>0</td>
<td>10</td>
<td>29</td>
<td>38</td>
<td>Unk (+14?)</td>
<td>91</td>
<td>Yes</td>
</tr>
<tr>
<td>Bobolink</td>
<td>2</td>
<td>14</td>
<td>35</td>
<td>46</td>
<td>51 (+)</td>
<td>89</td>
<td>Occasionally</td>
</tr>
<tr>
<td>Loggerhead Shrike</td>
<td>-30</td>
<td>-13</td>
<td>15</td>
<td>33</td>
<td>47</td>
<td>62</td>
<td>Yes</td>
</tr>
<tr>
<td>Horned Lark</td>
<td>N/A**</td>
<td>-15 (+)</td>
<td>7</td>
<td>17</td>
<td>35</td>
<td>105</td>
<td>Yes</td>
</tr>
<tr>
<td>Vesper Sparrow</td>
<td>-23</td>
<td>0</td>
<td>21</td>
<td>31</td>
<td>51</td>
<td>90</td>
<td>Yes</td>
</tr>
<tr>
<td>Eastern Meadowlark</td>
<td>-45**</td>
<td>7</td>
<td>31</td>
<td>43</td>
<td>51</td>
<td>80</td>
<td>Yes</td>
</tr>
<tr>
<td>Savannah Sparrow</td>
<td>-30**</td>
<td>5</td>
<td>34</td>
<td>43</td>
<td>63</td>
<td>96</td>
<td>Yes</td>
</tr>
</tbody>
</table>

* All species may re-nest if disturbed sufficiently early in the cycle.

** May overwinter (Savannah Sparrow and Eastern Meadowlark in limited numbers).

Descriptions: Arrivals = Pooled early arrival date. Nesting = Pooled early initiation of nesting (site selection and construction). Hatching = Pooled early hatching date. Fledging = pooled early departure from nest. Flighted = Pooled early date when young capable of sustained flight (generally >1 min. or >200 m). End of Cycle = Latest date at which young may become flighted.

The approximate breeding timing for New York's grassland birds as drawn from Morgan and Burger, 2008. The span between bold dashed lines indicates the designated bird breeding period used in this manual. Target breeding species for the Croton grassland are highlighted in red.

---

Key: A = Arrival Date; N = Nesting; H = Hatching; F = Fledging; Y = Young capable of sustained flight; E = End of Breeding Cycle.

* Present year-round (resident)

H. ROBEL POLE/VISUAL OBSTRUCTION METHOD

The Robel Pole/Visual Obstruction Method can be used to measure vegetative density and quantify ground cover volume of standing vegetation over large areas quickly. This information could then be combined with bird sightings from the volunteer bird monitoring program. More fine-tuned analysis could thereby occur into what bird species are using what vegetation zones and what the vegetation height-density of these zones is.

The Robel Pole is a 1-2 metre pole with alternating horizontal bands and a 4 metre line of rope or cord. Used by range ecologists and field biologists, the Pole is named after Dr. Robert J. Robel who developed the device. Modifications to the original design and its use are now known as the Visual Obstruction (VO) measurement method.

Guidelines on how to properly establish transects and calibrate measurements can be accessed online and in the following publication available online as a PDF:

I. GLOSSARY

Allelopathy
Biological phenomenon by which a plant produces one or more biochemicals that positively or negatively influence the growth, survival, and reproduction of other organisms. Many invasive plant species are allelopathic (e.g., Alliaria petiolata).

Alternate leaf arrangement
A single leaf or branch at each node of growth. See also opposite arrangement.

Auricles
Appendage extending from the leaf collar on a grass.

Awn
A slender needlelike attachment of varying lengths that extends from the glume.

Bunchgrass
Refers to a grass that grows in a clump, tuft, or hummock rather than forming a sod.

Conspecifics
Of or belonging to the same species.

Contact herbicide
An herbicide which kills the foliage it comes into contact with but does not translocate or otherwise affect the root system of the treated plant.

Cool season grass
A grass species that grows and flowers in the cool, more moist months (spring and fall). Most lawn grasses and pasture grasses introduced from Europe are cool season species.

Dioecious
Having the male and female reproductive organs borne on separate individuals of the same species.

Exotic species
With respect to a particular ecosystem, any plant species, including its seeds and other biological material, capable of propagating that species that is not native to that ecosystem. Also called nonnative or nonindigenous.

Inflorescence
The flowering portion of a plant.

Glume
A bract occurring at the base of a grass spikelet.

Leaflet
The leaf-like part of a compound leaf. Although it resembles an entire leaf, a leaflet is just part of a compound leaf.

Leguminous
Of, relating to, or denoting plants of the pea family. Seeds occur in pods and roots typically contain symbiotic bacteria that are able to fix nitrogen.

Lenticels
Porous tissue on a plant, often most visible on bark. Lenticels enable a plant’s internal tissue to exchange gases with the atmosphere.

Litter
Dead vegetation lying on the ground.

Monoculture
Systems that have very low diversity and consist of just one species.

Nonselective
Refers to an herbicide that will kill almost any plant. Also called broad-spectrum.

OMRI
Refers to Organic Materials Research Institute, which certifies products for organic production and processing.

Opposite leaf arrangement
Two opposing leaves at each stem node. See also alternate leaf arrangement.

Panicle
A branched inflorescence.

Pistillate
A flower that lacks stamens.

Pith
Soft, spongy tissue in the stems of vascular plants that stores and transports nutrients.

Fig. 45: Snow Bunting, Croton Point Park. Courtesy Benjamin Van Doren.
**Post-emergent herbicide**
Treats vegetation that has already established, as opposed to pre-emergent herbicides, which prevent weed seeds from germinating.

**Rachis**
The main axis of an inflorescence.

**Rhizome**
Modified subterranean stem of a plant capable of sending out roots and shoots from its nodes. If a rhizome is separated into pieces, each individual piece may be able to generate a new individual plant.

**Samaras**
A type of fruit in which a flattened wing of fibrous, papery tissue enables the wind to disperse the seed readily, such as in maples (genus *Acer*).

**Sink habitat**
A habitat that appears to offer suitable cover, food, and water to the breeding animal but production of young in the local population is less than the mortality rate.

**Source habitat**
A habitat that is capable of supporting stable or growing populations and is a net exporter of individuals.

**Soil seed bank**
The natural storage of seeds, typically in a dormant state, within the soil.

**Spike**
In grasses, an inflorescence having individual spikelets without stalks and being attached directly to the unbranched rachis.

**Spikelet**
In grasses, a small spike with one or more florets attached to a central axis and including the basal bracts.

**Staminate**
A plant having only functional stamens.

**Sucker**
A shoot that springs from the base of a tree or other plant, especially one arising from a below-ground root at a distance from the main stem or trunk. (Example: Mugwort, *Artemesia vulgaris*).

**Surfactant**
Chemicals that reduce the surface tension of water and help an herbicide adhere to foliage or penetrate a leaf’s outer layer. Also called adjuvant.

**Systemic**
Refers to a herbicide that acts by being absorbed into the plant rather than killing the plant on contact.

**Terrestrial**
Refers to plants that occur on land as opposed to in aquatic environments.

**Terrestrial**
Plant material from lodging of residual dead vegetation or from mowing detritus. Also referred to as litter.

**Warm season grass**
A grass species that grows and flowers in the warmer, drier months of the growing season. Most native prairie and dryland species are warm season species that remain dormant in cool weather. These species are also capable of what is known as C4 photosynthesis, which enables them to photosynthesize with less water loss through the foliage than C3 cool season species.
J. REFERENCES & RESOURCES

REFERENCES

Askins, Robert. 2015. Personal email communication.


Buckley, Paul. 2015. Personal email communication.


Hinickle, Andrew. 2015. Personal email communication via Anne Swaim.


FIELD GUIDES FOR SEEDED & PLANTED SPECIES


USDA-NRCS and Missouri Department of Conservation. *Seedling ID Guide for Native Prairie Plants: Central Region*.

FIELD GUIDES FOR WEEDS/INVASIVE SPECIES


ONLINE RESOURCES FOR CONTROL OF WEEDS/INVASIVE PLANTS

Center for Invasive Species and Ecosystem Health

[invasive.org](http://invasive.org)

*Images, maps, publications, and control information, with an emphasis on species of economic concern.*

Federal Interagency Committee for the Management of Noxious and Exotic Weeds

[www.fs.fed.us/ficmnew](http://www.fs.fed.us/ficmnew)

*Scientific and technical information.*

Invasive Plant Atlas

[www.invasiveplantatlas.org](http://www.invasiveplantatlas.org)

*Species information, images, distribution maps, and early detection reporting procedures.*

National Invasive Species Information Center

[www.invasivespeciesinfo.gov](http://www.invasivespeciesinfo.gov)

*Gateway for invasive species information, covering federal, state, local, and international sources.*

New York State Product, Ingredient, and Manufacturer System (PIMS) database

[pims.psur.cornell.edu](http://pims.psur.cornell.edu)

*Source for information on herbicides currently or previously registered in New York State with the New York State Department of Environmental Concern (NYSDEC).*

Plant Conservation Alliance
www.nps.gov/plants/alien
Species fact sheets, including control information.

The PLANTS Database
plants.usda.gov
Standardized species information, distributional data, characteristics, images, web links, and references.

PUBLISHED BIRD RESOURCES


ONLINE BIRD RESOURCES
All About Birds – Cornell Lab of Ornithology

Audubon New York
ny.audubon.org

Birds of North America Online
bna.birds.cornell.edu/bna

eBird listings for Croton Point Park
ebird.org/ebird/GuideMe?cmd=decisionPage&getLocations=hotspots&hotspots=L509108&bYear=2014&eYear=2014&bMonth=1&eMonth=12&reportType=location&parentState=US-NY

Effects of management practices on grassland birds.

Flushing Bar Project
theflushingbarproject.net

Hudson River Valley Priority Birds
http://ny.audubon.org/hudson-river-valley-conservation

Partners in Flight
partnersinflight.org
NATIVE SEED SUPPLIERS

Brandywine Conservancy
1 Hoffman's Mill Road
Chadds Ford, PA 19317
610-388-2700
www.brandywine.org
Contact: Mark Gormel, Horticultural Coordinator
mgormel@brandywine.org
• Limited quantities

Ernst Conservation Seeds
8884 Mercer Pike
Meadville, PA 16335
800-873-3321
www.ernstseed.com
• Provides northeast ecotypes.

Prairie Moon Nursery
32115 Prairie Lane
Winona, MN 55987
866-417-8156
www.prairiemoon.com

Roundstone Native Seed, LLC
9764 Raider Hollow Road
Upton, KY 42784
888-972-8819
www.roundstoneseed.com
• Provides eastern ecotypes.
NATIVE GRASSLAND INSTALLATION CONTRACTORS

Brian O'Neill
Weeds, Inc.
250 Bodley Road
Aston, PA 19014 (office also in Bethlehem, PA)
610-358-9430
weedsinc.com

Bob Swain
Dawson Corporation
PO Box 400
Clarksburg, NJ 08510
732-928-0600
www.dawsoncorporation.com

Entities within the New York region reported by the Truax Company to own Truax no-till drill seeders include:

  Applied Ecological Services
  467 E. Church Road
  King of Prussia, PA 19406
  610-238-9088
  info.pa@AppliedEco.com

  USDA-NRCS Big Flats Plant Materials Center
  3266A State Route 352
  Corning, NY 14830
  607-562-8404
  Contact: Martin van der Grinten, PMC Manager
  Martin.Vandergrinten@ny.usda.gov

WEED & INVASIVE SPECIES CONTROL CONTRACTORS

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610-358-9430
weedsinc.com
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