MUTUALISM BETWEEN NATIVE AND NON-NATIVE SPECIES: GLOBAL TRENDS AND CALIFORNIAN CASE STUDIES

Clare E. Aslan, Arizona-Sonora Desert Museum
Benjamin Sikes, University of Texas-Austin
Keryn Bromberg Gedan, Smithsonian ERC
Marcel Rejmánek, University of California-Davis
Rob Klinger, US Geological Survey

California Invasive Plant Council; Rohnert Park, CA
October 12, 2012
Presentation Outline

• Mutualism background

• Novel mutualisms in three systems
  • Common characteristics
  • Key patterns
  • Knowledge gaps

• Bird dispersal of non-native plants
  • Dispersal limitation
  • Targeted high-efficiency spread detection
  • Riparian invaders
Mutualisms: Background
Mutualisms: Background

Interactions between species in which both participants experience fitness boosts
How do mutualisms arise?

- Nectar
- Water & Nutrients
- Fruit
- Transportation
- Protection
- Cleaning
How do mutualisms arise?

Gene flow

Competition

Body condition

Disease Resistance
Mutualisms and non-native species

Gene flow

Body condition

Competition

Disease Resistance
Novel mutualism review

What patterns are evident among novel mutualisms?

Dr. Ben Sikes, UT-Austin

Dr. Keryn Gedan, SERC
Novel mutualism review

- Marine patterns
  - Long-distance dispersal
  - Strong top-down effects

- Belowground patterns
  - Heterogeneity of resources
  - Limiting transportation

- Aboveground patterns
  - Limiting transportation
  - Competition
Novel mutualism review

- Novel mutualism characteristics
  - Facultative
  - Diffuse
  - Free resources
Novel mutualism review

• Key patterns emerging
  • Aboveground examples
    • Seed dispersal: Himalayan blackberry
    • Pollination: Yellow starthistle, iceplant
    • Shared attraction: Camphor tree
    • Ant protection: *Cecropia*
  • Belowground
    • Mycorrhizal fungi-root relationships: Spotted knapweed
  • Marine
    • Native *Diopatra* polychaete-Non-native *Gracilaria* alga
Novel mutualism review

- Marine patterns
  - Long-distance dispersal
  - Strong top-down effects
    → Protective mutualisms

- Belowground patterns
  - Heterogeneity of resources
  - Limiting transportation
    → Nutritional mutualisms

- Aboveground patterns
  - Limiting transportation
  - Competition
    → Reproductive mutualisms

Mutualisms provide access to limiting resources and a competitive edge
Novel mutualism review

• Information gaps
  • Marine???
  • Microbial mutualisms
Novel mutualism review

• Take-home messages
  • Novel mutualisms are common
  • Non-native species can benefit
  • Limiting factors guide frequency
  • Typically facultative and diffuse
  • Research gaps remain
Case study: Bird-mediated seed dispersal of non-native plants in California

- *Olea europaea*
- *Triadica sebifera*
- *Ligustrum lucidum*
Fleshy-fruited plants and birds
Dispersal limitation

<table>
<thead>
<tr>
<th>Proportion removed</th>
<th>Fruit loads</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chinese tallow: 24%</td>
<td>38,462</td>
</tr>
<tr>
<td>Olive: 88%</td>
<td>10,642</td>
</tr>
<tr>
<td>Privet: 77%</td>
<td>712,820</td>
</tr>
<tr>
<td>Toyon: 94%</td>
<td>105,983</td>
</tr>
</tbody>
</table>
From frugivory to spread

Barriers?
From frugivory to spread

Photo credit: University of Illinois

Directed Dispersal

American Society of Landscape Architects
Examples:
Chinese tallow, European olive, and glossy privet

<table>
<thead>
<tr>
<th>Chinese tallow</th>
<th>European olive</th>
<th>Glossy privet</th>
</tr>
</thead>
<tbody>
<tr>
<td>European starling</td>
<td>European starling</td>
<td>Cedar waxwing</td>
</tr>
<tr>
<td>American robin</td>
<td>Western-scrub jay</td>
<td>American robin</td>
</tr>
<tr>
<td>Northern flicker</td>
<td>Western meadowlark</td>
<td>Northern mockingbird</td>
</tr>
<tr>
<td>Nuttall’s woodpecker</td>
<td>American robin</td>
<td>Hermit thrush</td>
</tr>
<tr>
<td>Western-scrub jay</td>
<td>Wild turkey</td>
<td>Northern flicker</td>
</tr>
<tr>
<td>Northern mockingbird</td>
<td>Western bluebird</td>
<td>Yellow-rumped warbler</td>
</tr>
<tr>
<td>American crow</td>
<td>Northern mockingbird</td>
<td>Western-scrub jay</td>
</tr>
<tr>
<td>Cedar waxwing</td>
<td>American crow</td>
<td>American crow</td>
</tr>
<tr>
<td>Hermit thrush</td>
<td>Hermit thrush</td>
<td></td>
</tr>
<tr>
<td>Black phoebe</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Chinese tallow (*Triadica sebifera*)

- Bird-dispersed and water-lovin’
- Riparian area growth

---

**Survival over time at five elevations**

![Graph showing survival over time at different elevations](image)

Chinese tallow

- Barrier detection?

<table>
<thead>
<tr>
<th>Potential barrier to invasion</th>
<th>Detected?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seed production</td>
<td>No</td>
</tr>
<tr>
<td>Seed transport by dispersers</td>
<td>No</td>
</tr>
<tr>
<td>Seed germination</td>
<td>Not along waterways</td>
</tr>
<tr>
<td>Seedling survival</td>
<td>Not along waterways</td>
</tr>
</tbody>
</table>

Apparent invasion potential along waterways: High

Glossy privet (*Ligustrum lucidum*)

- Bird-dispersed and water-lovin’
- Irrigated area growth

Glossy privet

- Barrier detection?

<table>
<thead>
<tr>
<th>Potential barrier to invasion</th>
<th>Detected?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seed production</td>
<td>No</td>
</tr>
<tr>
<td>Seed transport by dispersers</td>
<td>No</td>
</tr>
<tr>
<td>Seed germination</td>
<td>Not along waterways</td>
</tr>
<tr>
<td>Seedling survival</td>
<td>Not along waterways</td>
</tr>
</tbody>
</table>

Apparent invasion potential along waterways: High
European olive (Olea europaea)

- Bird-dispersed and upland

European olive

• Barrier detection?

<table>
<thead>
<tr>
<th>Potential barrier to invasion</th>
<th>Detected?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seed production</td>
<td>No</td>
</tr>
<tr>
<td>Seed transport by dispersers</td>
<td>No</td>
</tr>
<tr>
<td>Seed germination</td>
<td>Low?</td>
</tr>
<tr>
<td>Seedling survival</td>
<td>Low?</td>
</tr>
</tbody>
</table>

Apparent invasion potential along bird dispersal pathways: Low at landscape scale... but high in certain sites
Detecting spread of fleshy-fruited exotics

• Something will eat them
• Track likely dispersal paths
• Target habitat
• Early detection, rapid response
• Source population focus
Bird dispersal as key

- Under certain circumstances
- When to think about it
- Why to think about it
Thank you!

- Marcel Rejmánek
- Rob Klinger
- Rejmánek Lab
- Land use permissions: Putah Creek Riparian Reserve, Bidwell Park, City of Davis
- Interns and volunteers!
- Countless wise advisors...
- David H. Smith Conservation Research Fellowship
- National Science Foundation

Questions?