Dolores River Restoration Partnership: Ken Lair Site Visits
Technical Assistance, Conversations, and Observations

July 18-20th, 2012

Background

At its first meeting in January 2012, the DRRP Implementation Committee discussed some of the revegetation challenges that some managers had encountered. Recognizing the opportunity to gain from external expertise, the committee agreed to bring Dr. Ken Lair, who is very experienced with post-tamarisk revegetation in the American West, to the Dolores. For three days, Lair met with public and private land managers to provide technical assistance and initiate conversations with managers on a variety of issues surrounding active revegetation along the Dolores River. While the site conditions varied, some of the thematic challenges were shared across field offices and state lines. The most prominent of these included contending with:

- The allelopathic legacy of Russian knapweed
- Substantial amounts of woody debris remaining after tamarisk treatments
- Drought and dry conditions
- Restoration in highly saline sites

What follows is a synopsis of these site visits where Ken Lair not only made suggestions and shared his thoughts, but where DRRP managers collectively discussed—with Lair and each other—their observations, experiences, and lessons learned.

I. July 18th: Beaver Creek and Stateline Sites

In harsh environments like this (i.e. arid and salty), there are ways for dealing with soil types and droughts. Some of these techniques are considered "supplemental" and often dismissed by those not wanting to bother with them; however, they can really give active revegetation efforts a leg up. In these systems, what it always comes down to, though, is weed control.

A. Invasive Species Control

Russian knapweed in the abandoned agricultural field: due to its allelopathic effects, Russian knapweed should be treated with either Coperlid (same chemical family as Miletsone) or a low application of Tordon for the knapweed and thistle; IF knapweed is reduced by at least 75% then till (2-3 inches below the surface) and disc. Otherwise, apply second application of herbicide before tilling/disking.

Tilling will help break down the allelopathic legacy of knapweed, thus facilitating growth of other native species present in the soil. Spraying in mid-spring (leading up to the first bloom) may be more important than fall treatments. At low rates, Tordon is selective towards broadleafs. If too much is applied, it can harm grasses and even sterilize the soil.

If doing tamarisk work in the winter time, consider doing a basal bark treatment (rather than cut-stump).

B. Active Revegetation

In some of the bare sites, consider starting active revegetation with grasses (a fall seeding: perhaps alkali sacaton, wheatgrass, thickspike wheatgrass, salt grass during wet period, slender wheatgrass in moister sites like near the meander, side oats gamma) to stabilize the soil and provide cover and cooling shade before future plantings of shrubs. Eventually, the abandoned agricultural fields (presently knapweed fields) could be converted into a grass meadow – lots of potential here.

Mycorrhizal Inoculants (MZI): these fungi have a mutualistic relationship with the flora; the plant provides the fungi with nutrients while the fungi provide the plant with moisture. There are two kinds of MZI: ecto- (typically for trees; attaches to the outside of the roots) and endo-mycrorrizae (for grasses and shrubs). Exceptions worth noting: four-wing saltbush is not mycorrhizal and cottonwoods & willows like a mix of both endo and ecto MZI.

MZI can be applied in a variety of ways (granular, liquid form, tea bags, seed coating)

- Wide mouth nozzle could work to apply liquid form
- If using inoculum, work it into soil with drill or disk AS SOON as inoculum is applied – mycorrhizae is very sensitive; will not work if exposed to sunlight for long
- A roller chopper could be used to get through mulch layer
- Many wheatgrasses, gramas, and wildrye species are strongly associated with mycorrhizae
- One possible strategy: broadcast seed over mulch, then spray inoculum, then use roller chopper to incorporate seed and inoculum down through mulch
- If feasible, collect local MI from native soil (e.g. set aside an area to disturb and harvest MI) as part of seed bed prep.
- If purchased, it cannot be exposed to the sun for hours: spray or dip the plant, then quickly get it in the ground. MI can be purchased at Reforestation Technologies International (http://reforest.com/) in California, Biosis (in Denver), and Micro Rizal Applications (Oregon).

MZI is probably not needed if you are working in a site where natives (e.g. wheatgrasses, gramas, and wildrye species , rabbitbrush and sagebrush) are present. *But if the site is dominated by tamarisk and Russian knapweed, it probably lacks MI.* On the Rio Grande, they have studied this phenomenon: no MI in thick stands of saltcedar, but just 3 ft away from the stand you start to find MI.

Polymers*:* can be purchased as a dip to be used with transplant materials (cuttings, bare root, containerized). They are non-toxic and inexpensive (e.g. a mixed of polymer and water in a 5 gallon bucket could treat 30 plants). The polymer is applied to the roots to enhance the plant's ability to hold moisture close to the roots for a longer period of time. It does not add much for seeding, but does aid with transplants. MZI can be added to polymer: simply dip the plant into the mixture, then put in the ground. Seeds can be coated with nutrients, MI, polymers to provide a favorable micro-environment for germination. This is only economical is seeding done on a large scale.

Saltgrass: plugs and seedlings can be temperamental; they have to be kept moist to take off and won't grow without shallow water (e.g. 4 ft). Doesn't need wet feet, but likes moisture.

Consider shifting seeding to the fall (e.g. late November), late enough so there is not germination before winter sets in. Some plants like switchgrass need the cold treatment.

While having transplants with more root than shoot may help, the location of planting is so much more important (i.e. connectivity to water table). Cottonwoods, for example, will not thrive if the water table is routinely deeper than 8 feet.

C. Other Lessons Learned

Two of the most important things to consider: salinity and monitoring wells. For sampling soil salinity, if you have a defined 6-inch A-horizon, do a composite sampling. If there is no clear A-horizon, then do a composite sampling: 0-6 in, 6-12 in, 12-36 in. (or even deeper, depending on the type of plants being planted). Or, if funding is limited, 0-6 and 6-12 in. If you're seeding, then you will want to know about the top 6 inches; plantings, then at least 12 inches. Take a sample near the burned/ash sites, where you will presumably have the highest salinity.

BLM-Moab has limitations associated with relying on the fire & fuels crew (e.g. during the summer, they are off fighting fires). As such, there needs to be a prioritization not just of where invasive species are controlled, but where maintenance occurs. Maybe don't do it unless you can maintain it. In planning future plantings/reveg, perhaps consider allocating funds and time to pay interns or Conservation Corps crews to water plants.

Plastic tubing to protect planting from herbivory are good in the winter, fall, and spring. But during the summer, they have an oven effect and can cook the plant.

In other river systems, they have noticed that leaving some tamarisk may actually help other native plants like willow: tamarisk provides both a shading effect and a hydraulic pull (basically elevating the water table) that other species may benefit from, if not rely on.

With old, closed stands of tamarisk (e.g. 3-5 decades old), these stands actually create a cool, sub-humid micro-climate with little shading, sometime resulting in mellow (i.e. not saline) soils.

The water table does not have a linear relationship with the river (i.e. going further from the river, in some places, may not equal going further from the water table). Old meanders and historic features may retain water, thus creating an undulating water table (look for evidence in the distribution of cottonwoods).

Removing a portion of the rock berm near stateline could reinvigorate the old meander and enhance the floodplain and southwestern willow flycatcher habitat. Do not remove the entire berm; rather, focus on the region between the toe slope and the large Russian olive tree. Leave a low-water retention wall (i.e. don't take all the way down) and some of the toe slope protection. There are a number of considerations here: consider 3-5 year flood marker as a guide, using Rio Mesa stream guide. Talk with BOR about the possibility of BLM taking care of the berm if BOR provides a release every two years that will breach the low-water retention.

Bennet Pipe Supplies (Denver, CO) offers ready-built PVC water wells.

II. July 19th: Gateway Area and Uncompahgre Pilot Projects

On this day, we visited several of Sparky's (BLM-GJ) sites and the Burton property in the Gateway area, as well as several of Amanda's (BLM-Uncompahgre) pilot projects in the Paradox Valley, further south.

A. Invasive Species Control

BLM-Gateway: Sparky has found that natives respond well at several sites following knapweed treatment. At such sites, he has observed increases in sand dropseed, western wheatgrass, and saltgrass on drier sites.

Burton Property: For knapweed control on the Burton property, rotational grazing may be beneficial to help speed along grass recovery; the landowners can set up electric fencing perpendicular to river. Milestone would be a good herbicide to use. It is safe for grasses, but be careful: DO NOT use any manure on your garden or in compost from animals eating Milestone-treated fields or Transline-treated fields. Herbicides go right through animals and end up in manure. Allelopathic effects of knapweed may be mitigated through irrigation.

Pilot Projects: Drift from herbicide (Imazapyr) for tamarisk re-treatment in Amanda's pilot projects may have affected revegetation

- Basal bark treatment after natives planted were suggested
- Chemical may have volatilized in heat, causing drift.
- Garlon 4 + oil penetrates tamarisk best but cannot use it over 80 degrees F – will volatilize way too much and can really hurt nearby plants
- Milestone doesn't hurt privet, will 'dent' 4-wing, really hurts cottonwoods
- Habitat is the best herbicide on resprouts but it can really hurt grasses at recommended rates – Sparky put it in little spray bottles so that could apply very specifically and carefully

B. Active Revegetation

BLM-Gateway: Cattle were discussed as a seeding mechanism

- Cattle move through the Gateway BLM site north of the resort in the winter (Dec-Jan to Feb)
- Sparky has been thinking about using the cows to trample in seed and fertilize seed that has been spread out

Sparky talked about a willow planting done in February

- While there were no sign of salts prior to planting and many of the coyote willows leafed out, the ground has since turned white with salts (salts evaporated out of ground with lack of rainfall, high temperatures) and the willows dried up in May/June and many are now dead
- Sparky did discover that beaver were moving some of their bundles of willows and dragging them downstream and burying them with mud – and those buried bundles grew well
- Ken suggested looking at soil texture and salinity; issues may be further down in soil profile.
- Salinity readings on a site are very relative to soil texture
- In sandier soils, may get a better flushing out of salts when get high flows; in other soil types salts can be distributed throughout the soil profile
- Not a lot of overbank flooding at this and many other locations
- If going to sample soils, take soil samples throughout the soil profile, up to 36-40" deep. Need to be thinking about salts all the way down in the soil profile, especially the depth at which most of the roots of the plant will be
- Coyote willow is one of the more sensitive willow species to salinity; and coyote willow requires more water than some other willow species. In contrast, Goodding's willow which is found downstream, is adapted to slightly more upper bench areas, and can tolerate slightly more salinity.
- Next time, may want to dip cottonwoods and willows in mycorrhizal product

Burton Property: For the island on property there is the potential for cottonwood survival

- Island completely covered every five years or so with water
- Sparky thinks it would be beneficial to walk through the island and cage the cottonwoods currently there to protect them from beaver

Fig. 2 Potential species for active revegetation at the Burton Property
Trees and shrubs: Cottonwoods, Goodings willow, Box elder, New Mexico privet, Three-leaf sumac, Woods' rose, Golden currant, Four-wing (but seed viability drops off really quick, so don't 'save' seed; if purchasing this seed, try to get this year's lot), Sagebrush (may move in on own), and Rabbitbrush (may move in own)
Grasses: Sand drop seed, Saltgrass (can move plugs around), Alkali sacaton, Canada wildrye

Pilot Projects: After Gateway, we visited several pilot projects, including one in the Paradox Valley. This was determined to be a highly variable site: about 30% quite salty, 70% low salts.
At the pilot projects, the best survival of planting occurred under tamarisk canopy treatments. This may be due to the fact that tamarisk can elevate the water table, benefitting adjacent plants too. Overall, many of the plants died and seeds did not germinate. In addition to the drought, Ken proposed the possibility that the seeds may not have received good ground contact.

- Ken suggested seed coating for this site; coating adds mass not volume
  - Celpril is a company that specializes in coatings
  - Seed Dynamics is another company (http://seeddynamics.com/)
- If a site can't be treated with a roller chopper (or similar piece of equipment), you could try to double seeding efforts and hope something hits the ground and makes contact with soil
- "Teabags" of polymers may be good to try; works out to about .25 cents a plant

Seeding after treating knapweed (see above for more specifics on managing knapweed and its allelopathic legacy) may include some of the following grasses:

Fig. 2 Potential species for active revegetation at the Paradox Valley site	Salt grass plugs might be good to try in areas with some moisture ▪ Salt grass seeds are difficult to find; not very many females out there ▪ Seeds need to be soaked for 30 minutes in hydrogen peroxide to scarify
Seed greasewood in flat areas that receive runoff	Privet seems to tolerate salt too
Slender wheatgrass could fill a niche	Baccaharis ▪ Use plugs/cuttings ▪ Seed very expensive
Suaeda does well with seeding; salt tolerant but not in moist spots; Suaeda can indicate salts	Phragmites might be good to experiment with

C. Other Lesson Learned

Sparky discussed his concern about what to do with large amounts of biomass (from tamarisk and elm):

- possibly cut trees as firewood and give to the public, mulch trees, or burn them
- Burning could be problematic: potentially a lot of salty material released onto the soil with burning tamarisk, may work against revegetation efforts; other typical hazards of burning
- Mulching may be the best option
    - Could hand broadcast seed and then mulch; equipment will do the work for you
    - Removing biomass could expose site to other weed species; keep in place
    - Western wheatgrass may a good species to seed
    - If going to broadcast seed other species in area where cheatgrass is already dense, will want to try to break up the cheatgrass by manipulating mulching machinery etc so that can get exposed bare soil – need good seed-soil contact for broadcast seeds

Salinity can vary significantly between and within revegetation sites. Ken suggested that the partnership consider investing in and then sharing the Geonics EM38 meter for soil sampling (http://www.geomatrix.co.uk/em38-mk2.php)

- Must correlate with lab samples, but it is a quick and easy way to collect soils data
- Can lay flat on ground to get reading
- It would be worth the money to purchase it if going to be taking a lot of soil samples at a given site. It's effectiveness is that it provides good RELATIVE salinity – so at a given site one would collect a few soil samples and have official laboratory analyses conducted on these samples to determine ACTUAL salinity, then can use these results to calibrate/ground truth all of the points that you sample with the Geonics meter

July 20th: Big Gypsum and Disappointment Creek

A. Invasive Species Control

Thus far, BLM-Tres Rios has focused on removing tamarisk and treating the secondary weeds; no active revegetation has been completed at this point. In hindsight, they might have had a crew treat the knapweed right after the tamarisk crews.

Are individual tamarisk found amidst solid willows worth worrying about?

- If it looks like it is seeding and recruiting and is accessible, then yes
- However, shading by willows will usually control new seeds

Defoliated or stressed tamarisk will not translocate herbicide as well as healthier specimens. Stress could be from beetles or could occur when high-cut treatments are stump-cut at a later date. Because tamarisk has a segmented vascular system, basal bark treatments need to reach EVERY stem. If you do not achieve uniform cover, the herbicide will be compartmentalized to select roots and others will continue to grow. Basal bark sprays are also typically more effective on smooth bark (characteristic of younger tress), than corky, older bark. The best time for basal bark treatments (Tricpyr or Garlon 4) is in Nov-Dec, after the trees have lost their leaves. If using Imazapyr, then need the foliage to absorb the herbicide.

B. Active Revegetation

In areas where burned slash:

- If they spray the knapweed, can they also plant grasses?

- Herbicides like Transline, triclopyr do not have lots of soil residuals to worry about
- The greater concern is the salt loading from burning

Fig. 1 Potential species for active revegetation at the Big Gypsum Site
Shrubs: four wing saltbush, sueda, wolfberry on burned sites
Grasses: Western wheatgrass , slender wheatgrass, sacatone, plugs of inland saltgrass
Forbs: globemallow

- Consider planting four wing saltbush and sueda on these burned sites. Both of these species can be hand collected and seeded; note that 4-wing has a very short shelf life and should be planted soon after collection (i.e. not stored). Globemallow may be a suitable forb.
- Western and slender wheatgrass have high salt tolerance and could also probably handle the burned sites.
- Plugs of inland salt grass would be suitable here; untreated seeds don't work well. Ken suggests treating seeds with hydrogen peroxide at smaller sites where this would be more feasible. You can purchase or harvest your own plugs. If harvesting, do so during dormancy. A "pro-plugger" devise, which can be purchased from most forestry suppliers, is best for lifting saltgrass from the ground and putting in a tray for planting. This is something a Conservation Corps crew could do for a week.
- A fall seeding of a sacaton-seed mix would let the seed be dormant and then take advantage of spring moisture; the seeds don't travel far, but have great salt tolerance. Granite Seed, with locations in CO and UT, is a good source of mycorrhizal inoculum and native seeds: http://www.graniteseed.com/products/planting-aids/mycorrhzal-inoculum.
- Rabbitbrush: not as salt tolerant but would be appropriate on the first terrace where you find some moisture
- Of the species listed above, saltgrass and sacaton might need watering, but only if economical
- Consider trying several experimental revegetation sites, phased demonstrations to see what works (polymer, no polymer, MZI, no MZI, several species).
- Use a conservative seeding rate in dry sites. A PLS (pure live seeding) of 20 seeds per square foot is fine; above 40-60 is a waste of money.
- A woody mulch cover on these types of sites would also reduce the evaporative pull of salts to the surface
- Polymers and MZI on transplanting, bare roots, or poles of upland species (e.g. wolf berry) would also be appropriate on these terrace sites
- Beavers are a concern here. Ken suggests mesh caging over plastic cages (to avoid the oven effect described above). Repellants (e.g. for deer or rodents) may also work.
- The Disappointment Creek site seemed appropriate mostly for passive revegetation with a few opportunities for active reveg:
    - hand-scarify and scatter four-wing saltbush in random patches
    - galleta grass could also be added to a seed mix
    - Remove decomposing tamarisk mulch, seed these sites, and then cover with another non-tamarisk mulch (e.g. a hay mulch, even hand-pulled kochia if it is not seeding) to improve odds.

C. Other Lessons Learned

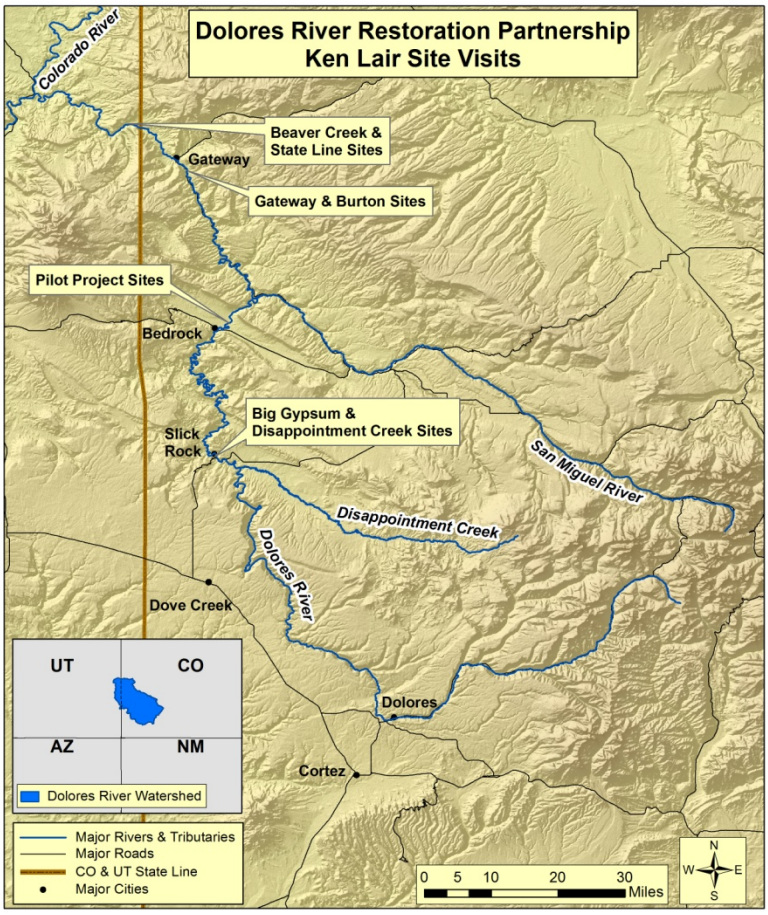
Managers also considered how to reclaim areas with significant amounts (e.g. 7 inches) of decomposing mulch.

- This decomposing matter is very salty and has largely suppressed natural revegetation
- Where feasible, flail masticators and headers could be used to move the matter and expose mineral soil. Rakes or other hand devices might have to suffice in remote areas. Fire would reduce the biomass, but release the salts into the soil. Prioritize and remove portions of the decomposing mulch, then either plant or allow passive revegetation (if there is a native seed source nearby).
- While tamarisk seeds can sometime be suspended in this matter, they are typically not viable after a year

Conclusion:

While the sites and treatment histories varied as we traveled from the northern stretch of the Dolores near Beaver Creek down to Big Gypsum and Disappointment Creek, there were a number of common takeaways. Fundamentally, is the need to understand the site. Site variables are many; but the key ones for revegetation at these arid sites included river morphology and depth to water table, salinity profiles, and soil texture. These conditions will dictate if and how active revegetation should occur.

In areas that are prioritized for active revegetation, plans should address proper site preparation (e.g. scarification, control of weeds, removal of decomposing tamarisk debris, reduction of knapweed allelopathic legacy) and long-term maintenance (e.g. reliable staff to water plantings, cage trees, and monitor). A number of tools may be applied, from the application of polymers and mycorrhizal inoculants, to the Geonics EM38 for measuring salinity and "pro-pluggers" for harvesting inland saltgrass plugs. But no matter what tools are used, the site conditions must be appropriate and conversations and lessons learned should continue to be shared and built upon.



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