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Hydrologic factors influencing establishment of *Tamarix* spp. in Montana.

Saltcedar (*Tamarisk* spp.) has long been recognized as an ecological issue in the American southwest, where it can dominate riparian communities, but it has only recently garnered attention in the country's northern regions. In Montana, saltcedar has been present since at least 1960 and is abundant on sections of the Bighorn and Yellowstone Rivers as well as Fort Peck Reservoir. This research investigated how hydrologic conditions and saltcedar seed longevity may affect its future establishment. Saltcedar cross sections were collected from river and reservoir sites and tree ages were determined. Fort Peck Reservoir samples indicated that establishment very closely followed the receding water level and that rising water caused population mortality. River populations did not appear to follow any pattern of establishment, indicating that saltcedar can establish after periods of either high or low flow. For the seed longevity experiment, saltcedar seeds were collected and stored at 4 different temperatures (-14°C, 5°C, 20°C and 35°C) for 0, 3, 7, 30 and 90 days) and then 4 replications of 20 seeds each were planted. Seedlings were counted for 24 days and the total number emerged for each treatment was recorded. Seedling emergence declined with both storage time and increasing temperature. Some seeds at all storage temperatures did remain viable for up to 30 days, and seeds from all temperatures except 35°C remained viable for 90 days. These results indicate that seeds may survive longer than previously believed and could possibly survive Montana winters to establish seedling the following spring.



Factors Influencing *Tamarix* spp. Establishment in Montana

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Introduction

Tamarix species and their hybrids¹ have long been recognized as an ecological issue in the American southwest where they can dominate riparian communities, but it has only recently garnered attention in the country's northern regions. In Montana, *Tamarix* has been present since at least 1960² and is abundant on sections of the Bighorn and Yellowstone Rivers as well as Fort Peck Reservoir. Establishment along the rivers is primarily confined to back channels and occasional gravel bars, while at Fort Peck *Tamarix* is abundant in a "bathtub ring" below the high water mark. *Tamarix* is a copious seed producer throughout the growing season, and its seeds are dispersed via water and wind for many kilometers³.

Methods

Determining *Tamarix* Establishment Patterns – At Fort Peck Reservoir, *Tamarix* trees were selected along a topographical gradient from the water edge in 2009 up to the historical high water mark. Along the Bighorn and Yellowstone Rivers, where there was little topographic variation, trees were randomly selected from along the riversides. The location (position and elevation) of each sampled tree was recorded via a Trimble GeoXT GPS (Figure 1). Establishment dates of individual *Tamarix* trees were determined by cutting a cross section from each tree at the root crown, sanding the samples with progressively finer sandpaper, and counting the tree rings (Figure 2). Establishment dates were correlated with historical flows in the rivers and water levels at Fort Peck.

Assessing *Tamarix* Seed Viability – Seed viability under conditions representative of Montana summers and winters was tested. Seeds were collected during peak seed production from a site on the Yellowstone River and segregated into four subsets which were stored at -14°C, 5°C, 20°C and 35°C. Four replicates of twenty seeds from each subset were planted in pots in the Montana State University Plant Growth Center (Figure 3) at 0 (no storage time), 7, 30, 90 and 180 days. Pots were watered with an automatic misting system three times daily, and the total number of seedlings were counted daily over a period of 24 days after planting.

Results

Establishment Patterns – Based on estimated establishment dates, there appears to be no pattern between peak river flows and *Tamarix* establishment, as it established equally well in years of very low flow, very high flow and average flow (Figures 4 and 5). In contrast, at Fort Peck, establishment dates were associated with falling water levels (Figure 6), suggesting that rising water causes population mortality, as only two sampled individuals were survivors of the most recent full pool level during 1997.

Seed Viability – From the initial emergence rate of 49%, there was a decline in seed viability at seven days. After that time, seeds stored at -14°C and 5°C maintained 25% to 35% viability for 180 days while the viability of seeds stored at 20°C and 35°C declined (P<0.005) (Figure 7). The time for 25% of seedlings to emerge increased with storage time (P<0.005) (Figure 8). With no storage, 25% of seedlings emerged in < 4 days, and after 7 days of storage, 25% emergence required > 12 days. Storage at warmer temperatures increased emergence time and decreased viability, and after 30 days of storage <25% of seedlings emerged for seeds stored at 20°C and 35°C. After the initial increase in emergence time, storage had little effect on emergence time for seeds stored at -14°C and 5°C.

Objectives

1. Investigate relationship between hydrology and *Tamarix* establishment in Montana.
2. Evaluate the longevity of *Tamarix* seed viability under a range of temperatures.



Figure 1. Marking *Tamarix* location.



Figure 2. Cutting *Tamarix* tree; prepared sample for aging.

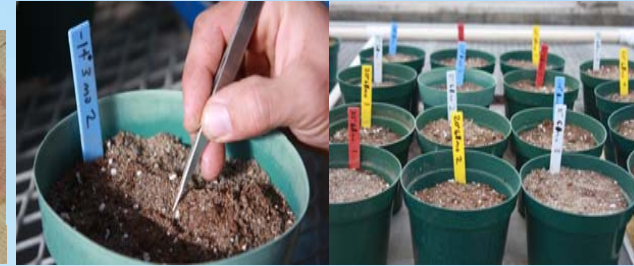


Figure 3. Planting *Tamarix* seeds for germination study; pots planted with *Tamarix* seeds.



Conclusions and Discussion

Establishment

- Establishment on the Bighorn and Yellowstone Rivers was not limited to times following high runoff events (Figs. 4 and 5). Rather, it is able to establish in very low flow years.
- High flows in the years following establishment did not cause population mortality.
- *Tamarix* at Fort Peck reservoir could be controlled by allowing the water level to reach full pool (Fig. 6). As Lesica and Miles⁴ suggest, this would submerge most of the populations around the reservoir, leaving only older trees at or above the full pool level.

Seed Viability

- Seeds were not tolerant of hot conditions, but 25-35% of seeds survived extended periods of cool or cold weather under low humidity conditions (Fig. 7). Under field conditions, humidity and soil moisture will likely preclude the accumulation of a substantial seed bank to persist through winter, as most seeds are reported to germinate within 24 hours in warm moist soil³.
- Because of such lengthy seed viability at colder temperatures, however, it is possible that some seeds dispersed at the end of the growing season may be able to persist through cold northern winters and be able to germinate the following spring if moisture conditions are suitable.
- The ability of *Tamarix* to establish under a range of hydrologic conditions, and its extended seed viability under cool conditions, indicate that *Tamarix* has potential to continue to occupy new sites in its northern range.

References

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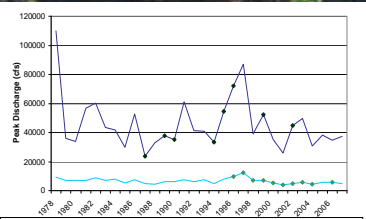


Figure 4. Estimated *Tamarix* establishment dates show no correlation with peak annual flow at two locations on the Yellowstone River, Montana.

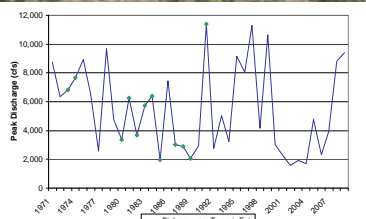


Figure 5. Estimated *Tamarix* establishment dates show no correlation with peak annual flow on the Bighorn River, Montana.

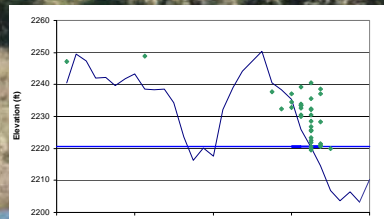
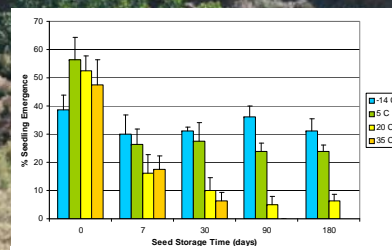
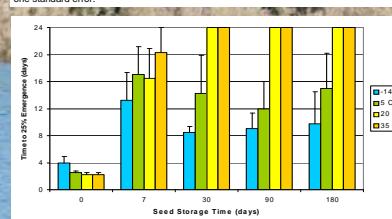


Figure 6. Few *Tamarix* trees survived the latest full-pool episode of 1997 at Fort Peck Reservoir, Montana.



Tamarix seedling emergence over time for different temperatures. Error bars represent one standard error.



Time for 25% of *Tamarix* seedlings to emerge for different storage temperatures. A time of 24 days indicates total emergence of <25%. Error bars represent one standard error.