

Case Histories

Natural landscapes modified by intensive agriculture

- Banerjee, M.J., V.J. Gerhart and E.P. Glenn. 2006. Native plant regeneration on abandoned desert farmland: effects of irrigation, soil preparation and amendments on seedling establishment. *Restoration Ecology* 14(3):339-348.



Abandoned Arizona farmland

- 400,000 ha of Arizona farmland is now abandoned
 - Land is degraded by salinity and susceptible to damage by flooding and erosion

Re-vegetation generally uses direct seeding with some other treatments:

- Mulching
 - Decreases evaporation and increases infiltration by slowing water
- Chiseling
 - Increases percolation and aerates soil
- Imprinting
 - Provides micro-catchment sites for moisture and OM accumulation-
- Fertilizer
 - Helps start nutrient cycling

- Dry seeding may be unreliable in areas with less than 200 mm (8") of rain/yr
- Low amounts of irrigation may improve germination and establishment
 - If applied at the right time
 - Summer watering resulted in soil moisture higher than in un-irrigated plots, but well below field capacity

Experiment

- Conducted on 400 ha abandoned cotton farm near Phoenix
 - Farmed for 30 y
 - Abandoned in 1987
 - Site mainly bare with sparse annual growth
 - *Salsola iberica* (Russian thistle) in summer
 - *Brassica nigra* (black mustard) and *Schismus* spp (Mediterranean grass) in winter
 - Rainfall 188 mm/y, summer monsoon and winter

Desirable natives

- Shrubs
 - *Atriplex canescens* (four-wing saltbush)
 - *A. polycarpa* (desert saltbush)
 - *Larrea tridentata* (creosote bush)
 - *Ambrosia dumosa* (white bursage)
- Trees
 - *Cercidium floridum* (blue paloverde)
 - *Olneya tesota* (ironwood)
 - *Prosopis velutina* (velvet mesquite)
 - *Acacia greggii* (catclaw acacia)

- Treatments begun in Feb 2002 by disking
- Treatments:
 - Soil prep
 - Mulching
 - Imprinting
 - Phosphorus addition
 - Chiseling
 - Post-seeding management
 - Supplemental irrigation
 - Supplemental irrigation and weeding
 - No irrigation, no weeding

- Particulars
 - Chiseling done to depth of 10 cm
 - Mulching with wheat straw at 25 kg/ha
 - Irrigation 30 min/d with sprinklers from Feb to Oct
 - Water was brackish

- Results
 - Low success for seeds.
 - Less than one germination per m²
 - Significantly better with irrigation
 - Weeds dominated all plots, irrigated or not

- Discussion
 - Direct seeding, even with irrigation, may be unreliable
 - Abandoned farm soils have large weed seedbank
 - Irrigation results in luxuriant weed growth
 - Irrigated plots were saltier than non-irrigated
 - Removal of *Salsola* actually resulted in higher cover in removal than non-removal plots

- Sweeney, B.W., S.J. Czapka and T. Yerkes. 2002. Riparian forest restoration: increasing success by reducing plant competition and herbivory. *Restoration Ecology* 10(2):392-400.



Maryland stream corridor

- The site is former agricultural land in a historically forested riparian area on the Chester River in Maryland
- Through restoration it is hoped to regain lost ecosystem services
 - Watershed protection
 - Stream enhancement
 - Wildlife conservation
 - Carbon sequestration

- Decrease in water quality in North American streams has to some degree been made worse by clearing for agriculture and logging
- Ecosystem services of intact systems may outweigh the economic benefits of agriculture and logging

Experiment

- Treatments
 - Rootstock: bare root or container
 - Herbivore protection: tree shelters
 - Weed control: mowing, herbicide, weed mats
 - Sites: riparian, lakeside
 - Species: *Quercus palustris*, *Q. rubra*, *Q. alba*, *Acer rubrum*, *Betula nigra*

- Particulars
 - Bare root seedlings were 2 years old and planted 5 April 97
 - Tubex tree shelters (tan) were 1.2 m tall
 - Weed treatments were in 1 m² around base of seedling
 - Mowing and herbicide application (Roundup) twice each growing season for two years

- Results

- 4 year mortality was significantly greater than 1 year mortality
- Survival with tree shelters was significantly greater than without
- In tree shelter treatment, survival was best with herbicide, then tree mats, then mowing

- Results

- Growth
 - Seedlings with shelters grew 21 times faster than w/o
 - Growth was greatest in herbicided plots
- Differences in survival between bare root and container not significant
 - Price difference slight
 - Container use more flexible (timing)
 - Containers less vulnerable to root drying and poor handling

- Ambrose, L.G. and S.D. Wilson. 2003. Emergence of the introduced grass *Agropyron spicatum* and the native grass *Bouteloua gracilis* in a mixed grass prairie restoration. *Restoration Ecology* 11(1):110-115.

Grasslands National Park

- Site is in Grasslands National Park in SW Saskatchewan
- Cultivated until 1947
- Sown to *Agropyron cristatum* (crested wheatgrass)
- Field site surrounded by mixed grass prairie with *Bouteloua gracilis* and *Stipa (hesperostipa) comata*

- Prairie restoration on northern plains is impaired by persistence of introduced grasses like *A. cristatum*
 - Low diversity systems
 - Low root biomass
 - Low inputs of N and C to soil
 - *A. cristatum* spreads to surrounding native stands

- Climate at site is semi-arid, cold
 - 155 snow-free days
 - 313 mm precipitation
 - windy

Experiment

- Treatments
 - Seeds sown into plant collars
 - Herbicide
 - Neighbors herbicided
 - No herbicide
 - Water
 - High: same as highest annual precip last 20 y
 - Low: same as lowest annual precip last 20 y

- Results
 - Soil moisture in spring and fall was significantly higher in the high water treatment than low
 - Soil moisture not significantly different in summer
 - Agropyron seeds emerged from seedbank, Bouteloua did not
 - Emergence of surface and buried sown seeds was increased by high water treatment

- Results
 - Herbicide did not increase soil moisture
 - Herbicide did not affect seed emergence