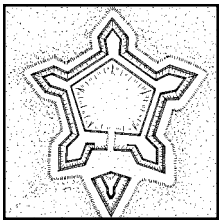
TECHNIQUES FOR ESTABLISHING AND MANAGING NATIVE GRASSES



Technical Support Topic Six

A diverse mix of native grasses can provide one of the best types of cover for earthworks that are presently in open, sunlit situations. The combination of erosion-controlling capability, relatively low management requirements, and aesthetic quality make this a logical cover for sites (1) which are currently mowed turf, (2) which have been planted to a single exotic species, or (3) which have recently been cleared for interpretive purposes.

In making recommendations for these three types of situations, the author is drawing on a comprehensive literature review, his own experience of the past two decades, and observations made in the field during the 1995 field reconnaissance of the seven subject parks. The amount of intervention necessary to establish a functional native grass cover on sites in the three categories above will of course vary. In all cases, however, the principle of *minimum* intervention for the specific set of conditions will be proposed.

As suggested in Chapter Six of this Handbook, the adoption of techniques that have not previously been applied to earthworks should be tried on an experimental basis initially. It must be recognized at the outset that specific climatic conditions are highly variable from year to year, so results are never 100% predictable.

Following are recommendations for establishing a predominantly native grass cover under three general sets of conditions that are likely to prevail.

EARTHWORKS UNDER MIXED SPECIES, MOWN TURF

This is the easiest situation to deal with, in terms of the amount of intervention required. It is targeted specifically at earthworks which currently have a variety of species as a cover, but which are mown to approximately two inches during the growing season. The management program for such earthworks centers around taking the following steps:

a. Raising the mowing height to 5"-6", permitting suppressed native grasses to develop.

b. Reducing the mowing frequency to once a month during spring and early summer for one or two growing seasons; and withholding any mowing after mid-July, in order to permit warm-season grasses to flower and produce seed.

c. In any bare areas, seeding with a mix of locally-collected grass seed (may be hand-collected by volunteers or student interns). Seeding may be done in hand-raked bare areas in fall (October-November) or spring (April-May). After seeding at a rate of 1/2 lb. per 100 square feet, rake seed in. Compact by tamping with a 4"x4" post, or simply by trampling the seeded areas by foot. Seed mix may contain three to five of the native grasses included in Section 3, matched with the conditions. It is strongly recommended that locally-harvested seed be used, to avoid introduction of varieties that are not adapted to local conditions.

d. As native grasses fill in bare areas, by the second or third growing season, mowing may be reduced to once a year, in late winter/ early spring.

The best evidence that this technique will be effective is the fact that fields adjacent to mowed earthworks in several of the parks in this study have been converted to predominantly native grass cover simply by reducing the mowing frequency to once or twice a year at five inches or higher.

EARTHWORKS UNDER A SINGLE EXOTIC SPECIES

This technique is specifically targeted at earthworks which have been seeded to a monotypic cover of tall fescue. Conversion of this cover type to a native grass cover is more difficult because the existing cover is allelopathic (i.e., it inhibits the growth of other species through chemical interactions), and generally suppresses other species. Tall fescue has been identified by the Virginia Department of Conservation and Recreation as an "Invasive Alien Plant Species." It is listed in that agency's "most invasive" category, and as such, is a species which may "disrupt ecosystem processes, and cause major alterations in plant community composition and structure."

Because of its invasiveness on the one hand, and its being subject to an endophyte fungus infection on the other, it would be desirable to revegetate earthworks under this cover to a mix of native grasses.

The steps leading to this conversion are as follows:

a. Mow the existing cover to a height of 4"-6" in late March to early April, or in mid-September.

b. After the tall fescue has shown new growth, spray with a glyphosate herbicide at a rate of two quarts per acre.

c. In May or October following the herbicide application, drill a mix of native seed mix into the soil. A Truax drill or equivalent is recommended, with two seed boxes: a fine seed box and a box for

large or fluffy seeds, and a maximum row spacing of 8". The drill should be equipped with trash rippers which will penetrate the vegetative mat and dig a furrow one inch wide and 1/2" deep. Seed is dispersed into the furrow, and a packer assembly compacts soil over it.

Seeding should be at a rate of 20 lbs. per acre PLS (Pure Live Seed). A mix ideally will include species in each of the following categories, in order to insure adaptability to the variable earthwork conditions:

Cool Season Grasses, e.g.,

Elymus virginicus (Virginia Wildrye)

Warm Season Grasses, e.g.,

Andropogon ternarius (Splitbeard Bluestem)
Andropogon virginicus (Broomsedge)
Eragrostis spectabilis (Purple Lovegrass)
Tridens flavus (Purpletop)

Warm Season rhizomatous grasses, e.g.,

Bouteloua curtipendula (Sideoats Grama Grass)
Panicum virgatum (Switchgrass)
Sorghastrum nutans (Indiangrass)

Seed may be obtained commercially, but again, most of these species are present within many of the parks in this study in presently open fields. Field collecting from these fields by volunteers or student interns is preferable by buying the seed from distant sources.

d. During the first growing season, mow the newly-seeded area to a height of 5"-6" on approximately a monthly interval, to keep annual broad-leafed weeds from shading out the native seedlings, and to suppress any woody species which might appear.

e. During the second growing season, mow at 6" early in June and again in early July, permitting warm-season grasses to flower and produce seed during late summer and fall.

f. Thereafter, mow once each year, either in late fall or early spring. Early spring may be preferable because this treatment provides wildlife cover and the aesthetic benefits of the grasses in their winter colors of tan, copper and bronze.

RECENTLY CLEARED EARTHWORKS

This process is developed for earthworks that have been recently cleared and where bare soil now is exposed. An important consideration in such situations is the prevention of erosion. Therefore, the inclusion of one or more fast-growing annuals in the seed mix is highly advisable. Annuals provide early cover, but will not persist as perennial species develop. On many sites, there are seeds of annual grasses present in the soil (such as *Digitaria sanguinalis* and/or *Setaria* species) which serve a useful purpose as nurse crops, but which typically diminish in importance the second and third years after planting, just as they do in natural old field successional processes.

The establishment of a cover of predominantly native grasses in this situation includes the following steps:

a. Prepare site by cultivating to a depth of 3", in late April or early May for spring seeding, or in October for fall seeding.

b. Install seed immediately after cultivation, either drilling with a Truax drill, using the procedure outlined in "Earthworks Under a Single Exotic Species" above, or by broadcasting. Drilling with a Truax drill, as described above, has the advantage of planting the seed at a uniform depth. If the site is too steep for drilling, however, or if the appropriate equipment is not available, broadcasting the seed is a viable alternative. After broadcasting into the tilled seedbed, harrowing or hand-raking followed by compaction is recommended to insure good seed to soil contact.

   Seed mixes for planting in this situation again should include at least three to five of the native grass species listed in Section 3. The combined weight of native grass seed, planted either by drilling or broadcast methods, should be 20 lbs./Acre. Additionally, annual species might be planted, at the following rates:

   Lolium temulentum (Annual Ryegrass): 10 lbs./Acre
   Chamaecrista fasciculata (Partridge Pea): 10 lbs./Acre

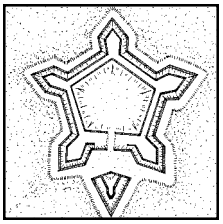
c. Mulch the seeded area either with hay from a local tallgrass-dominated field at a rate of one ton per acre or with clean oat straw at a rate of 1.5 ton per acre.

d. During the first growing season, mow to 5"-6" on approximately monthly intervals.

e. During the second growing season, mow at 6" in early June and in early July, permitting warm-season grasses to flower and produce seed.

f. Thereafter, mow once each year, either in late fall or early spring, to suppress woody species and to remove standing dead matter.

INVASIVE PLANT SPECIES AND CONTROL MEASURES



Technical Support Topic Seven

A continuing problem in earthworks management is the invasion of plant species which tend to reduce plant diversity through their competitive ability or which diminish aesthetic quality and legibility due to their vigorous growth habits or coarse textures.

In this section, invasive plant species which were observed as problems in the seven subject parks are listed, along with possible control measures. Much of the information on control treatment is based on various authors' experiments or field observations which are compiled in *Compendium on Exotic Species*, published by the Natural Area Association. More complete documentation on the control measures summarized here may be found in that Compendium. For information on the results of on-going work on the control of invasive species, the reader in referred to current issues of *Natural Areas Journal* and to *Restoration and Management Notes*, both of which are cited in section eight.

Elaeagnus umbellata (Autumn Olive)

Native range: Japan, China, Korea

Introduced: 1830

Habitat: Disturbed upland areas, successional fields, open woods and forest edges.

Reproduction: Plants produce abundant seed crops which are spread by birds, raccoons, skunks, and opossums.

Control Treatments:

Mechanical: Pull plants when they are young and when soil is moist.

Mechanical / Chemical: Cut and paint stumps with a 10%-20% glyphosate solution in water, using sponge or sponge-type applicator, late in the growing season (i.e. July to September).

Note: Plants will resprout after burning, mowing, or cutting. Cutting at ground level without herbicide treatment of stumps is not effective.

Festuca pratensis (Tall Fescue)

Native range: Europe

Habitat: Pastures, abandoned fields, roadsides, grazed woods, along railroad tracks, levees and stream banks.

Reproduction: Seed. Forms dense solid stands, is allelopathic to many other species, and tends to reduce diversity where it develops.

Control treatments:

Mechanical: Mowing is ineffective

Burning: Late spring burning, repeated for several years, may gradually reduce Tall Fescue.

Chemical: A 1%-2% glyphosate solution, sprayed in early spring or late autumn when fescue is green but most other plants are not, is effective.

Biological: Infection by an endophyte fungus which suppresses Tall Fescue has been reported in Virginia and North Carolina by Stephen Capal of the Virginia Department of Game an Inland Fisheries. (This infection is occurring without being actively introduced as a management tool).

Ligustrum sinense (Chinese Privet)

Native range: China

Introduced: 1852

Habitat: Disturbed woods, fence rows, floodplains, old homesteads

Reproduction: Produces large numbers of black berries, which are ingested by birds, thus spreading seed.

Control treatments:

Mechanical / Chemical: Cutting and painting stumps with a 20% glyphosate solution has been found to be effective.

Chemical: Spraying with glyphosate solution during early spring or fall, when it is green but when most other species are dormant. May use fosamine herbicide if there is a desirable herbaceous vegetation present, since fosamine only affects woody species.

Lonicera japonica (Japanese Honeysuckle)

Native range: Japan

Introduced: 1806

Habitat: Thickets, fence rows, woodlands, meadows, prairies and roadsides.

Reproduction: Seeds transported by birds, root sprouting, rooting at nodes of runners.

Control treatments:

Mechanical 1: Pulling of young plants (less than 2 years old) can be effective.

Mechanical 2: Mowing twice in one growing season (about July 15 and September 15) prevented the spread of Japanese honeysuckle at an Ohio site.

Mechanical / Chemical: Cutting and painting stumps with a 20% glyphosate solution in water has been found effective.

Burning / Cutting: Burning in early spring, followed by cutting twice, in mid-to late summer has been found effective.

Note: A single cutting or single burn in one year has not proven effective in Japanese Honeysuckle control.

Rosa multiflora (Multiflora Rose)

Native range: Japan

Introduced: In 1866, as understock for ornamental roses. In 1930s, for erosion control and "living fences".

Habitat: Pastures, abandoned fields, hedgerows, open woods.

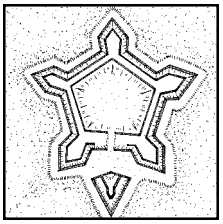
Reproduction: Abundant seeds eaten by birds and scarified in the digestion process; also rooting at ends of arching canes.

Control treatments:

Mechanical: Mowing annually in July has been found effective in keeping Rosa multiflora from spreading in a Pennsylvania study.

Chemical: Spraying of glyphosate solution in fall or spring has been found effective. However, it is non-selective, killing everything that is growing at the time. Fosamine herbicide is selective for woody species and may be suitable in situations where desirable herbaceous cover (e.g. grasses) exists.

EARTHWORKS MANAGEMENT SUPPLIES AND EQUIPMENT COSTS



Technical Support Topic Eight

Costs of vegetation establishment and management are subject to many variables, especially when non-traditional practices are used. The availability of volunteers, Americorps workers, or student interns can reduce the costs of such tasks as collecting seed, preparing seedbeds by hand-raking, hand-broadcasting seed, and compacting the soil after planting. Following are representative costs for plants or seeds of species recommended in this handbook.

Grass Seedlings or Plugs

Grass seedlings or plugs in flats, wholesale or contract-grown: $.50 to $.75 each. At 12" spacing, cost per acre, not including installation costs: $21,780 to $32,640 per acre.

Grass Seed

Commercially-grown grass seed, with a variety of species, ranges from $9.00 to $25.00 per lb., PLS (Pure Live Seed), depending on harvest method and abundance of seed. At an average estimated cost of $18.00 per lb. PLS, at a planting rate of 20 lbs./Acre, seed cost per acre, not including installation costs: $360.00 per acre.

Seed Drill

To drill seed of mixed species with seed ranging from fire, hard-coated seed to light, fluffy seed, along with cover crops, a special drill with multiple seed boxes is necessary. The drill should be capable of planting into an existing stubble (e.g. dead exotic grass stubble after herbicide), and compacting soil over seed in drill rows. Truax Seed Drill (available from Truax Company Inc., 3609 Vera Cruz Ave., N., Minneapolis, MN 55422; (612) 537-6639) is designed specifically for these purposes. Cost ranges from $12,500 for an 8-ft. wide drill to $19,000 for a 15-ft. drill.

Site preparation costs

(1994 data based on information obtained from Dave Shockley, Petersburg).

Tree clearing

Cutting trees at ground level, and grinding stumps to 4" below surface. Clearing a total of 78 trees, generally in trunk diameter range of 18"-30", under contract, total of $21,245 or $272 per tree.

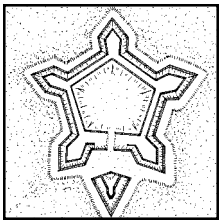
Herbicide Treatments

Application of Garlon-3A on 1/2 acre at Fort Gregg: $719.

Application of Garlon-3A on 68,185 s.f. at Fort Wadsworth: $2156.

Application of Banvel CST, to 42 stumps, Fort Wadsworth (applied at rate of 1 ounce per inch of trunk diameter, 4.5 feet above ground): $958.

USEFUL REFERENCES FOR VEGETATION MANAGEMENT ON EARTHWORKS



Technical Support Topic Nine

Journals

Natural Areas Journal, published quarterly by the Natural Areas Association, P.O. Box 900, Chesterfield, Missouri 63006-0900.

Restoration and Management Notes, published twice yearly by the University of Wisconsin Press for the Society for Ecological Restoration. Journal Division, 114 N. Murray Street, Madison, WI 53711.

Restoration Ecology, the quarterly journal of the Society for Ecological Restoration, Blackwell Science, Inc. 238 Main Street, Cambridge, MA 02142.

Books and Reports

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Minnesota Department of Transportation, Turf Establishment and Erosion Control Unit, Office of Environmental Services. 1993/94. *Guidelines For Establishing Native Grasses and Forbs on Roadsides*. Prepared by Robert L. Jacobson, Botanist, MN/DOT.

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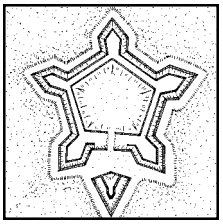
PRESERVATION OF ARCHEOLOGICAL RESOURCES



Technical Support Topic Ten

Archeological investigation can sometimes be the only way to determine the original form of an existing earthwork structure. Although few earthworks sites will actually be excavated, part of the preservation of all sites is the preservation of possible archeological resources. The following information will provide site managers with a basic understanding of where these resources are located and how, through prescribed maintainance, to best preserve them, thereby maintaining the potential for future archeological research.

Understanding the typical archeological profile of an earthwork structure is useful in understanding how archeological resources are distributed. Most all earthworks consist of two basic components, an excavated ditch and an earthen wall or parapet. At the time of construction, soil would have been excavated from the ditch and piled to create an adjacent parapet.

Typically, erosion occurred quickly in the years following the abandonment of a site. Over time, soil from parapets as well as from naturally higher ground would have been eroded through the forces of wind, water, and gravity to at least partially fill the ditch. As parapets eroded away and ditches were filled in, the overall relief of most earthworks features was greatly reduced. Factors such as the steepness of slopes, soil texture, vegetative cover, and land use effected how quickly this process progressed on different sites. In sites which returned to agricultural use, erosion rates would have been increased with repeated working of the land increased the amount of leveling which occurred. As vegetation colonized most abandoned earthworks, levels of erosion generally stabilized.

In-fill, deposited in ditches and downhill from earthworks forms in a series of geologic lenses or strata. These lenses appear as mottled remixed soils and tend to be dominated by silts. This is because the small silt particles tend to be moved most easily by erosive forces. Larger particles often settle out in place on the slopes as the smaller particles are moved down slope by water and wind. This in-fill can be made up of distinct soil lenses, each one representing an erosional episode, or it can be a much more homogenous blend. However, the point at which this disturbed soil meets the undisturbed soil below is generally more distinct. This boundary is where the most archeological evidence of the form and function of the earthwork is found.

Understanding where archeological resources are located can help in determining what types of maintenance activities may be harmful to them and jeopardize both their preservation and the future potential for study. Future archeological investigation of a site would depend on two primary types of information. First, analysis of soil layers helps to establish the original profile of an earthwork structure. Second, analysis of artifacts and where they are found within the soil helps to determine how the earthworks were used.

Maintenance activities that significantly displace soil, thereby destroying this information, or activities that leave soil vulnerable to erosion, would have a significant detrimental effect on archeological resources. Minor disturbance of the soil surface for the purpose of vegetation establishment would in most cases be preferable to leaving earthworks in a condition that would allow continued erosion.

Removal of hazard trees is an example of another maintenance activity which may disturb surface soils, but would be preferable to having major soil displacement occur in a windfall event. Special care should be taken in falling trees on or near earthworks to prevent gouging by equipment or falling branches.

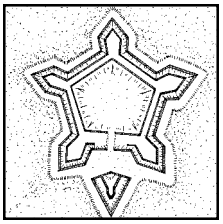
The following considerations would apply to maintenance or repair activities conducted on any earthworks sites:

1. Test any experimental establishment or maintenance techniques on a small section of an earthworks site, or in another location with similar conditions if available.

2. If repairing holes in earthworks caused by fallen trees, burrowing animals, or other causes, use soil from a sterile source, i.e., soil which would not contain artifacts that could be taken out of context.

3. If doing any major stabilization work, have an archeologist or site curator on the project planning team to assist in proactively planning for resource protection.

BOARDWALKS AND VIEWING PLATFORMS FOR EARTHWORKS



Technical Support Topic Eleven

(To be developed for inclusion in the completed document)

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