Why Should We Care About Invasive Species?

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Exotic
Exotic Species
What does it mean to be exotic?

• A species that comes from another place...
• But WHEN??
• But HOW??
Last Glacial Maximum ~ 20,000 years ago
Exotic Species
Exotic Species
What is an exotic species?

An introduced species is a species that is living outside its native distributional range, which has arrived there by human activity, either deliberate or accidental.

In the United States this usually refers to species introduced after the arrival of Europeans.
Why introduce a species to a new place?
Invasive Species

- Introduced species that adversely affect the habitats and bioregions they invade economically, environmentally, and/or ecologically.
Not all exotic species are invasive

• **Weed** = a plant (or other organism) in an undesired place
  – can be native or exotic

• **Exotic species** = a species that has been introduced (usually by humans) from another place
  – Can be introduced from another country, state or region

• **Invasive species** = a species that has a large negative economic, environmental or ecological impact
What makes an exotic species an invasive species?
So How Bad Is it?

- One in ten species imported to a new area will appear in the wild.
- One in ten of the species that appear in the wild will become established.
- One in ten of those that become established will become a pest.

So which ones are the bad ones?

PUBLIC ENEMY

What makes them bad?
Mixed Messages

Don’t judge species on their origins

Conservationists should assess organisms on environmental impact rather than on whether they are natives, argue Mark Davis and 18 other ecologists.
Impacts of Invasive Plant Species

• Predation and Competition
  – Local extinctions, changes in community composition

• Impacts based on resource use or habitat changes
  – Fruit for migratory birds
  – Insect use
  – Tick habitat

• Impacts based on ecosystem processes
  – Soil nutrients
  – Microbes
  – Allelopathy

http://www.allaboutbirds.org/guide/Northern_Cardinal/id
Invasive Species and Native Ecosystems

• Predation and competition
Predation and competition

http://www.theirishduck.info/2013/06/30/littleshop/
Competition

http://oak.ppws.vt.edu/~flessner/weedguide/puelo.htm
http://arcofappalachia.org/events/invasives-info.html
Effects of Exotic Plant Competition

• 4000 naturalized plant species in continental US in 400 years.
• 20% of the continent’s vascular plant species.

No evidence for even a single extinction or state-wide extirpation because of competition from an introduced plant species.

http://www.fs.fed.us/ne/delaware/biotrends/trends_invasives.html

Effects of Exotic Plant Competition

Fig. 2. Native and naturalized plant richness are highly correlated across oceanic islands. The log number of extant native plant species explains 96% of the variation in the log number of naturalized plant species. See Table S1 for a list of islands and richness values.

Effects of Invasive Plant Competition

http://botany.okstate.edu/floras/floras21.gif
Competition

http://oak.ppws.vt.edu/~flessner/weedguide/puelo.htm
http://arcofappalachia.org/events/invasives-info.html
Habitat loss → Pollution → Over-exploitation → Exotic species → Small, fragmented isolated populations → Inbreeding → Loss of genetic diversity → Reduced adaptability, survival and reproduction → Reduced $N$ → Environmental variation → Catastrophes → Demographic stochasticity → Habitat loss

EXTINCTION VORTEX
Competition
Invasive Species and Native Ecosystems

- Impacts based on resource use or habitat changes
  - Insect use
  - Fruit for migratory birds
  - Tick habitat

http://www.allaboutbirds.org/guide/Northern_Cardinal/id
http://davesgarden.com/guides/pf/go/81750/#b

http://www.birdfellow.com/birds/veery-catharus-fuscescens
http://www.allaboutbirds.org/guide/No rthern_Cardinal/id
Caterpillars on July 26 2014

<table>
<thead>
<tr>
<th>Tree</th>
<th>Number of Caterpillars</th>
<th>Number of Species</th>
</tr>
</thead>
<tbody>
<tr>
<td>White oak</td>
<td>233</td>
<td>15</td>
</tr>
<tr>
<td>Black cherry</td>
<td>53</td>
<td>10</td>
</tr>
<tr>
<td>Burning bush</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Callery pear</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

A single pair of breeding chickadees must catch 7500 caterpillars to rear one clutch of young.
Invasive vs. Native Fruit

Figure 1. Relationship between average energy density and average fat content of native (solid symbols) and invasive (open symbols) fruits collected during fall 2010. There was a significant correlation between percent fat and energy density of fruits ($r_s[24] = 0.85, P < 0.001$).

Native, or Not So Much?
Native plants transformed into flashy “nativars” may look pretty, but are they good for wildlife?
05-25-2016 // Janet Marinelli
Ticks and Barberry


https://theplymouthpress.files.wordpress.com/2013/08/japanesebarberry.jpg
How Lyme Disease Cases Have Spread In The U.S.

The number of confirmed and probable Lyme disease cases in the U.S. more than doubled from 2001 to 2015. In 2015, 95 percent of confirmed cases were reported in the 14 states labeled below.

Notes

Because data are reported on the county level, the CDC randomly placed a dot within the county of residence for each case.

Source: Centers for Disease Control and Prevention

Credit: Map: CDC. Annotation: Katie Park/NPR
Invasive Species and Native Ecosystems

• Impacts based on ecosystem processes
  – Soil nutrients
  – Microbes
  – Allelopathy

http://www.science20.com/darkharmony/biological_era
dication_of_invasive_species_using_allelopathy
http://www.caryinstitute.org/science-program/research-projects/organisms-ecosystem-engineers
Soil Mediated Effects
Impacts of Invasive Plant Species

• Competition
  – Changes in community composition
    • Localized loss of infrequent species

• Impacts based on resource use or habitat changes
  – Poor insect food source
  – Non-nutritious fruit for migratory birds
  – Japanese barberry increases tick habitat

• Impacts based on ecosystem processes
  – Changes to soil nutrient cycling
  – Loss of beneficial soil mutualists, increase in pathogens
  – Allelopathy prevents seedling germination
Nest Success

Figure 1. Nest daily mortality rate (DMR ± 1 SE) by nest substrate for American Robin and Wood Thrush. Sample sizes are given above bars.
Nest Success

Nesting in barberry vs. on the ground can increase annual fecundity by 10%.

http://davesgarden.com/guides/pf/go/81750/#b
https://www.allaboutbirds.org/guide/Veery/id
Insects and Invasive Plant Species

Loomis, J. D., & Cameron, G. N. (2014). Impact of the invasive shrub Amur honeysuckle (Lonicera maackii) on shrub-layer insects in a deciduous forest in the eastern United States. *Biological invasions, 16*(1), 89-100.

http://davesgarden.com/guides/pf/go/81750/#b
Invasive Plants and Nest Success

- Specific physical traits of plants, rather than their status as exotics, per se, that determine their impact.
Insects and Invasive Plant Species

• Birds and insects may have different responses to exotic plant species depending on how they use the vegetation
  – Less impact on species that use vegetation for shelter and habitat
  – More impacts on species that use vegetation for food source

• More distant relationship between an exotic plant species and local native species = fewer insects supported.
So which ones are the bad ones?
Always look for native alternatives

Exotic plant species have a far shorter evolutionary history with our native wildlife and are overall less well adapted to provide quality food and habitat.

DO NOT PLANT!

Always look for native alternatives.
Prioritize and remove with caution!

• Most exotic plant species will provide some level of habitat or food for wildlife. In very disturbed habitat these plants may be the only option.

• Fill in with native species to replace lost food sources and habitat.

• Address issues that lead to exotic plant establishment.
What to do?

• Removal is insufficient

http://www.invasiveplantcontrol.com/about.html
http://solveoregon.org/why-we-care/invasive-plants
Habitat loss → Pollination → Over-exploitation → Exotic species → Small, fragmented isolated populations → Reduced N → Reduced adaptability, survival and reproduction → Inbreeding → Loss of genetic diversity → Environmental variation → Catastrophes → Demographic stochasticity
What to do?

• Wholesale removal of invasive species will not solve the problem.
  – Not possible to control after invasion is greater than ~100 acres
  – Constant upkeep and maintenance needed
  – Need to revegetate to provide habitat

• Target species that are known problems

• Focus on invasive removal in special areas

• Prevent new invasives from coming in
  – Stress native species in landscapes wherever possible.

• Address issues that allow species to become passengers
The case for caution

• In areas where native vegetation has decreased due to stress, exotic plants may
  – Be one of the only safe nesting sites away from predators.
  – Be one of few (although low quality) sources of food.
  – Provide complex vegetative structure, resources such as food or shelter, and favorable microenvironment or microclimate for insects