PLANTING WETLAND (NON-WOODY) CONTAINERIZED PLANTS AND ROOTSTOCK

TECHNICAL GUIDANCE DOCUMENT

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INTRODUCTION

Live, vegetative material—plants—help establish emergent aquatic vegetation when seed is unavailable or difficult to grow. Shallow open water, deep marsh, and shallow marsh zones present special difficulties in seeding and several . sedge, wet meadow and wet prairie species are notoriously difficult to grow from seed. . Also, a combination of both plants and seed increases the chance of establishing a diverse plant community. Plants can be used in a variety of forms including bare-root, containerized plants, pre-vegetated mats, and plant fragments.

The planting of containerized and bare-root plants needs to be timed with the restoration of hydrology. Plants must have sufficient moisture from the start. In some cases, plants are installed during the second year of a restoration, after water levels have stabilized. Watch weather forecasts around the time of planting to see if water levels could change significantly in the days before or after planting. If bare-root plants are being dug from nursery beds or otherwise transplanted, conduct the planting relatively early in the spring to limit leaf growth that could lead to excessive moisture loss during establishment. Containerized plants can be planted through June if the weather is favorable. Plugs need to be grown through May in greenhouses to be large enough for transplanting into restoration projects. Using larger containers increases the rate of establishment but will add significant cost compared to relatively-inexpensive plugs. Bare root plants have well-developed root systems, so they can establish quickly. Research has shown that May or June is the best time for aquatic plant establishment. Late summer plantings have low survival rates. There has been some success with planting plugs in late fall after they are dormant but they can be susceptible to harsh winter weather or flooding in the spring.

Environmental influences such as waves, turbidity, fluctuating water levels, herbivores, and ice heave can influence the survival of aquatic vegetation.

When using containerized plants and rootstock, ensure that adequate wetland hydrology will be present to ensure survivability of the plants. After wetland vegetation is planted, the soil must be kept consistently moist. When possible, plant after a rain or during a rainy period. If hydrology cannot be managed or is not yet present in the wetland, consider utilizing overhead irrigation systems, drip irrigation, or watering trucks during dry periods until wetland hydrology is sustainable. Where watering is impractical, a gel-like substance can be applied to the roots of the plants before planting to help the plant retain water (Bohnen and Galatowitsch, 1999). Terrasorb® and SoilMoist® are two common brand names.

Open water sites present special difficulties that require individualized assessment. Whether planting emergent or submergent vegetation, find areas protected from wind and waves such as protected coves. Because sufficient light penetration will affect submergent plant growth, investigate water quality and clarity . There is no point planting if an algae bloom or suspended sediment will block the sunlight. Herbivore control to prevent grazing by carp, geese, and muskrats can be essential for some projects.

Due to limited commercial availability of many wetland plant species, check with suppliers well in advance of specifying them for a project. Most plant species will spread vigorously once they are installed. Clusters or colonies of plants can be placed throughout the site and they will expand from there. The number of clusters or colonies of individual species established on a site will vary depending on the size of the project, but a minimum of three to five is recommended per species.

Equipment used for planting include spades, shovels, planting bars, water holding gels, containerized plants, bare root plants (rootstock), and prevegetated mats.

APPLICATION

Containerized Plants – Potted plants are used for establishing emergent species (such as bulrushes, sweet flag, bur-reed, and wild iris) that can spread into open water as well as species in wet meadows and wet prairies that do not establish well from seed. An increasing number of submergent and floating-leaved species are becoming available in containers or as bare-root plants.

Seedlings that have been established for one to three months in 48-72 cell plug trays are used for re-vegetating forbs and grasses in situations where wave action or other disturbances will not damage the small plants. In some cases, coconut fiber logs or similar products are used along shorelines to buffer wave energy. Plugs are staggered along the edge of the water to allow for changing water levels. Larger plants in two-inch, four-inch and gallon containers have advantages over plugs in that larger plants can handle greater changes in water levels and other disturbance such as wave action. It is common to install containerized plants in early summer after they have had time to sufficiently grow into containers and before the heat of summer. Some research has shown that August and September plantings do not result in high survival rates (Vanderbosch & Galatowitsch, currently unpublished data). Research has also indicated that planting seedlings of Carex such as lake sedge and tussock sedge may result in better survival than planting rhizomes (Budelsky and Galatowitsch 2004).

When grown in containers, plants should have roots visible at the edge of the root ball prior to planting. Roots should be visible when plants are removed from containers. If root masses are too small, the plants may have

difficulty establishing (Garbisch 1994). If potted plants become root bound, cut or tear the root mass before planting to allow the roots to grow naturally. It is important to pre-order plants as early as possible to ensure that appropriate species are available and that there will be sufficient time for them to root into pots. Re-vegetating sites with herbaceous species that were grown in greenhouses have been shown to have a higher establishment rate than plugs collected from wild populations (Hoag and Sellers 1995).

If plants are installed without seed, space them 18" apart for slower-growing species and up to five feet apart for fast-growing species. If both seed and plugs are installed, the plugs can be spaced further depending on budget and project goals.

Pre-vegetated Mats - Pre-vegetated mats come in a variety of sizes. An erosion control product is the base in which the plants are grown. The cost of pre-vegetated products is higher than that of containerized plants because of their size, material, and the effort it takes to grow and transport them. Pre-vegetated mats and blankets are useful for stabilizing shorelines and channels where erosion is a concern and rip-rap is not desired. They are also used for the establishment of emergent vegetation in wetlands where hydrology has already been restored or created. Pre-vegetated products need to be pre-grown for a minimum of five weeks during the spring and early summer to ensure that the seedlings get established before installation. If adequate time is not provided, there is a risk that slower-germinating species, inundated too early in their life stage, will drown. Pre-order pre-vegetated mats to ensure availability.

Install pre-vegetated products when the water level is relatively stable. Species installed as live plants in clusters or pre-vegetated mats will spread quickly either from rhizomes or from seed.You don't need to saturate an entire site with live plants. Mats are secured with biodegradable stakes or, in standing water, with rocks .

Bare-Root Plants and Transplants –Transplants are dug from wild populations; bare-root plants are grown in production beds with the soil washed off before transport. Permits are often needed for collecting transplant material. Transplants of wetland species should be collected from well-established beds and, if possible, planted the same day. It is not necessary to go deeper than five to six inches when digging rootstock; this will allow for the collection of sufficient root mass while allowing the parent plant enough root mass to grow back. Most rootstocks and bare root plants are collected in early May, however, there has been success with transplanting as late as mid-July. Rootstocks of aquatic species should not be collected in areas where invasive species such as purple loosestrife are present. In nurseries, it is common to wash soil off of roots to minimize the transport of invasive species seed and decrease shipping costs. The removal of soil works best early in the spring when temperatures are cool, decreasing plant stress.

It is crucial to keep roots moist during the planting process and to set them firmly into the ground. A tree-planting bar or tile spade can be used to plant propagules above ground and underwater. Plant at a depth so that the previous soil line on the plant matches the new soil line (Hammer 1992).

Wetland plugs will spread about 9 to 12 inches in a growing season. Plants should be spaced according to the growth rate of the plants. For example, river bulrush, which grows quickly, should be spaced four to five feet apart while the slower-growing hard stem bulrush should be planted two feet apart

(Galatowitsch and van der Valk, 1994). Plants can be installed from April through late October as long as there is sufficient water (Hoag, 2000) but early season planting may be most successful. It helps to cut off half of the above-ground growth immediately with pruners if planted during warm weather.

Emergent plants must be planted with their tops out of the water or they will not survive. Exceptions include species such as water lilies, arrowhead, and pickerel weed that spend part of their life cycle under water. The zone where emergent species are planted ranges from areas with saturated soils to areas having several feet of water. Some species prefer saturated soils for establishment but can later grow in deep water; an example is pickerel weed. Bulrushes will grow in both deep and shallow water. Hardstem bulrush prefers calcium rich substrates while softstem bulrush and river bulrush is tolerant of a broader range of conditions (Shuttleworth, 1999). Most sedges prefer shallow water and saturated soils. If a project goal is to establish food for waterfowl, plans should include planting of species such as wild rice, duckweed, arrowhead (or duck potato), wild celery, sago pondweed, and bur-reed. These species are used by both diver and puddle ducks .

Cattails are generally not planted into restored wetlands. Although broad leaf cattail (Typha latifolia) is a desirable native emergent species, it tends to out-compete other emergent species in restored wetlands. Hybrid cattail (Typha glauca) is invasive and can aggressively colonize and dominate restored and created wetlands. Cattail seed is dispersed widely by wind and germinates easily on moist soil. Cattails can rapidly vegetate a wetland and, once established, their dense leaves and dead plant litter can prevent other emergents from growing. Techniques for removing cattails are discussed in Appendix 5-A.

Submergent plants can be established as live plants, tubers, or plant fragments, depending on the species . Install four to six species (minimum), more if possible. Submersed aquatics should be planted in sheltered areas under two to four inches of water. Mats of algae should be removed to allow sunlight to reach the plants.

Planting Strategies for Emergent Species	
Wild Rice (Zizania aquatica)	An annual plant established from seed. Seed is stored in a submerged condition from harvesting up until being sown into the water. Optimum water depth for wild rice ranges from 12 to 18 inches deep. Seed can be harvested from public waters with a DNR license purchased at DNR license vendors. Wild rice naturally occurs north of the Minnesota River and east of the Red River Valley in Minnesota. It may be difficult to establish and maintain outside of its natural range.
Softstem Bulrush (Schoenoplectus tabernaemontani)	Can be grown from containerized plants in early spring to mid-summer in sand to muck soils. Softstem bulrush is susceptible to muskrat herbivory (Smart et al. 2005).
Arrowhead (Sagitttaria latifolia) (also known as "Duck Potato")	A staple waterfowl foodreadily established from seed widely available. It can also be established by planting tubers or from nursery-raised plugs. If started from seed, seed must be sown in moist soil at the water's edge for best results. There are several closely related species of arrowhead that provide suitable food value.
Wild Celery (Vallisneria americana) *And* Sago Pondweed (Potomogetan pectinatus)	Established by planting tubers (root segments) taken from live plants. They are planted in one to five feet of water, provided the water is clear enough that sun penetrates to the depth planted. These plants could also be started using pre-vegetated mats, the tubers encased in clay balls and planted at one- to two-foot spacing. Very few vendors market wild celery and sago pondweed tubers and even fewer sell the seed. The seed should be sown in the fall using fresh seed lightly

	pressed into the substrate. Plants can be harvested from public waters only under a permit granted by the Minnesota Department of Natural Resources, Division of Ecological Services. Care must be taken to not harvest and spread such plants as Eurasian Milfoil if harvesting the tubers yourself (Moore and Jarvis 2007).
Giant Bur-Reed (Sparganium eurycarpum)	Provides food for waterfowl and muskrats as well as excellent cover for duck broods. Tolerant to grazing by muskrats and pollution once established. Will compete favorably with cattails and reed canary grass. It can establish from seed, tubers or from nursery-raised plugs. It is reported that the seed has to go through dormancy twice before it will germinate reliably.

Table 5.18 Planting Strategies for Submergent and Floating Leaved Species

Duckweed (Lemna minor and Spirodela polyrhiza) (also known as "Duck Meat")	Established by transplanting live plants that can be seined from existing populations.
White Water Lily (Nymphaea odorata)	Grown from containers or bare root in early spring to mid-summer in sand to muck soils (Smart et al. 2005).
Illinois Pondweed (Potamogeton illinoensis)	Grown from containers or bare root in early spring to mid-summer (Smart et al. 2005).
American Pondweed (Potamogeton nodosus)	Grown from containers or bare root material in early spring, or from cutting from spring to mid-summer (Smart et al. 2005).
Water Stargras (Heteranthera duia)	Grown from containerized plants in early spring to mid-summer (Smart et al. 2005).

Protecting New Plantings - Enclosures of wire may be necessary to protect new plantings from rough fish or muskrats. The enclosure should be about six feet wide and 12 feet long and covered (often with flagging tape) to keep wildfowl out while the plants are becoming established. Such enclosures are needed for a variety of wetland plant types in order to exclude herbivores such as geese (Galatowitsch and van der Valk, 1994).

In areas where there is significant wave action, wave-breaking devices may be needed to protect plantings of submergents. These devices can be constructed of coconut-fiber logs, willow bundles, hardwood brush, rock within filter fabric, plywood, or double layers of plastic fence. These materials may need to be anchored with stakes, depending on how buoyant and moveable they are (Henderson et al. 1999). A University of Minnesota Extension publication, *Shoreland Landscaping Series, A Guide to Natural Landscaping and Revegetation for Enhancing Lake Quality*, includes building plans for constructing a wave-break structure. The wave-break structure in the Guide is constructed out of PVC pipe. The structure is recommended for sites with low wave impacts. Structures made out of rock, steel, or wood may be necessary for sites with greater potential for wave action. Weed control for new establishing plants may include spot herbicide application, mowing, hand pulling, or clipping of weeds.

OTHER CONSIDERATIONS

The use of containerized plants and rootstocks may influence the maintenance strategies that are selected for a project. In cases where only containerized plants are used (without seed), sites can be flooded early in establishment to suppress weed germination and establishment. Careful control of water levels is important while seedlings are establishing. When seed and containerized plants/rootstock are used together, spot treatment of weeds and mowing will still be primary strategies to control invading weeds.

COSTS

The costs for planting non-woody containerized plants vary depending on the size of the area to be planted, the size of plant material, and vendor or staff time to conduct the planting. For contractor installation of plants plugs tend to cost around $1.75-$2.10 installed, 4" containers $5.00-$7.00 installed, and bare root plants $2.00-$3.00 installed. Mulching plants will add additional cost.

ADDITIONAL REFERENCES

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