COMPLEXITY, CONSTRAINTS AND CHALLENGES OF HERBICIDAL AND BIOLOGICAL TAMARISK TREATMENT IN THE MOJAVE RIVER WATERSHED

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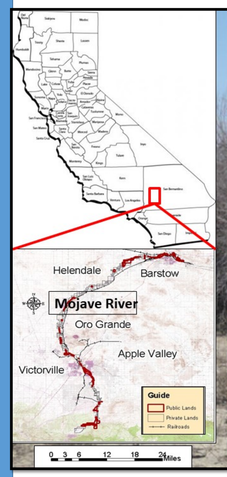
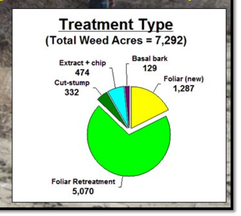
TREATMENT AREA, 2007 - PRESENT



Headwaters of the Mojave River near Las Flores Ranch (southern end) to Camp Cady SWA east of Barstow, CA (northern end):

- Approximately 80 river miles;
- Approximately 70% private property (over 600 landowners);
- 24,490 acres inventoried; 7,292 acres treated (including re-treatment over time).



Tamarisk species effects

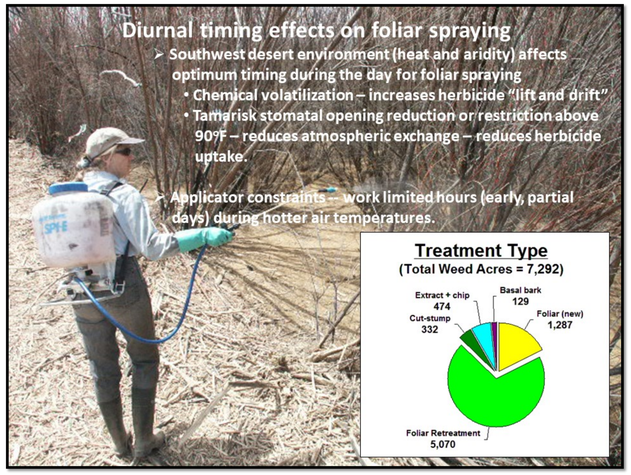
Three species – *Tamarix parviflora, T. ramosissima, T. chinensis*
– with possible hybrids between these species.
– different phenological maturation rates.

Tamarix ramosissima *Tamarix parviflora*

- Mojave River watershed dynamics
  - Significant fall in elevation, from Mojave Forks to Barstow, yielding significant differences in riverine micro-climate.
  - Significant changes in geology affecting both micro-climate (e.g., Mojave Narrows), and particularly groundwater depth.
    - ✓ Geologic "sills" at Mojave Narrows and Camp Cady
    - ✓ Other areas without sills, keeping groundwater at deeper depths.
- Different optimum herbicidal treatment timing
  - *T. parviflora* – earlier
  - *T. ramosissima / chinensis* – later
- Requirement to spray after September 15 to avoid bird nesting / brood period necessitates late treatment, which is not optimum for *T. parviflora*.
- Differential herbivory by *Diorhabda* tamarisk leaf beetle species.

Diurnal timing effects on foliar spraying

- Southwest desert environment (heat and aridity) affects optimum timing during the day for foliar spraying
  - Chemical volatilization – increases herbicide "lift and drift"
  - Tamarisk stomatal opening reduction or restriction above 90ºF – reduces atmospheric exchange – reduces herbicide uptake.
- Applicator constraints – work limited hours (early, partial days) during hotter air temperatures.



Plant morphological effects

- Scattered, patchy stand distribution
  – increased time and labor for coverage.
- Individually large, clonal ("clumpy") plants, with layered canopies and very high canopy volume (laterally and vertically).
  - Increased time, labor, materials, and need for higher pressure sprayer technology for full canopy coverage with foliar techniques.
- *Nearly impossible to conduct basal bark treatment* due to limited access to plant interiors.
- Increased time, labor, and materials for full coverage with cut-stump techniques.

Soil effects

- Very sandy streambed and riparian soils, resulting from stream flow dynamics and localized high wind erosion impacts.
  - Limits equipment access.
  - Increases water infiltration and deep percolation, while lowering water holding capacity in the root zone.
  - Reduces plant vigor and atmospheric exchange, reducing herbicide uptake.
  - Reduces vigor and competiveness of associated desirable vegetation.
  - Soil and climate interaction makes tamarisk distribution and morphology even more patchy and clumpy.
  - Creates constraints relative to preservation of:
    - ✓ Aesthetics for adjacent landowners.
    - ✓ Streambank and flood control berm stabilization and maintenance.
- Difficult to maintain sufficient cover of desirable species to reduce erosion.

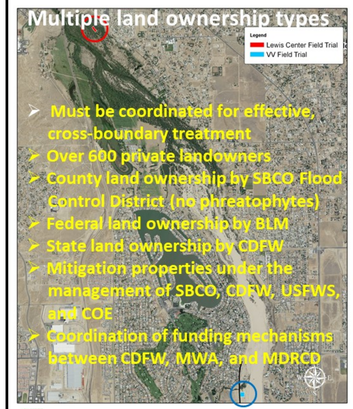
Habitat effects

- Potential Southwestern willow flycatcher (SWF) habitat at Mojave Narrows and Camp Cady SWA. If so designated in the future, represents technical and political issues that might limit options for controlling tamarisk.
- Dunes formed below tamarisk are habitat for potentially sensitive species such as desert panicgrass (*Panicum urvilleanum*) and desert twinbugs (*Dicoria canescens*).

Water conservation, salvage, and recharge effects

- Effluent and aquifer recharge discharge sites into the Mojave River increase islands of tamarisk establishment, propagule dissemination, and stand expansion.
  - CDFW Fishery discharge site [up to 8,000,000 gallons (~25 ac-ft) per day].
  - MWA aquifer recharge sites (2).
  - Victor Valley Wastewater Reclamation Authority and Barstow water treatment ponds and discharge sites.
- Mojave Water Agency – large $$$ and priority consideration – tamarisk control for groundwater salvage.
- Mitigation properties (COE, CDFW, SBCO, and private developers) – $$$ and priority consideration – tamarisk control for habitat improvement.

Multiple land ownership types



- Must be coordinated for effective, cross-boundary treatment
- Over 600 private landowners
- County land ownership by SBCO Flood Control District (no phreatophytes)
- Federal land ownership by BLM
- State land ownership by CDFW
- Mitigation properties under the management of SBCO, CDFW, USFWS, and COE
- Coordination of funding mechanisms between CDFW, MWA, and MDRCD

Occasional saltcedar genetic mutations after fire injury –

- Stem and leaf coalescence into fans;
- Plants develop resistance to herbicide treatment.

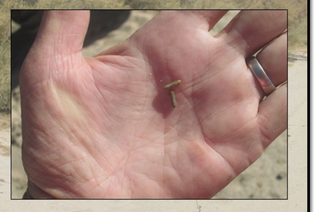
Not supported by scientific study, but experience indicates it occurs occasionally following plant injury by fire.

Starting in 2019

Increase in biocontrol activity & saltcedar injury

(herbicide treatment halted due to beetle presence)


Diorhabda carinulata
Photo Courtesy of Rivers Edge West, Grand Junction, CO



Biocontrol Impacts

- There have been small experimental releases of the *Diorhabda* tamarisk leaf beetle at five river reach sites in the last 10 years, conducted jointly by APHIS, ARS, USBR, and USFWS under authority of federal and/or state permits. This effort in CA is part of a west-wide, multi-agency effort since the early 2000's to manage and reduce the impact of the invasive tamarisk shrub, which significantly reduces groundwater reserves and strongly competes with native vegetation.
- There has been uniform browning and defoliation of all saltcedar species for the last three years along the northern two-thirds of the river reach (Helendale to Camp Cady SWA).
- The direct beetle herbivory (feeding) results in major loss of water, and subsequent desiccation of tissues. Later defoliation may occur as injury symptoms progress. If beetle populations maintain themselves from year to year, it will probably be about 3 years from initial infestation before substantial mortality is observed, as repeat defoliation gradually depletes stored metabolic reserves.

WATER SALVAGE OUTCOME

Based on 2,222 actual weed acres treated between 2007-present (exclusive of foliar re-treatments), and assuming 90% reduction in transpiring foliage canopy within the treated area, this translates into approximately 2,000 acres X 0.8 acre-foot/acre/year[1] = 521,362,000 gallons (1,600 acre-feet) of water now being saved and available for other uses annually via groundwater recovery and salvage.

[1] Neale, C.M.U., S. Taghvaeian, H. Geli, S. Sivarajan, A. Masih, R. Pack, A. Witheral, S. O'Meara, and R. Simms. 2011. Evapotranspiration water use analysis of saltcedar and other vegetation in the Mojave River floodplain, 2007 and 2010. Mojave Water Agency water supply management study, phase 1 report. Remote Sensing Services Laboratory, Department of Civil and Environmental Engineering, Utah State University, Logan, UT; and U.S. Bureau of Reclamation, Temecula, CA.