Competitive Opportunities for Native Plants

Invasive *Tamarix ramosissima*

Establishment Ecology

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acknowledgements

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John P. Taylor, Bosque del Apache NWR
Disturbance and invasion

- Often facilitates invasion
  - because native competitors removed
- What about ecosystems adapted to disturbance?
  - natives may be dependent on disturbance
  - = management dilemma
Threatened *Populus*

- Stimulated by flooding disturbance
- Tamarix also stimulated by flood
- How do these species interact after flooding?
Specific Questions

1. Can *Populus* establish by seed with *Tamarix* seed present?
2. How consistent are these results?
3. What are the implications for management?
The Approach

- Field observations
- Testing hypotheses developed in the field under controlled conditions
component #1: Field surveys

“What environmental factors explain species distributions?”
Location of field sites in New Mexico:

- Escondida
- Bosque del Apache, Wildlife refuge
A cleared, experimental plot that has been flooded
Clearing the *Tamarix*

Photos by Tim Carlson
Bosque del Apache

- seedlings germ. 1993
- indiv. tagged 1994
- abiotic: elevation, salinity, NH$_4$, PO$_4$, soil texture, plot location
Change in Densities over Time

- **Tamarix**
- **Populus**

![Graph showing change in densities over time with specific dates and plot density/m² scale.](image-url)
Regression of Populus against Tamarix at the first sampling period

R^2 = 0.39, p < 0.001
Regression of Populus against Tamarix at 38 months

\[ R^2 = 0.11; \ p < 0.03 \]
## Discriminant Analysis

<table>
<thead>
<tr>
<th>Variable</th>
<th>CAN1 P&lt;0.001</th>
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<tbody>
<tr>
<td>initial <em>Tamarix</em> density</td>
<td>-0.0325</td>
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<tr>
<td>initial <em>Populus</em> density</td>
<td>1.2462</td>
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<tr>
<td>soil texture</td>
<td>-0.2089</td>
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<tr>
<td>elevation</td>
<td>-0.0168</td>
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<tr>
<td>( v ) EC/salinity</td>
<td>0.3099</td>
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<tr>
<td>( NH_4 )</td>
<td>-0.1462</td>
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<tr>
<td>( PO_3 )</td>
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</table>
Discriminant Analysis

Canonical axis 1

Canonical axis 2

Populus

Mixed

Tamarix
<table>
<thead>
<tr>
<th></th>
<th>POPULUS</th>
<th>MIXED</th>
<th>TAMARIX</th>
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<tbody>
<tr>
<td>Tamarix t=0</td>
<td>557.8</td>
<td>193.2</td>
<td>171.26</td>
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<tr>
<td>Populus t=0</td>
<td>21.7</td>
<td>24.6</td>
<td>3.0</td>
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<tr>
<td>SOIL TEX.</td>
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<td>1.6</td>
<td>3.04</td>
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<tr>
<td>ELEVATION</td>
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<td>0.215</td>
<td>-0.02</td>
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<tr>
<td>SALINITY</td>
<td>39.89</td>
<td>25.54</td>
<td>34.71</td>
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<tr>
<td>NH$_4$</td>
<td>0.477</td>
<td>0.558</td>
<td>0.751</td>
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<tr>
<td>PO$_4$</td>
<td>0.224</td>
<td>0.38</td>
<td>0.281</td>
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Mortality patterns

- Change in densities over time
- Relationships between species
- What causes mortality
  - presence of neighbors
  - abiotic conditions?
Heights 2nd-5th yrs

Time*species p<0.001

Date measured

mean height (cm)

- Tamarix
- Populus
<table>
<thead>
<tr>
<th>indpt var.</th>
<th>Δ height of</th>
<th>Δ height of</th>
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<tbody>
<tr>
<td></td>
<td><em>Tamarix</em></td>
<td><em>Populus</em></td>
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<tr>
<td>plot</td>
<td>-2.61</td>
<td>-1.55</td>
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<td></td>
<td>0.05</td>
<td>NS</td>
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<tr>
<td>APCA1</td>
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<td>0.09</td>
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<tr>
<td>den. t=0</td>
<td>-13.41</td>
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<td>den. t=1 yr</td>
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<td>-20.03</td>
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Regression statistics

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<th>model</th>
<th>$R^2$=.60</th>
<th>p&lt;0.001</th>
<th>$R^2$=.40</th>
<th>p&lt;0.02</th>
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<tbody>
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<td>intercept</td>
<td>127.17</td>
<td></td>
<td>73.19</td>
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Summary of field data

- Relationship between species change
- Highest rates of mortality for *Tamarix*
- Abiotic factors - possible role of flood
- *Tamarix* mortality, growth affected by *Populus* densities BUT...
- ...not vice-versa

Question raised by field data

Is it possible that the native species is a superior competitor as a seedling?!
component #2: competition experiments

“Is competition occurring, and how is this affected by environment?”
RESPONSE SURFACE

TAMARIX DENSITY

POPULUS DENSITY
- Germination counted 17 days (90% in first 3)
- Height measured monthly
- Final above ground biomass
Populus mass in Clay with draw down

\[ R^2 = 0.46 \]
Populus mass in Sand with no draw down

![3D graph showing the relationship between Populus density and Tamarix density over mean mass (g).]
Tamarix mass in Clay with draw down

\[ R^2 = 0.47 \]
**Tamarix** mass in Sand with no draw down

\[ R^2 = 0.72 \]
Summary of Component #2

- *Populus* competitively suppresses *Tamarix*
- *Tamarix* is poor competitor, esp. against *Populus*
  - Competition intensity greatest with draw-down in high nutrient soil
Tamarix cannot compete if natives present.
- Promote natives
- Flooding disturbance
- ...may decrease invasion
Competition and plant invasions

- invasives not always competitive as seedlings
- Require disruption of native community to become established
- Importance of re-vegetation - no empty niche for invasion
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