Materials Plant Program

TECHNICAL NOTES

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PLANT MATERIALS TECHNICAL NOTE NO. 67

RIPARIAN RESTORATION IN THE SOUTHWEST: Focusing Your Planning on Crucial Factors Concerning Site Preparation, Landscape Goals, and Revegetation

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The increasing concern to control noxious tree species and revegetate riparian areas along New Mexico's rivers and streams has led to substantial riparian restoration activities during recent years. These efforts require substantial forethought to plan and implement restoration activities and to maintain these revegetated sites. This document is intended to concisely address a number of issues that will need to be considered by groups developing riparian restoration projects.

Large saltcedar eradication projects are concentrated along the floodplains of the Rio Grande and Pecos rivers. These floodplain sites have a distinct set of limitations affecting the control of exotics and revegetation with native riparian species. These challenges can be contrasted with problems facing riparian restoration projects on montane streams, incised arroyos, or lake/pond shorelines. By documenting the factors which challenge restoration activities in a variety of degraded riparian environments, it is hoped the planning of such projects will comprehensively address all potentially significant problems.

Although some factors affecting restoration are common to most disturbed riparian sites, certain features tend to overwhelm other issues for particular situations. The following lists are intended to summarize key concerns expected within these different riparian environments.

River Flood Plains

1. Lack of flood flows disturbing normal ecosystem function
2. Extreme depth to the water table and/or severe fluctuation in water table depth
3. Alteration of the floodplain by river channelization and/or levees
4. Invasion of noxious woody species requiring long-term commitment to control invasive species
5. Highly saline clay soils or areas of restrictive soil layers

Montane Streams
1. Scouring flood flows from spring runoff or monsoonal storms
2. Browsing or grazing by elk, cattle, and beaver
3. Wet meadow versus woody plant community types
4. Invasion of exotic grasses not capable of stabilizing stream banks

Incised Arroyos
1. Extremely erosive flood events
2. Unstable banks
3. Ephemeral moisture in channel sediments

Lake and Pond Shorelines
1. Extreme fluctuations in water levels
2. Monoculture emergent vegetation (cattails)

Principal Factors Affecting Revegetation Success

- **Depth to ground water and water table fluctuation**

Concern/Problem - The altered channels and flow regimes of today's rivers have transformed the ground water hydrology and channel characteristics of these anthropogenic floodplains. Lack of overbank flow, extreme depth to ground water, and severe fluctuations in water table depth are just three consequences of this hydrologic manipulation.

Response/Solution - To determine appropriate species and the most effective stock type (container depth or pole length) for revegetation, the depth to ground water should be measured; inexpensive shallow monitoring wells will allow the depth and yearly fluctuation to be verified. As an example, willow species in general can tolerate shallower ground water depths than cottonwoods. Stock types for sites with water table depths of 6 to 8 feet would require 14 to 16 foot dormant pole cuttings, while depths of 4 to 6 feet might require 30" tallpots and depths of 2 to 3 feet might only need 14" treepot stock. Extreme depths to groundwater may indicate that revegetation with xeric shrubs and grasses rather than riparian species is the only sustainable goal.

- **Revegetation limitations due to soil chemistry and/or soil texture extremes**

Concern/Problem - Extreme salinity and sodicity of floodplain soils can profoundly influence species suitable for revegetation. Salinity problems can be especially persistent in clay soils were natural leaching of salts is limited. Restrictive soil layers can be important factors constraining the species and stock type for revegetation. Soils with high percentages of cobbles can be impossible to augur; whereas augured holes in dry sands and gravels will often collapse before planting.

Response/Solution - Visual observation of soil samples from augured holes should be sufficient to determine if soil texture or restrictive soil layers will be limiting. These samples can be

analyzed for electroconductivity (EC) to establish if surface or subsurface salinity is a problem. Electromagnetic induction field instrumentation can be used to rapidly estimate soil salinity for large acreages. Exchangeable sodium percentage (ESP) will require soil tests. Species recommendations for different soil salinity levels have been determined from field planting success in the Middle Rio Grande Valley; more saline tolerant species include fourwing saltbush, wolfberry and screwbean mesquite. Salinity tolerance testing is presently being carried out by a number of researchers on many of the more important riparian species.

- **Loss of planting stock from the scouring action of flood flows**

Concern/Problem – High flow events on montane streams, unregulated rivers, and incised arroyos can easily erode shallowly planted containerized and cutting stock installed on stream bank zones. In arroyo systems, this can often be a more limiting factor than the ephemeral nature of surface flow in these drainages.

Response/Solution – Extreme channel instability coupled with either severe sediment aggradation or degradation should preclude revegetation attempts until some semblance of channel stability can be achieved through natural or human intervention. Dormant pole and whip cuttings planted to substantial depths can resist extractive forces of flood flows. The supple nature of willow whips allows this stock type to be more appropriate for higher flow regimes and less stable channel systems. Large caliper cottonwood poles are susceptible to stem breakage especially if lower branches are present to catch the force of water or if struck by large debris in the flood waters. Planting containerized stock with long root balls during the fall would also be advantageous by providing some root development prior to spring runoff especially in situations where scouring is severe. Some riparian species in small containers but with long stems can be buried in deep planting holes for anchorage. Many riparian species should be adapted to this planting method which is comparable to natural burial by deposits of sediment.

- **Eradication of woody invasive species and removal of resulting biomass**

Concern/Problem – The invasion of floodplain sites by noxious woody species has required intensive and long-term eradication efforts to allow the revegetation of native riparian plant communities.

Response/Solution - The methodology for initial control of woody invasive species has been well established. A long-term commitment for spot spraying of resprouts should be part of any control program. The dead biomass can be burned in slash piles for interspersed noxious woody plants or by crown fires in monoculture stands. The removal of large diameter biomass as firewood and burning of slash is another alternative. The mulching of biomass is expensive, but the benefits of the mulch may make it a worthwhile. Mulch will reduce wind and water erosion, will reduce moisture loss to aid reseeding efforts, and may provide enhanced salt leaching by reducing evaporation and increasing infiltration. A mulch layer will also retard the growth of weeds that commonly occurs after site clearing. Much still needs to be learned on how to manage the mulch layer to optimize revegetation benefits.

- **Woody riparian plant communities versus wet meadows**

Concern/Problem – A determination of the appropriate vegetation for a restoration site may or may not be obvious. Due consideration particularly in montane situations is required to evaluate whether a site is truly a wet meadow environment and not appropriate for woody vegetation. The leveling of wet meadows for hay production can eliminate micro-topographic mounds which provide deeper unsaturated soils and are more favorable to a diverse plant community including some woody species.

Response/Solution - Shallow depth to ground water, fine-textured, organic-rich, or anaerobic soils, and low stream gradients are some of the factors consistent with wet meadow environments. One factor to consider with montane wet meadow communities is that many of the dominant exotic grasses have meager soil stabilizing capability. Management of grazing and/or mowing of wet meadows can be useful in directing the species composition towards desirable native plant communities. On low elevation floodplains, saltgrass meadows are inappropriate for revegetation with woody species because of shallow groundwater level.

- **Weed competition affecting revegetation**

Concern/Problem – Site history will determine the importance of competition by annual weeds. Abandoned fields may have extreme weed problems. The proliferation of annual weeds can drastically influence reseeding efforts to re-establish native grasses and forbs. The competition of large dense weed stands can shade transplants and deplete soil moisture profoundly affecting the survival and growth of small containerized stock.

Response/Solution - A stand clearing crown fire may reduce the soil weed seed bank significantly. For severe infestations, herbicidal control of weeds for two years before reseeding may be appropriate to maximize reseeding potential. In some extreme situations, the installation of weed barrier fabrics in V-ditches or basins can be used for planting woody species to reduce weed competition, harvest runoff, and reduce evaporation.

- **Advance planning for plant materials and stock types**

Concern/Problem – Many riparian restoration projects whether low elevation floodplain or montane stream will require unconventional native species and/or stock sizes. Although most cottonwoods and willows are fast growing, many xeric shrubs are not and may require several years to produce large stock sizes.

Response/Solution - To achieve a suitably diverse native plant community, growers of native plant materials will have to be identified and contracts approved to produce the plant materials required for a large restoration project. Those planning revegetation projects need to consider the costs versus benefits of different stock sizes. Principal considerations of large stock are the high initial plant material and installation costs versus lower maintenance (i.e., irrigation) costs and higher survival rates. The calculation of advantages of large versus small stock will be

influenced by the availability and cost of labor and necessary planting, irrigation, and maintenance equipment. If a long-term volunteer commitment is possible and equipment for and oversight of the volunteers is available, the advantages of larger stock will be reduced and smaller stock sizes might be preferable.

- **Planting methods**

Concern/Problem – The time of year of installation, the planting methods employed, and equipment access can definitely influence the success of a revegetation project. Revegetation planning needs to specifically address these factors for the various stock types and seed mixes involved.

Response/Solution **-** Planting containerized woody plants in the fall offers benefits of lower evapotranspiration and of continuing root growth until soil temperatures decline appreciably. Dormant pole and whip cuttings need to be planted before budbreak, so a late winter to early spring planting window is required. Reseeding of low elevation floodplain sites should be timed to take advantage of anticipated summer rains. The stock type will greatly influence the planting equipment required. Sites with deep water tables may require long augers to access ground water for pole plantings. Willow whip cuttings can be effectively planted in most soils with three foot long, one inch diameter rotary hammer drill bits. Whips can also be planted using a water jet if a water supply is readily available. Tallpots are most efficiently planted using tractor mounted augers. Smaller stock can be feasibly planted with shovels but handheld augers will speed planting significantly. Large wheeled equipment requires site access which can be restricted by ditches, arroyos, levees, soft sand, or steep slopes. One unanticipated problem with access which has been identified with the recent upsurge in saltcedar clearing is the ubiquitous presence of cut stumps which can easily puncture heavy duty truck and tractor tires.

- **Watering of planted containerized stock**

Concern/Problem – With the exception of poles and whips planted into the water table, containerized plants should be watered at the time of installation. Establishment of containerized stock will require a few to many water applications depending on stock size, soil moisture conditions, and watering method.

Response/Solution **-** If planting holes stay open, filling the hole with water before planting and watering after planting to settle the backfilled soil is advisable. Conventional water basins can be used, but high evaporation losses and promotion of weed growth are deficiencies of this approach; however, these negative aspects are lessened with fall plantings. For stock sizes with 1 to 3 foot root ball lengths, the use of deep pipe irrigation can aid in getting the water around and below the root ball and in recharging deep soil moisture. Deep pipes can be perforated at root ball depth to allow more rapid and thorough distribution of water. Typically, deep pipes are fabricated from PVC pipe but cardboard mailing tubes or other tubing materials can be used. Larger diameter (3 or 4 “) pipes are helpful if starch based hydrogels are going to be applied. The hydrogel is costly and more difficult to apply than water, but the slow release of moisture will probably reduce the number of waterings required to allow establishment. If water can be obtained from streams, rivers, or ditches, a gasoline-powered pump can be used with long hoses

to fill basins or deep irrigation tubes. In many circumstances, the long distance between plants recommends the use of water tanks and shorter hoses allowing more efficient utilization of labor. Vehicle access questions must be considered for watering operations as they were with planting equipment.

- **Protection and maintenance of revegetated sites**

Concern/Problem – In addition to the irrigation of containerized stock until establishment, a number of other considerations will require post-planting attention including resprouting of noxious woody species, protection from grazing and browsing animals, and control of defoliating insects.

Response/Solution - The continued spot spraying of noxious woody sprouts and any other invasive weeds will be required for an indefinite period. The protection of the plantings from cattle will require adequate fencing and periodic monitoring of fence integrity. The presence of beaver necessitates poultry wire tree guards around individual pole plants as well as protection of unplanted poles and whips placed in streams or ditches for hydration. Elk-proof fences (e.g., 8 foot tall woven wire) will be required on sizeable montane riparian restoration sites. Small 5 foot high exclosures constructed from rigid welded-rod corral panels placed around individual plants or clumps of plants have proven to be provide effective elk protection. Control of defoliating insects can be crucial for pole plantings during the initial growing seasons; cottonwood leaf beetle occasionally will require control. The destruction of plantings by vandals should also be considered in revegetation planning.

- **Desired landscape objective**

Concern/Problem – On river floodplain sites which no longer experience flooding, the self-perpetuation of cottonwoods and tree willows can not be assumed due to the lack of natural recruitment. Other landscape objectives to be considered include the fuel load that will acceptable from the re-established plant community and the need for firebreaks and emergency access within the restored area.

Response/Solution - Riparian forest communities established through intensive planting approaches will evolve towards xeric shrublands/grasslands or savannahs if flooding is not re-established. These types of sites will require perpetual planting and management if the landscape goal is a park-like setting with groves or stands of riparian trees. Wildfire concerns may necessitate a landscape goal more reminiscent of a savannah than a gallery forest.

The End Result

Cost effective and successful riparian restoration can be achieved through diligent efforts during the planning stage to determine the concerns and problems apparent at a particular site and by addressing appropriate responses to these decisive issues. Although there is not a precise recipe that will guarantee success in riparian restoration, understanding site limitations and potential methods of resolving them is the most important planning step.