Why Should We Care About Invasive Species?

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Maryland Native Plant Society Fall Conference

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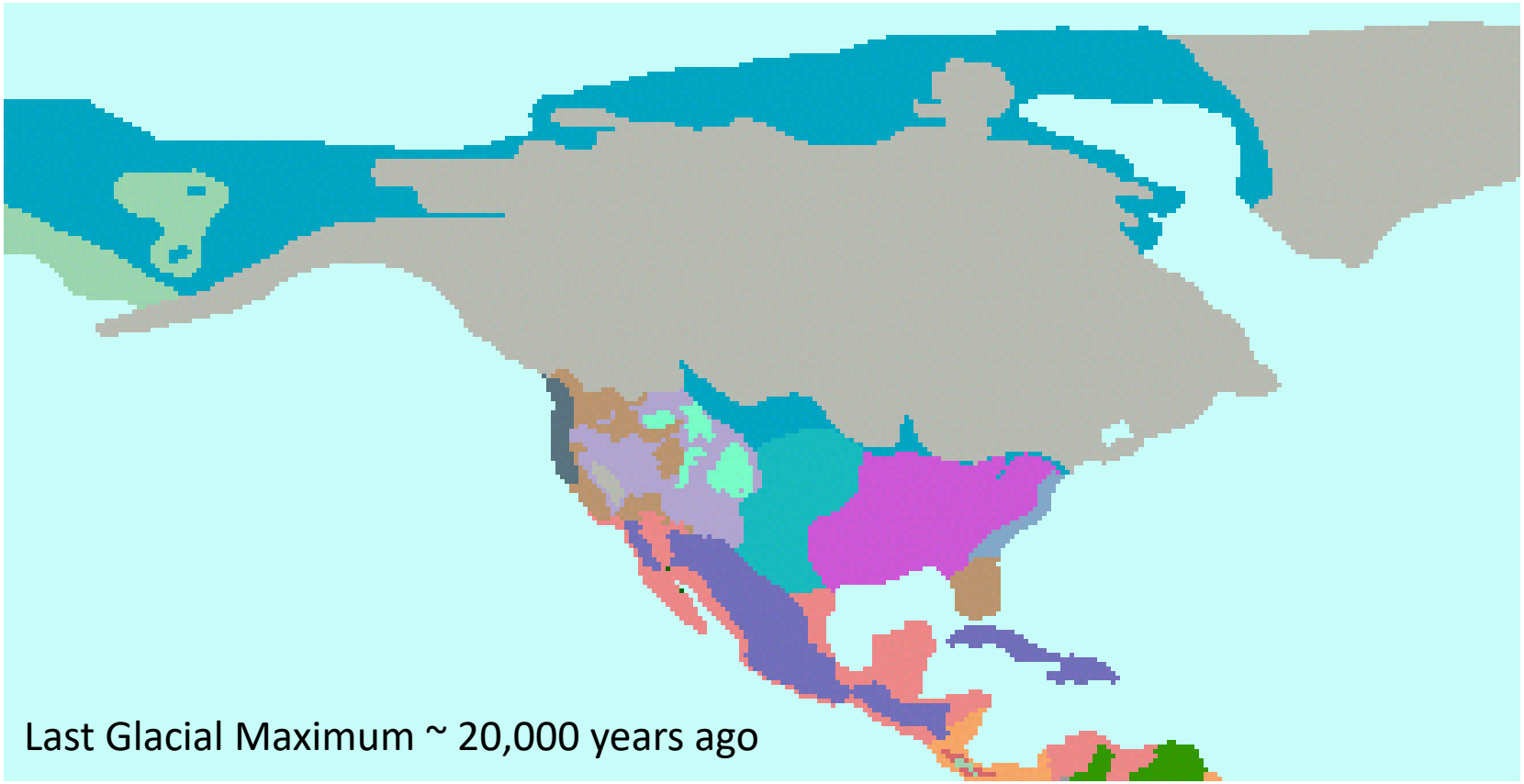
Exotic

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
Legend
Last Glacial Maximum Vegetation
Alpine tundra
Broadleaved temperate evergreen fores
Dry steppe
Forest steppe
Ice sheet or other permanent ice
Lakes and open water
Main Taiga
Monsoon or dry forest
Montane Mosaic
Montane tropical forest
Open boreal woodlands
Polar and alpine desert
Savanna
Semi-arid temperate woodland or scrub
Steppe-tundra
Subalpine parkland
Temperate desert
Temperate semi-desert
Temperate steppe grassland
Tropical extreme desert
Tropical grassland
Tropical rainforest
Tropical semi-desert
Tropical thorn scrub and scrub woodla
Tropical woodland
Tundra
Lakes
Continents

Exotic Species

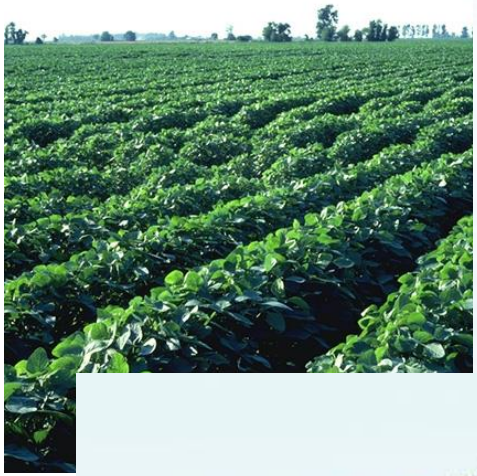
Exotic Species

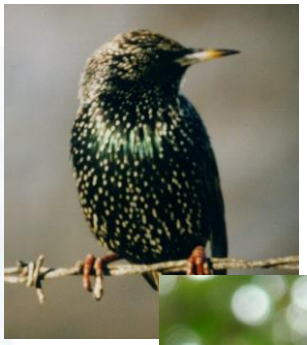
What is an exotic species?

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
  - Williamson, M., & Fitter, A. (1996). The varying success of invaders. *Ecology*,*77*(6), 1661-1666.

So which ones are the bad ones?

PUBLIC ENEMY

What makes them bad?

Nature June 9, 2011

The New York Times

A forester engages in efforts to eradicate the velvet tree *Miconia calvescens* in Hawaii.

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.

encouraged by persistent warnings from biologists about the dangers of foreign animals and plants moving into new territories.

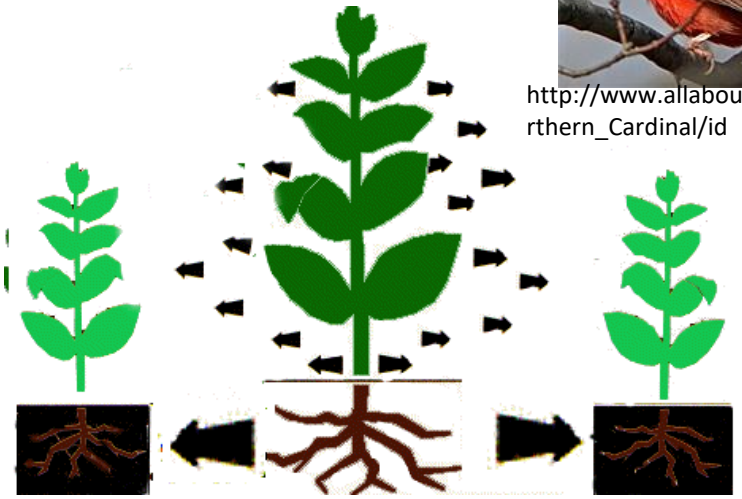
Conservation organizations bill alien species as the foremost threat to

RELATED COVERAGE

Impacts of Invasive Plant Species

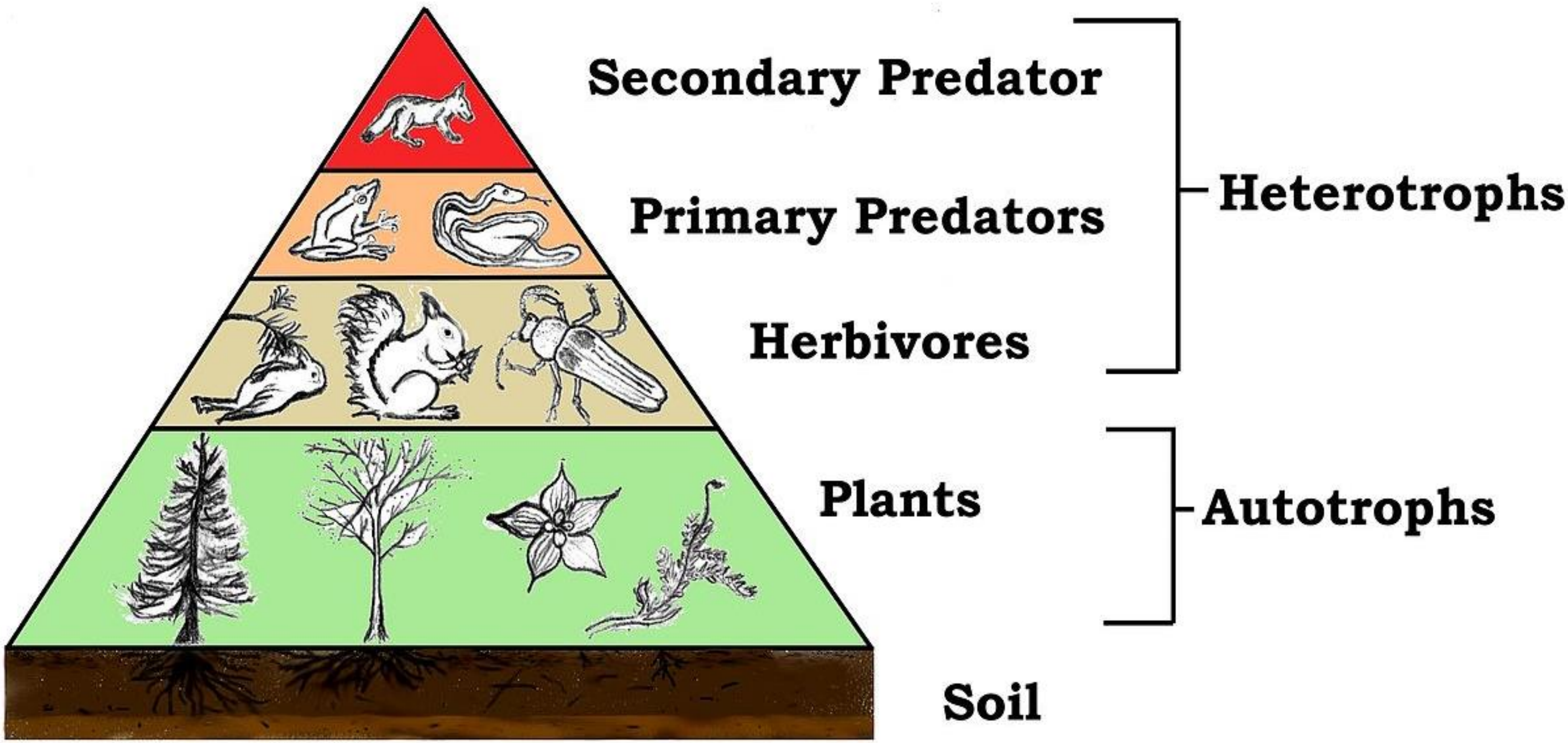
- Predation and Competition
  - Local extinctions, changes in community composition
- Impacts based on resource use or habitat changes
  - Fruit for migratory birds
  - Insect use
  - Tick habitat
- Impacts based on ecosystem processes
  - Soil nutrients
  - Microbes
  - Allelopathy

http://www.allaboutbirds.org/guide/Northern_Cardinal/id



Invasive Species and Native Ecosystems

- Predation and competition



Predation and competition

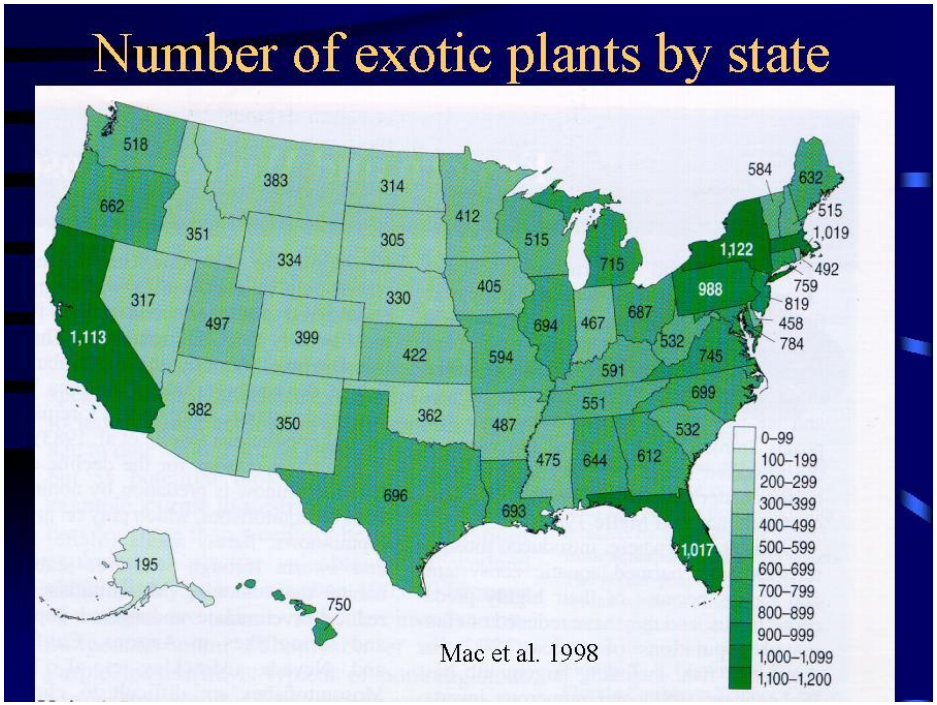
http://www.theirishduck.info/2013/06/30/littleshop/

Competition

http://oak.ppws.vt.edu/~flessner/weedguide/puelo.htm
http://arcofappalachia.org/events/invasives-info.html
http://www.centralalgomafreshwatercoalition.ca/threat-details.php?Aquatic-Invasive-Species-2

Effects of Exotic Plant Competition

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



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

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

Davis, M. A. (2003). Biotic globalization: does competition from introduced species threaten biodiversity?. *Bioscience*, *53*(5), 481-489.

Effects of Exotic Plant Competition

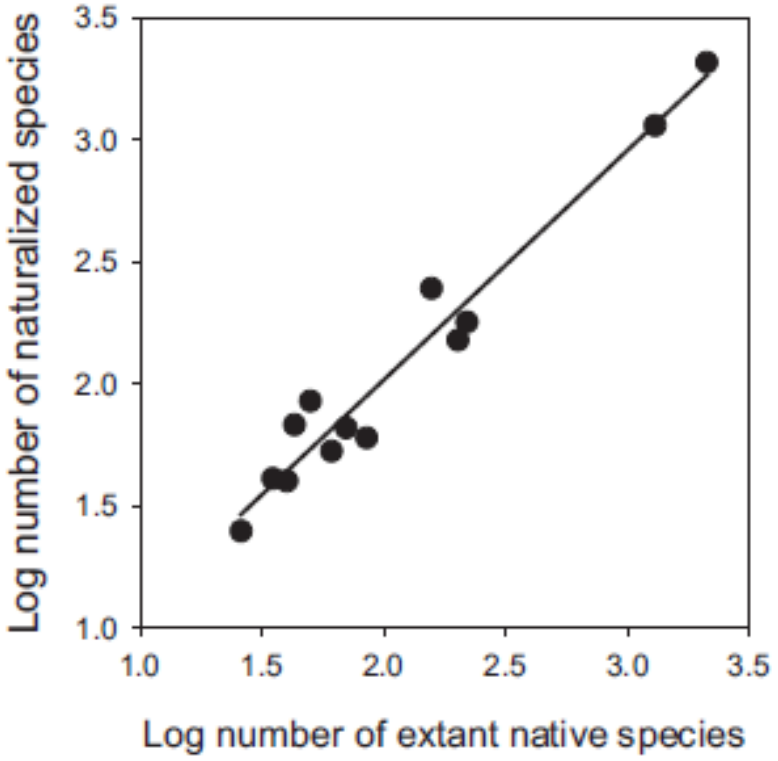
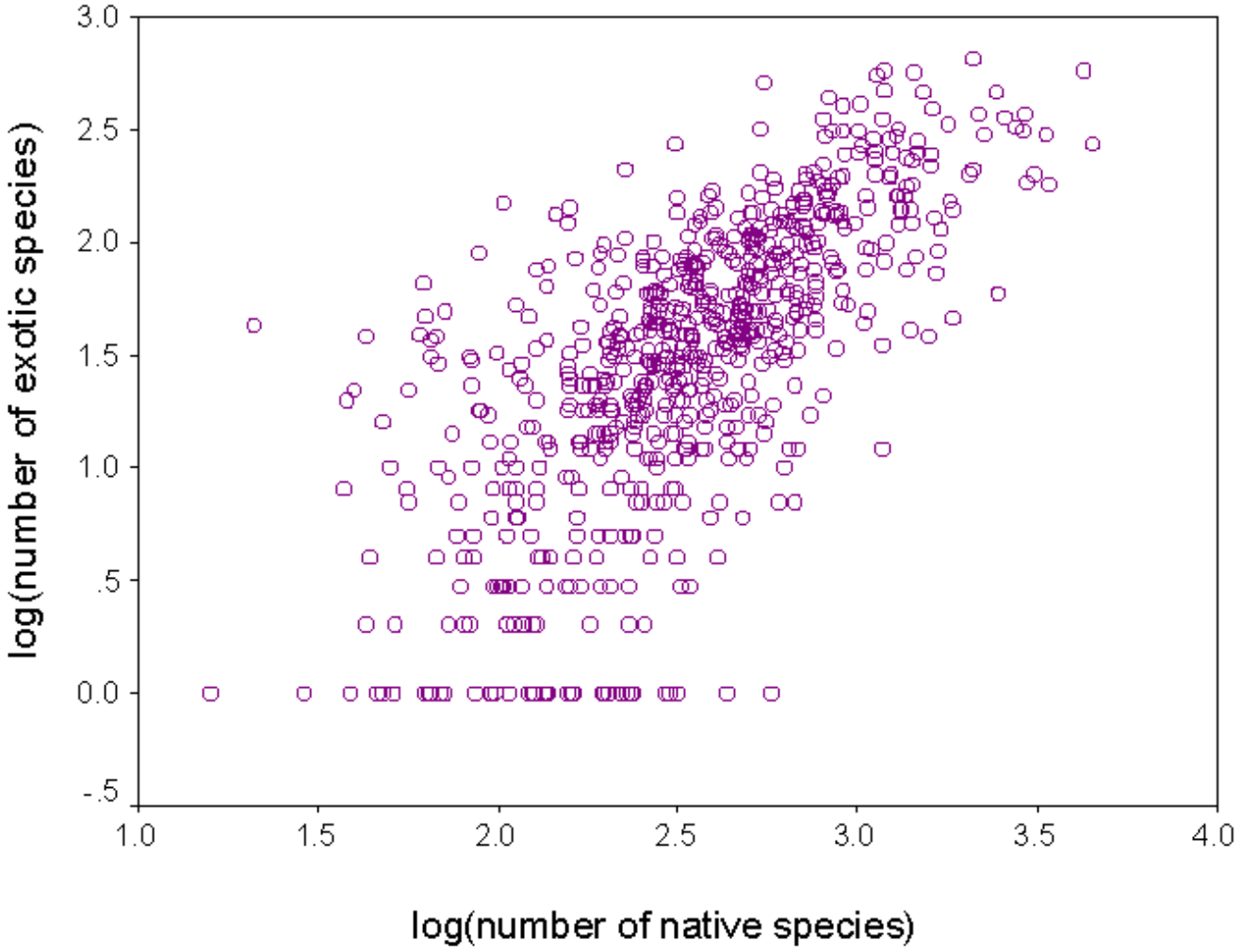


Fig. 2. Native and naturalized plant richness are highly correlated across oceanic islands. The log number of extant native plant species explains 96% of the variation in the log number of naturalized plant species. See Table S1 for a list of islands and richness values.

Sax, D. F., & Gaines, S. D. (2008). Species invasions and extinction: The future of native biodiversity on islands. *Proceedings of the National Academy of Sciences of the United States of America*, *105*(Suppl 1), 11490–11497. doi:10.1073/pnas.0802290105

Effects of Invasive Plant Competition



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

Competition

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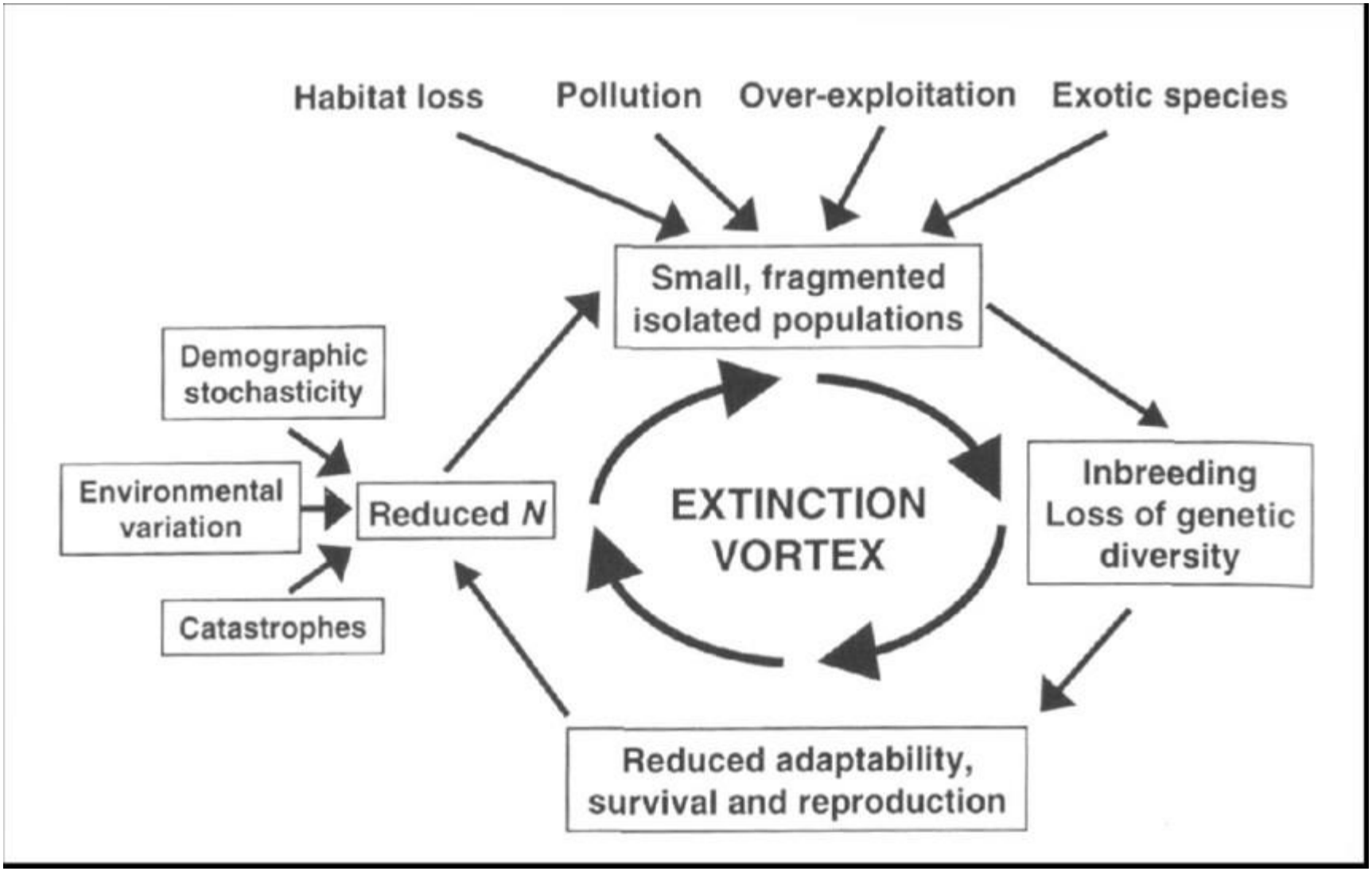
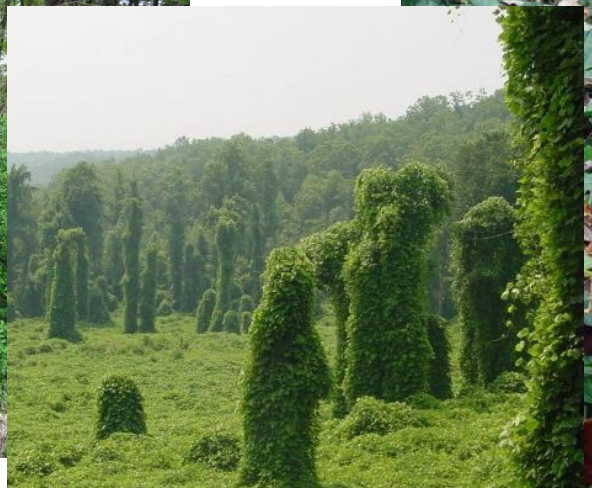
http://arcofappalachia.org/events/invasives-info.html
http://www.centralalgomafreshwatercoalition.ca/threat-details.php?Aquatic-Invasive-Species-2

https://www.srs.fs.usda.gov/compass/2016/02/18/native-trees-naturally-fight-invasives-in-some-eastern-forests/

http://davesgarden.com/guides/pf/go/81750/#b http://vtdigger.org/vtdNewsMachine/wp-content/uploads/2013/08/Japanese-barberry.jpg


Habitat loss
Pollution
Over-exploitation
Exotic species
Small, fragmented isolated populations
Demographic stochasticity
Environmental variation
Catastrophes
Reduced N
EXTINCTION VORTEX
Inbreeding Loss of genetic diversity
Reduced adaptability, survival and reproduction

Competition



Invasive Species and Native Ecosystems

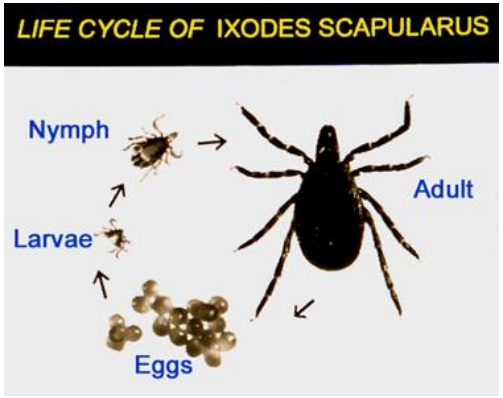
- Impacts based on resource use or habitat changes
  - Insect use
  - Fruit for migratory birds
  - Tick habitat

http://davesgarden.com/guides/pf/go/81750/#b

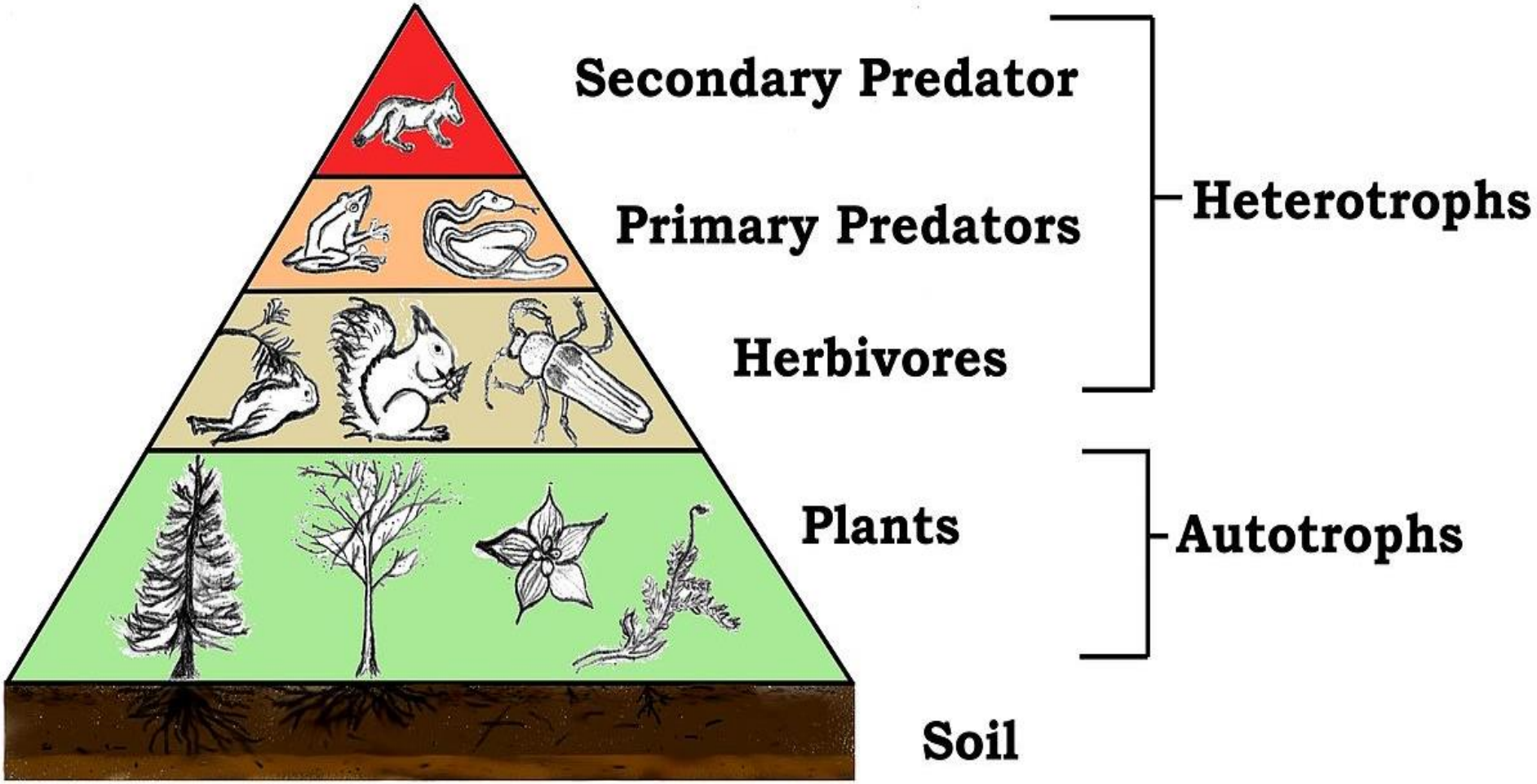
http://vtdigger.org/vtdNewsMachine/wp-content/uploads/2013/08/Japanese-barberry.jpg

http://www.birdfellow.com/birds/veery-catharus-fuscescens

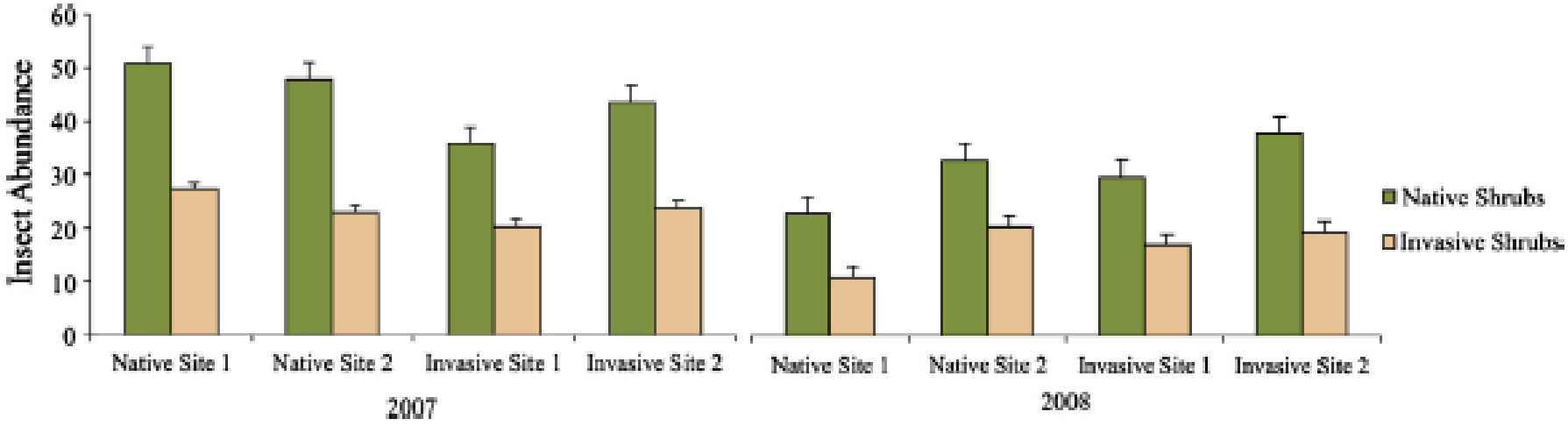
http://www.allaboutbirds.org/guide/Northern_Cardinal/id



http://blogs.scientificamerican.com/guest-blog/barberry-bambi-and-bugs-the-link-between-japanese-barberry-and-lyme-disease/



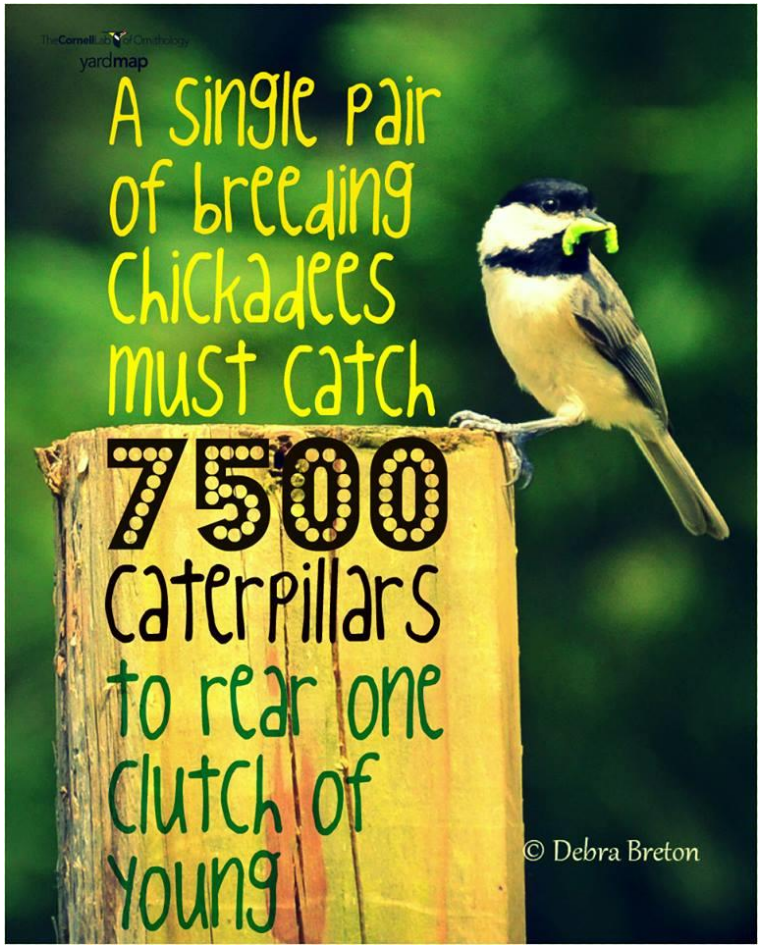
Insects and Invasive Plant Species



Fickenscher, J. L., Litvaitis, J. A., Lee, T. D., & Johnson, P. C. (2014). Insect responses to invasive shrubs: Implications to managing thicket habitats in the northeastern United States. *Forest Ecology and Management*, *322*, 127-135.

Caterpillars on July 26 2014

White oak	233 caterpillars:	15 species
Black cherry	53 caterpillars:	10 species
Burning bush	2 caterpillars:	1 species
Callery pear	1 caterpillar:	1 species



Invasive vs. Native Fruit

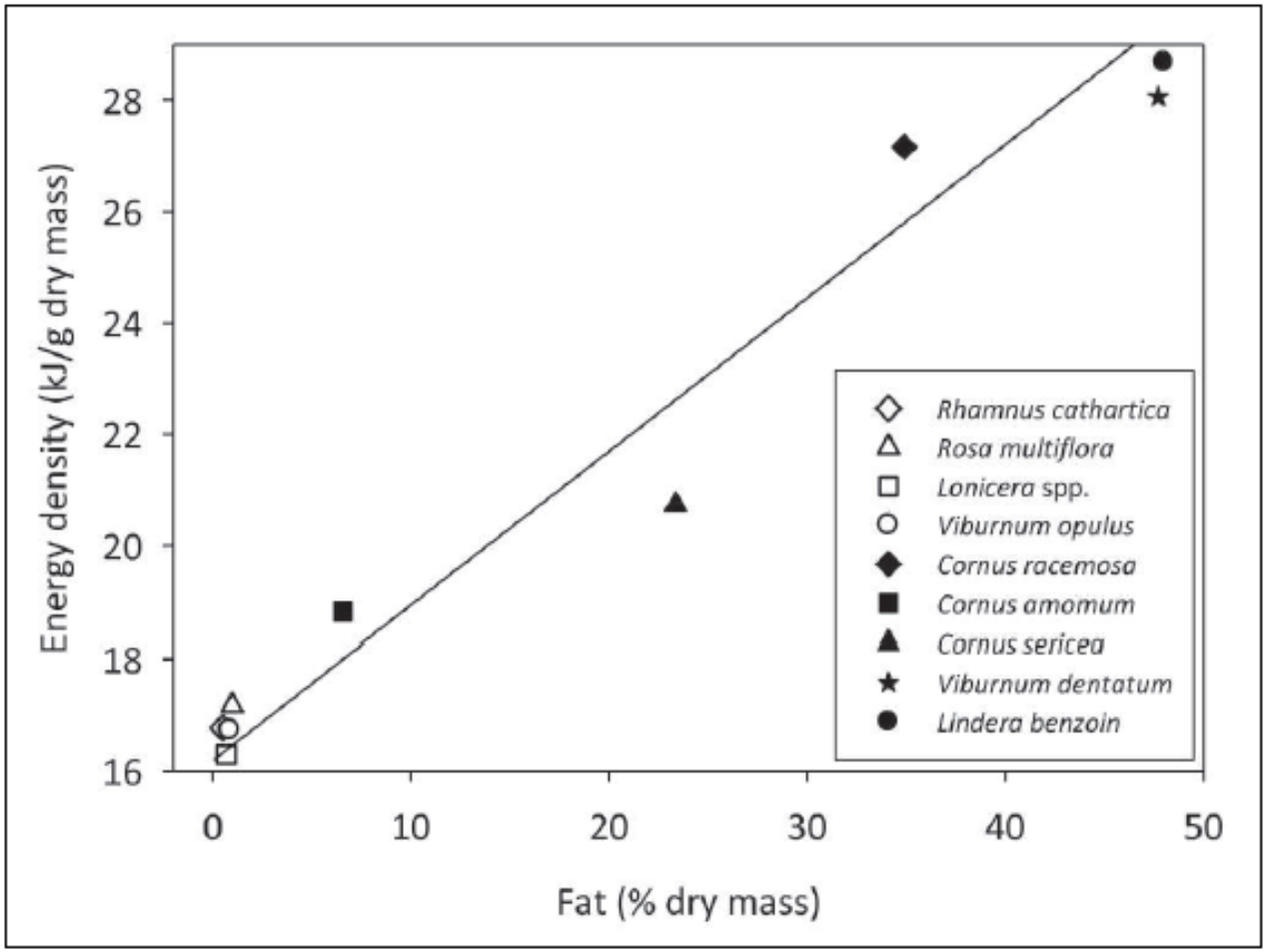


Figure 1. Relationship between average energy density and average fat content of native (solid symbols) and invasive (open symbols) fruits collected during fall 2010. There was a significant correlation between percent fat and energy density of fruits ($r_s[24] = 0.85$, $P < 0.001$).

Smith, S. B., S. A. DeSando, and T. Pagano. 2013. Value of native and invasive fruit-bearing shrubs for migrating birds. *Northeastern Naturalist* 20:171–184.

Insects and Invasive Plant Species

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

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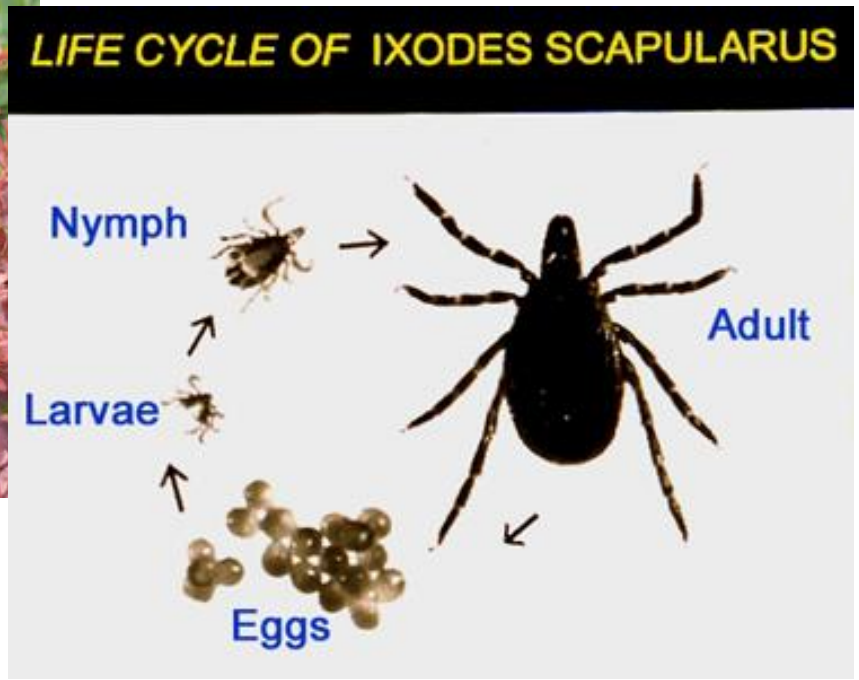
Ticks and Barberry



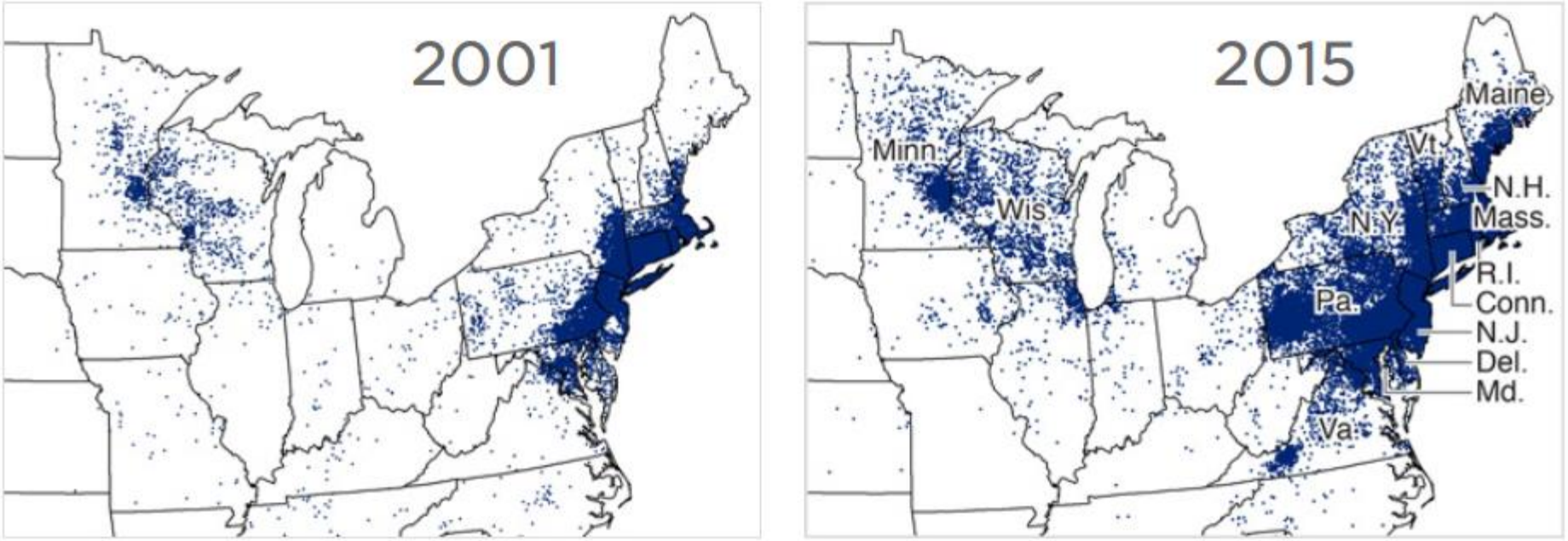
https://theplymouthpress.files.wordpress.com/2013/08/japanesebarberry.jpg

http://blogs.scientificamerican.com/guest-blog/barberry-bambi-and-bugs-the-link-between-japanese-barberry-and-lyme-disease/

Lubelczyk, C. B., S. P. Elias, P. W. Rand, M. S. Holman, E. H. Lacombe, and R. P. Smith. 2004. Habitat associations of *Ixodes scapularis* (Acari: Ixodidae) in Maine. Environ. Entomol. 33: 900-906.

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

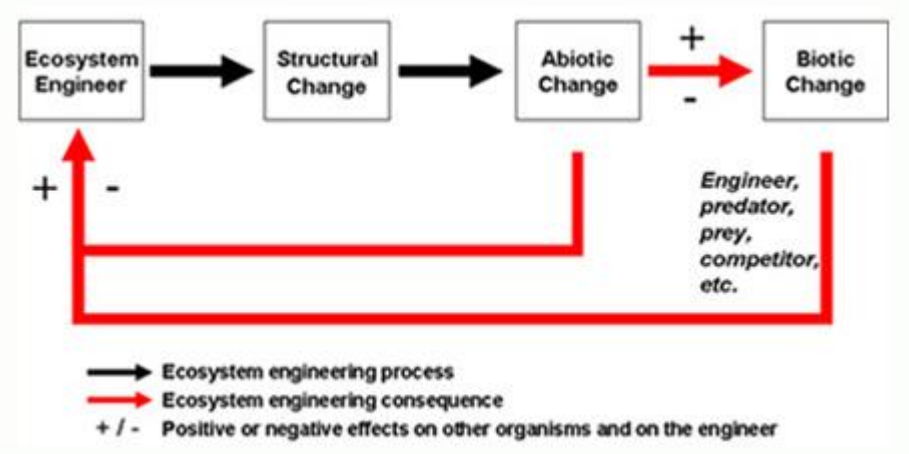
Because data are reported on the county level, the CDC randomly placed a dot within the county of residence for each case.

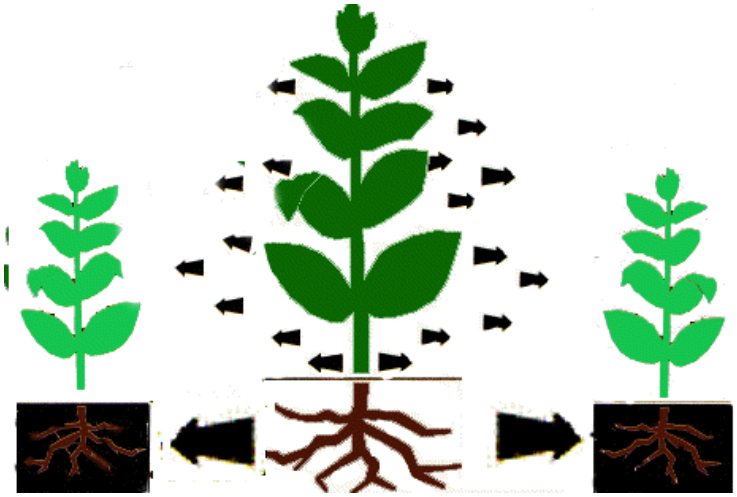
Source: Centers for Disease Control and Prevention

Credit: Map: CDC. Annotation: Katie Park/NPR

Invasive Species and Native Ecosystems

- Impacts based on ecosystem processes
  - Soil nutrients
  - Microbes
  - Allelopathy

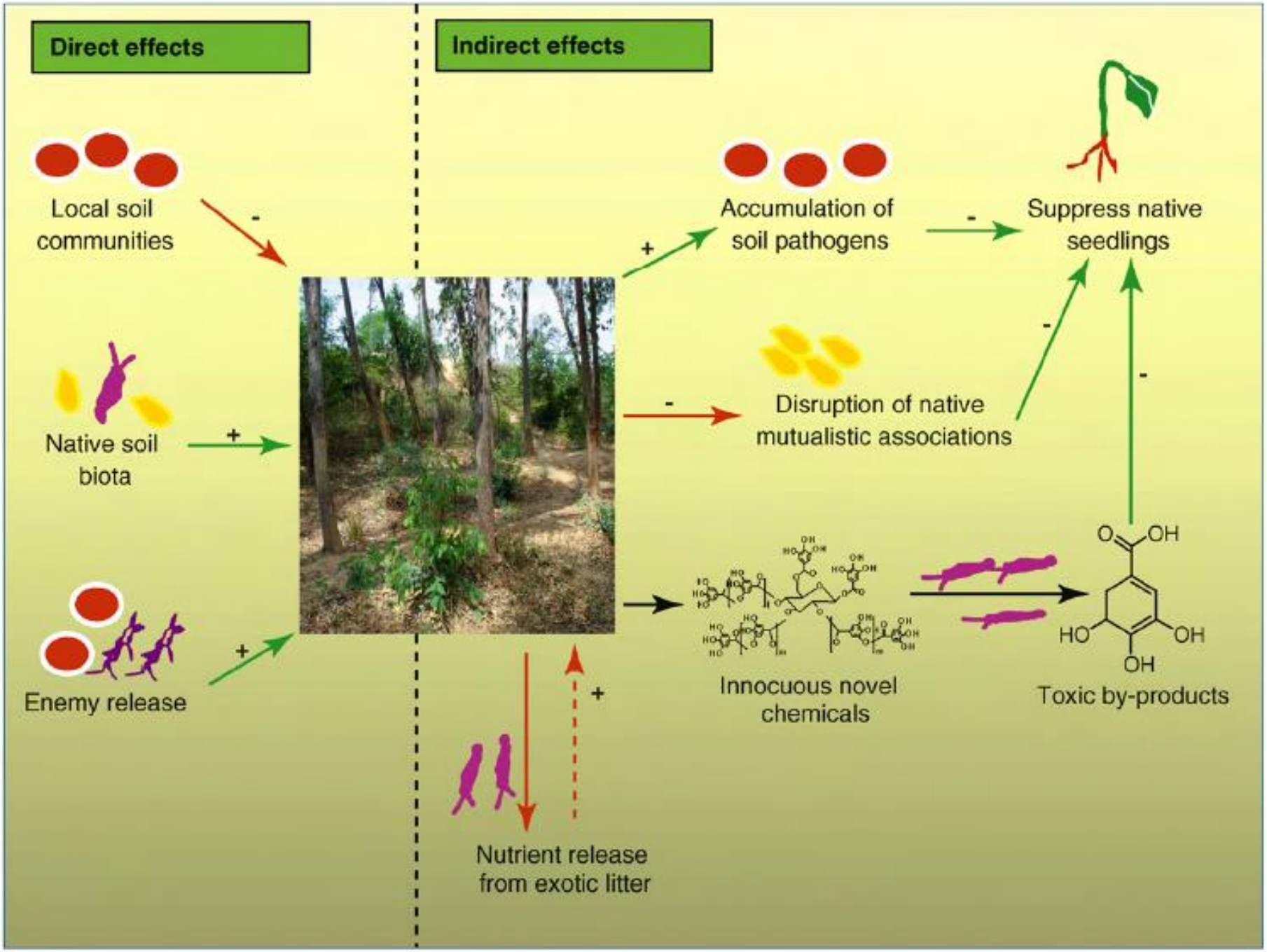




http://www.science20.com/darkharmony/biological_eradication_of_invasive_species_using_allelopathy

http://www.fws.gov/midwest/news/nativeprairies.html

http://www.caryinstitute.org/science-program/research-projects/organisms-ecosystem-engineers



van der Putten, Wim H. "Impacts of soil microbial communities on exotic plant invasions." *Trends in Ecology & Evolution* 25.9 (2010): 512-519.

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

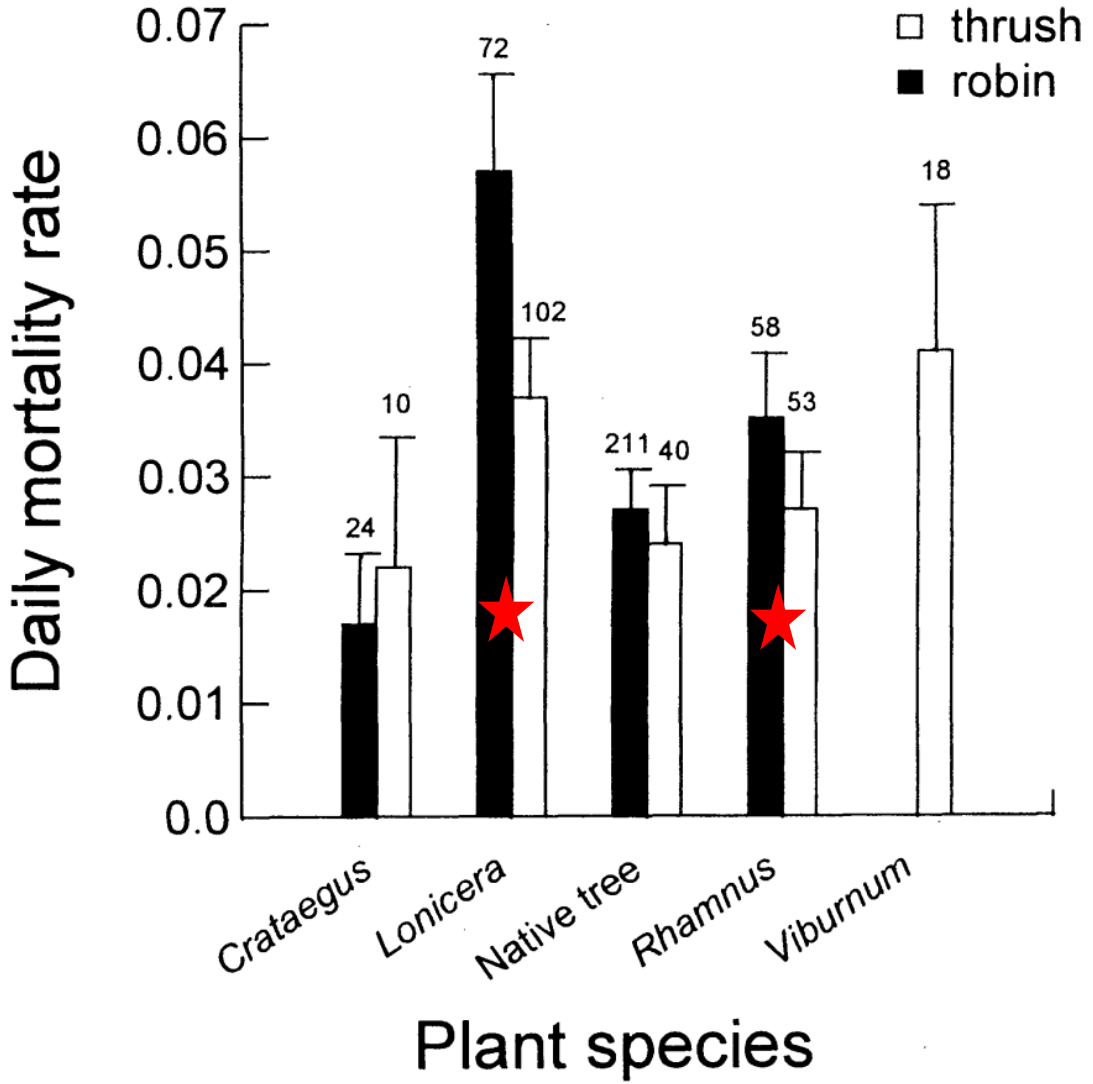
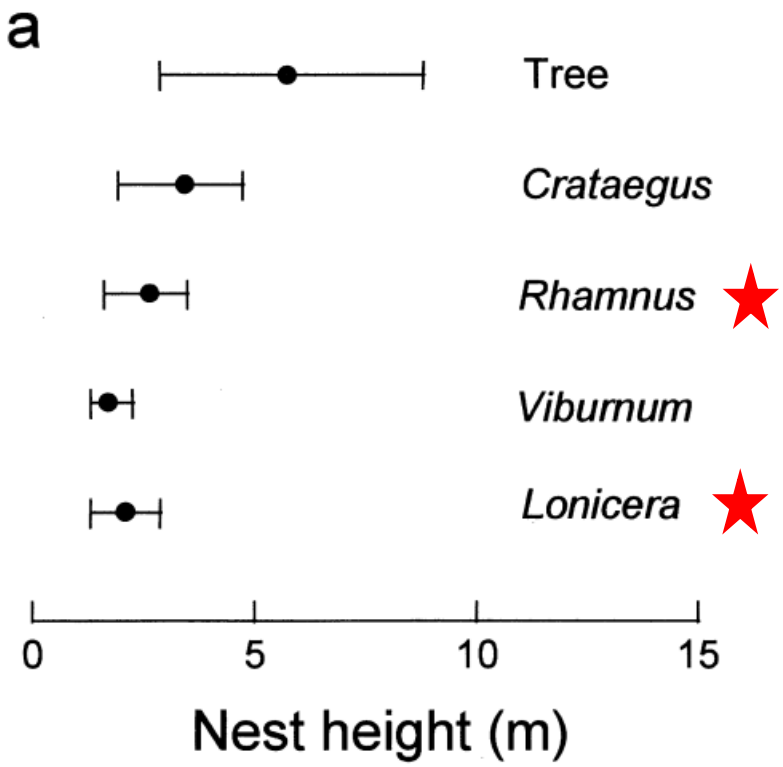
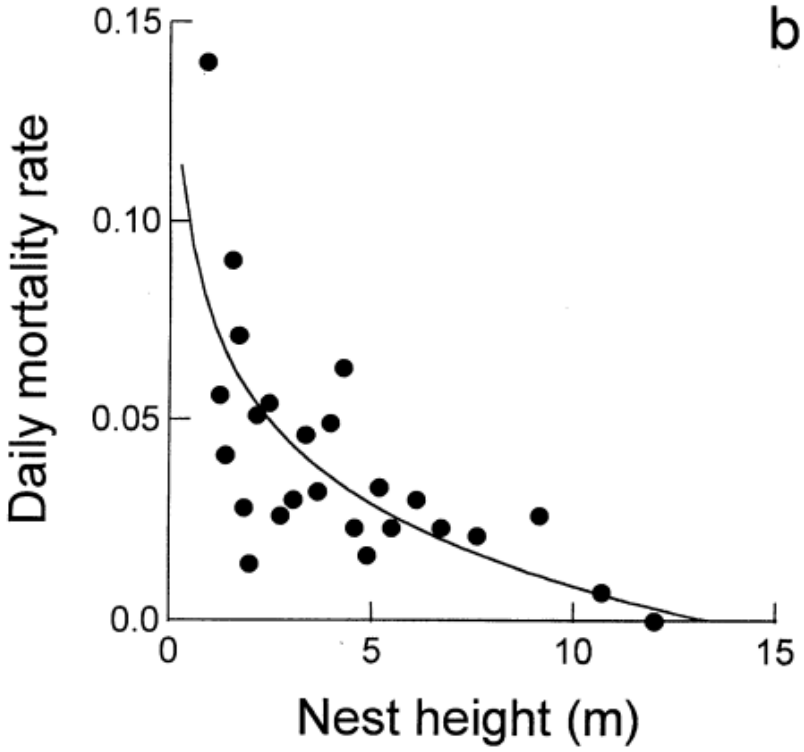


Figure 1. Nest daily mortality rate (DMR ± 1 SE) by nest substrate for American Robin and Wood Thrush. Sample sizes are given above bars.

Nest Success





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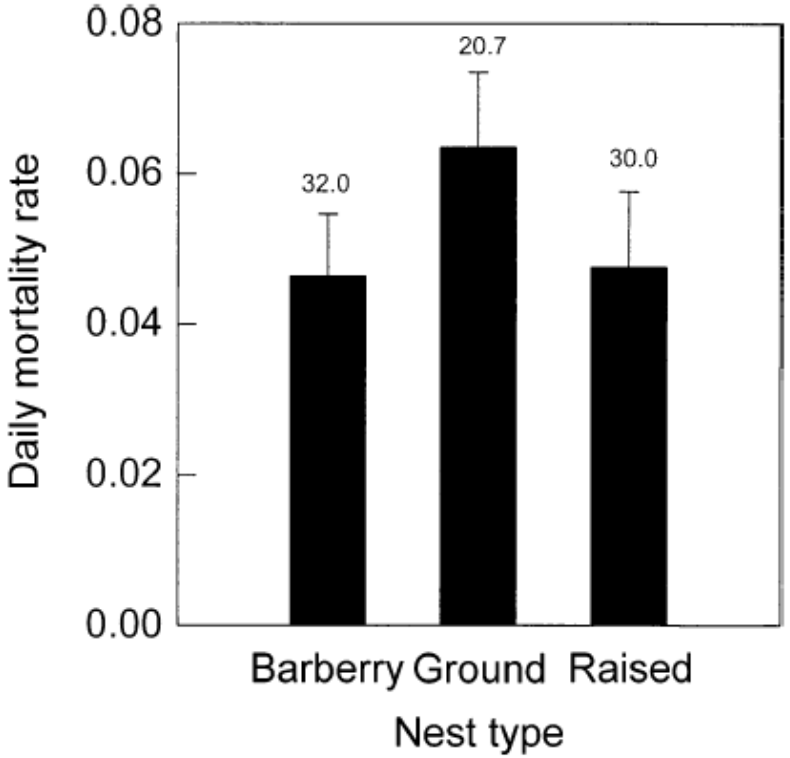


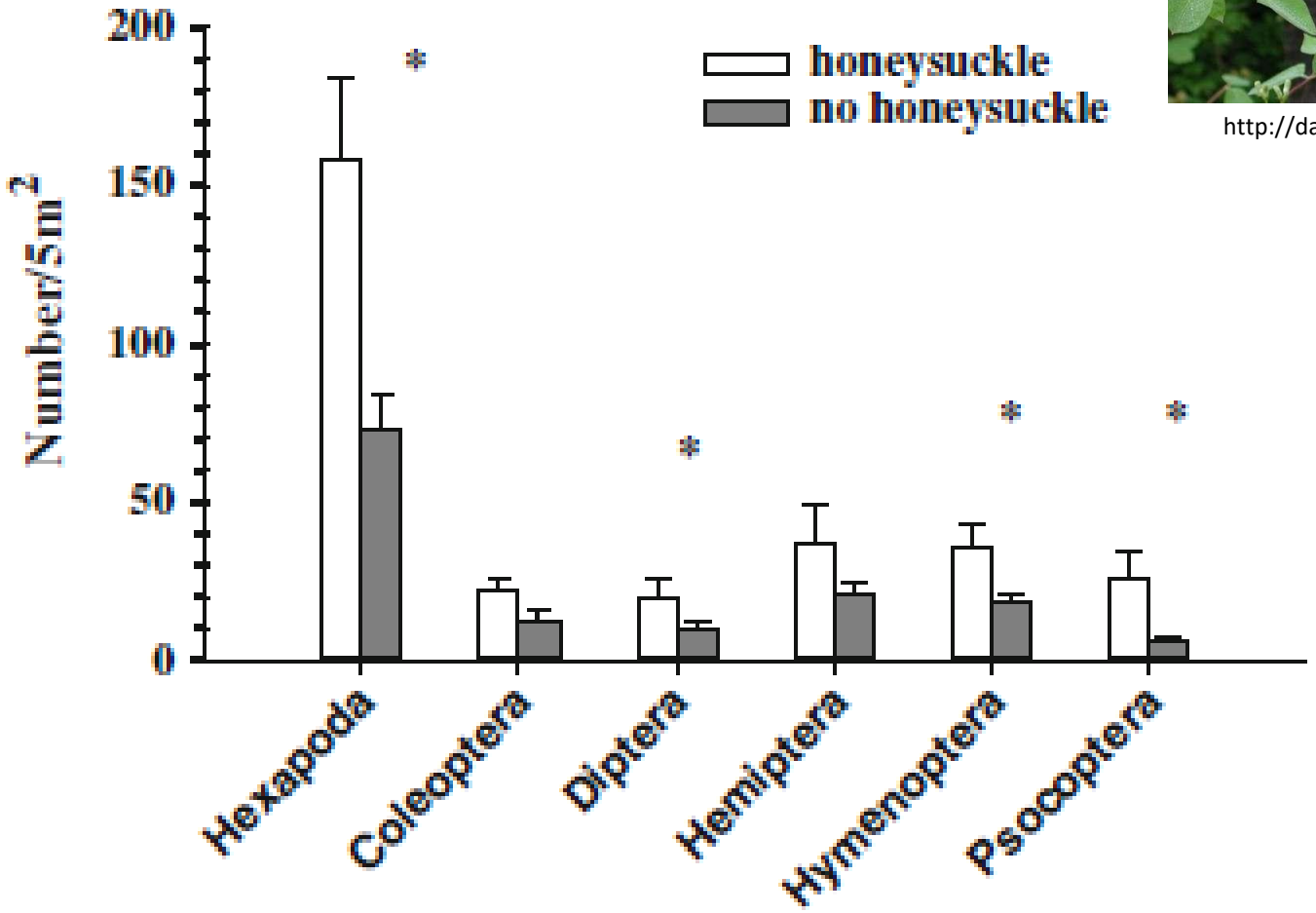
http://davesgarden.com/guides/pf/go/81750/#b

https://www.allaboutbirds.org/guide/Veery/id

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

Insects and Invasive Plant Species

http://davesgarden.com/guides/pf/go/81750/#b



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.

Invasive Plants and Nest Success

- Specific physical traits of plants, rather than their status as exotics, per se, that determine their impact.

http://davesgarden.com/guides/pf/go/81750/#b

http://www.allaboutbirds.org/guide/American_Robin/id

http://www.allaboutbirds.org/guide/Northern_Cardinal/id

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?

PUBLIC ENEMY

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.

https://www.fws.gov/refuge/Humboldt_Bay/wildlife_and_habitat/InvasiveSpeciesManagement.html

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://staugustine.com/news/local-news/2012-10-18#

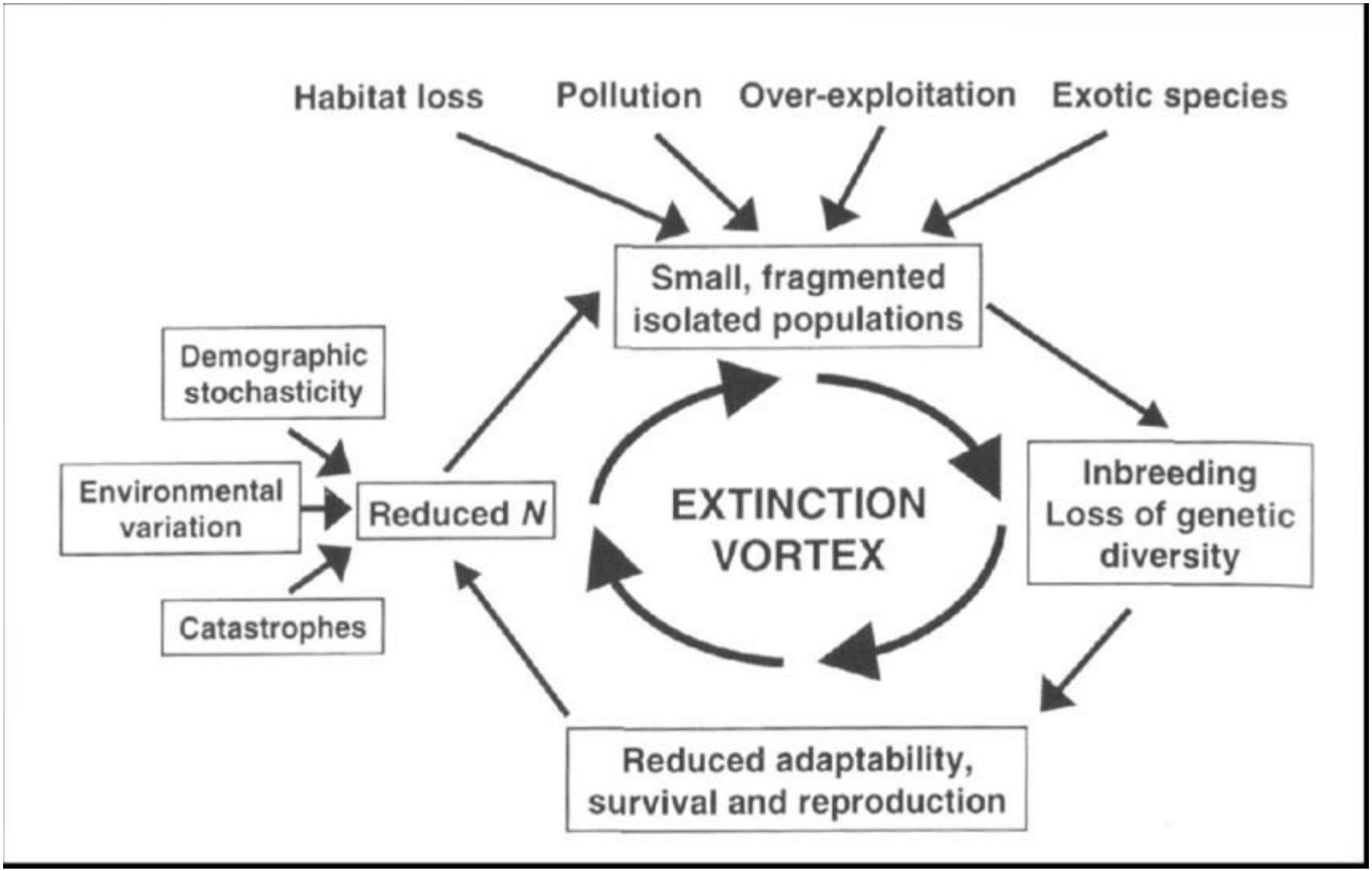
http://solveoregon.org/why-we-care/invasive-plants

http://oak.ppws.vt.edu/~flessner/weedguide/puelo.htm
http://arcofappalachia.org/events/invasives-info.html
http://www.centralalgomafreshwatercoalition.ca/threat-details.php?Aquatic-Invasive-Species-2

http://www.inwoodlands.org/invasive-vegetation-control/

http://www.alamy.com/stock-photo-aerial-view-north-east-of-morrisons-supermarket-suburban-housing-epping-14683259.html

http://www.srs.fs.usda.gov/compass/2012/12/19/srs-scientists-contribute-to-new-national-report/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Exotic species
Small, fragmented isolated populations
Demographic stochasticity
Environmental variation
Catastrophes
Reduced N
EXTINCTION VORTEX
Inbreeding Loss of genetic diversity
Reduced adaptability, survival and reproduction

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