

Buckthorn Research Overview

Community and Residential Approaches to Managing Invasive Buckthorn



Research Objective

- **Ecology**
 - What impacts do buckthorns have on ecosystems?
 - Competition with native plants
 - Concerns about soil nutrient fluxes
 - Concerns about water quality
 - Herbivore survival and fitness
 - Concerns about impact on soil organisms
 - Microbes, native & exotic earthworms

Research Objective

- **Management**
 - Physical removal technologies
 - Cultural/Horticultural Practices
 - Herbicide technologies
 - Biological control agents



Research Objective

- **Restoration**
 - Removal of buckthorn
 - Reduced impacts of buckthorn invasion
 - Increased diversity of native species
 - Return of ecosystem to “native state”



Ecological Impacts

- Competition with native plants
 - As understory and edge species they do restrict light penetration to native herbaceous species.
 - They will also compete for water and nutrients.
 - Prolific seeding, shade tolerance and early and late season photosynthesis allows for “gap” competitiveness.

(Knight et al. 2007)



Ecological Impacts

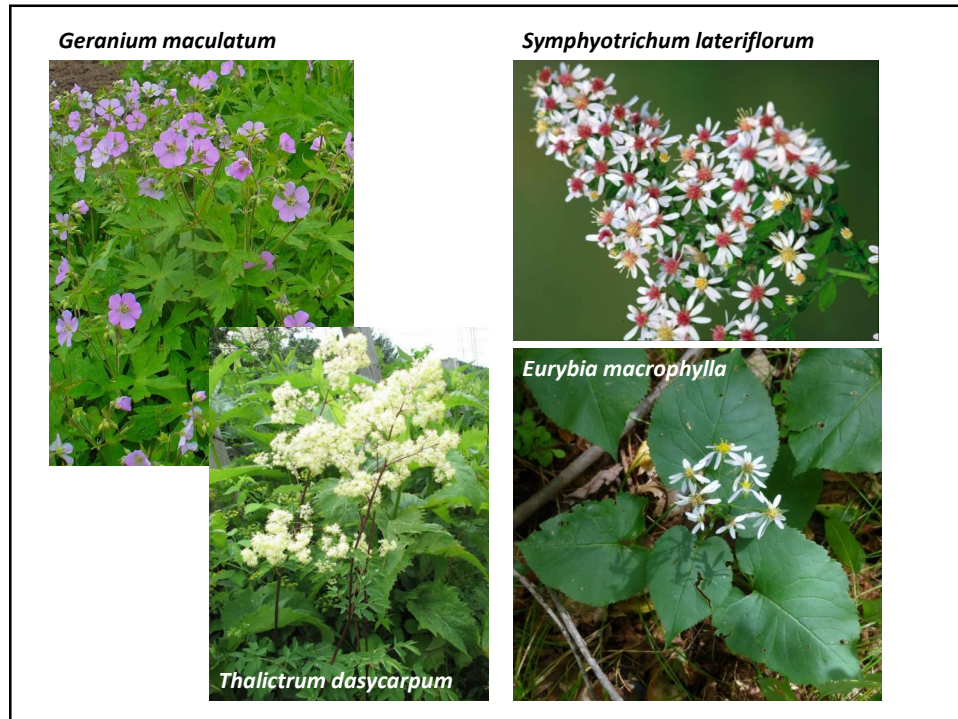
- Competition with native plants
 - Is there more to the story?
 - Allelopathic effects...
 - Exudates from the roots, bark, and leaf litter had **no** effect on seed germination (tomato, radish, lettuce)
 - Leaf exudates reduced alfalfa seed germination to 58% while fruit exudates reduced germination to < 1%

(Archibold et al. 1997; Seltzner and Eddy 2003)

Ecological Impacts

- Competition with native plants
 - There is more to the story
 - Four native Wisconsin forbs performed better in soils without any history of buckthorn.
 - Seedling survival, seedling height, and flowering percentage was reduced in sites currently infested and in soils that had previously been infested.
 - This was in direct contrast to soil nutrient status of the soils which were higher in buckthorn infested sites.

(Klionsky et al. 2011)



Ecological Impacts

- Competition with native plants
 - There is more to the story...
 - We still don't know what is causing the reduced response in native forb seedlings.
 - We still don't know how this "allelopathic effect" impacts the soil environment.
 - We still don't know how to remediate the effect.

Ecological Impacts

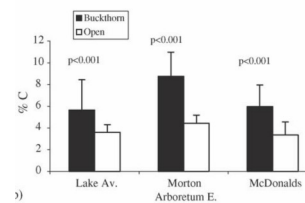
- Impacts on soil nutrients
 - Senesced buckthorn foliage is high in Nitrogen (N)
 - Senesced fruits are also high in Nitrogen (N)*

*As compared to native North American species



Ecological Impacts

- Impacts on soil nutrients
 - Rate of foliage decomposition was increased in buckthorn infested sites
 - pH was higher
 - Total carbon increased
 - Total nitrogen increased
 - Increase in water content

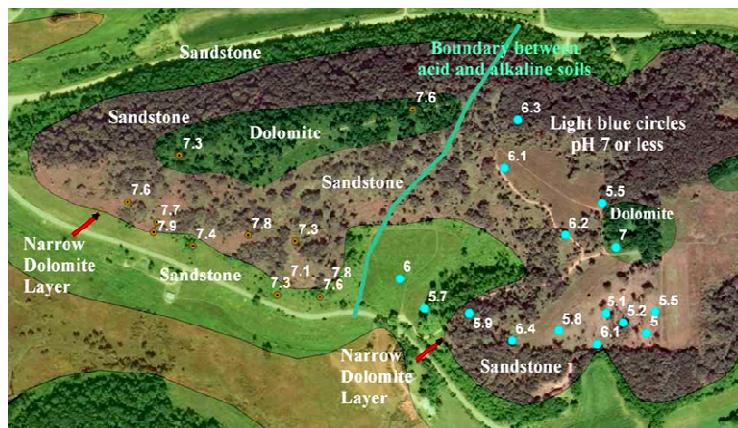


(Heneghan et al. 2004, 2006)



Ecological Impacts

- Impacts on soil nutrients or ...

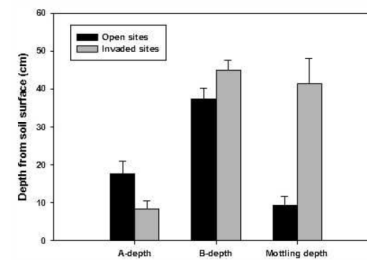


Ecological Impacts

- Soil characteristics that support invasion



Frangula alnus



(Williams & Krock 2012)

Ecology

Heneghan, L., F. Fatemi, L. Umek, K. Grady, K. Fagen, and M. Workman. 2006. The invasive shrub European buckthorn (*Rhamnus cathartica*, L.) alters soil properties in Midwestern U.S. woodlands. *Applied Soil Ecology*, 32 (2006) 142–148.

Knight K. S., J.S. Kurylo, A.G. Endress, J.R. Stewart, and P.B. Reich. 2007. Ecology and ecosystem impacts of common buckthorn (*Rhamnus cathartica*): a review. *Biological Invasions*, 9 (2007) 925–937.

Klionsky, S.M., K.L. Amatangelo, and D.M. Waller. 2011. Above- and belowground impacts of European Buckthorn (*Rhamnus cathartica*) on four native forbs. *Restoration Ecology*, 19 (2011) 728–737.

Williams, C.E., and S.L. Krock. 2012. Patchy invasion of riparian savannas by *Rhamnus frangula* L. in northwestern Pennsylvania: Is soil drainage a factor? *Castanea*, 77 (2012) 318–326.

Research Objective

- **Management**
 - Physical removal technologies
 - Cultural/Horticultural Practices
 - Herbicide technologies
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Management Research

- Physical Control & Horticultural Practices



Management Research

- Cultural control of buckthorn
 - Adding buckthorn mulch to soils, whether tilled or not, did not decrease either buckthorn reinvasion or soil N availability.
 - Mechanical tilling reduced reinvasion by killing small buckthorn (< 5 cm tall).
 - New seedling rate decreased over time, suggesting that buckthorn seeds are short-lived.

(Iannone et al. 2013)

Management Research

- Herbicide Technologies
 - Standard Stump Treatments



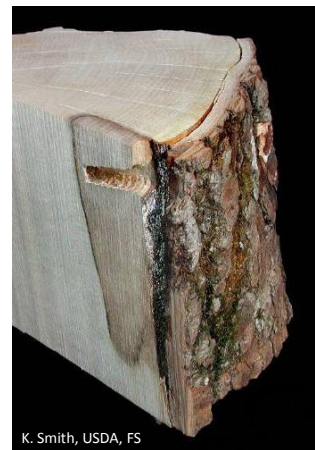
Management Research

- Herbicide Uses
 - Fall (October) Stump Treatments
 - % control increased with glyphosate concentration
 - Increased efficacy with glyphosate on buckthorn growing in dry soils
 - 98% control at 41% concentrate
 - Decreased efficacy with glyphosate in moist soils
 - 60% control at 41% concentrate

(Dornbos & Pruim 2012)

Management Research

- Herbicide Technologies
 - Xylem injection systems
 - Herbicide contained in tree
 - Reduce collateral damage
 - Tree injection
 - Stump injection



K. Smith, USDA, FS



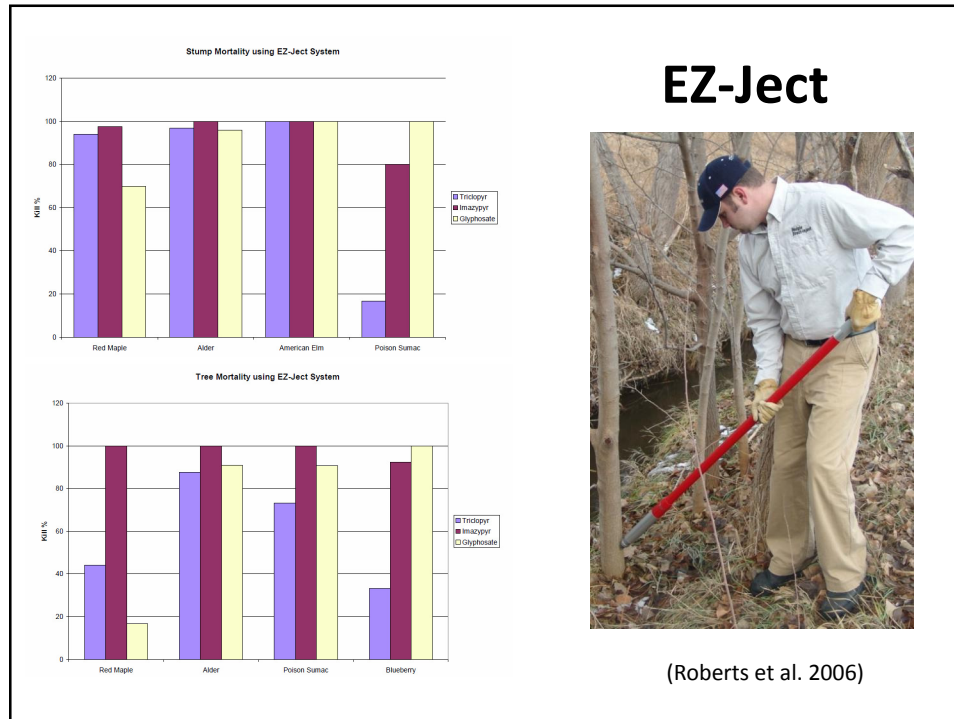
Diamondback
HERBICIDE SHELLS

Glyphosate

Copperhead
HERBICIDE SHELLS

Imazapyr





Management Research

- Biological Control
 - Stem and root borers (3 species)
 - Sap suckers (3 species)
 - Defoliators (5 species)
 - Fruit and seed feeders (1 species)
- Issues with specificity
 - Insects also feed on native North American buckthorn
- Issues with pathogenicity
 - Species vectored phytoplasma that could infect natives



(Gassmann & Tosevski 2013)

Management Research

- **Biological Control?**
 - Silver Leaf Disease



Management Research

- **Biological Control**
 - Chontrol Peat Paste (*Chondrostereum purpureum*)
 - Reduced re-growth of girdled buckthorn treated in early spring when wet conditions favored infection.



(Au & Tuchscherer 2014)

Management

Roberts, M., A. Smith, M. Cornman, D. Kline. 2006. Effects of Triclopyr, Imazapyr, and Glyphosate on Woody Vegetation in Potential Bog Turtle Habitat. Biological Opinion the US Fish and Wildlife Service. 44pp.

Dornbos Jr., D.L. and R. Pruim. 2012. Moist soils reduce the effectiveness of Glyphosate on cut stumps of buckthorn. Natural Areas Journal, 32 (2012) 240-246.

Iannone III, B.V., L.G. Umek, L. Heneghan and D.H. Wise. 2013. Amending soil with mulched European Buckthorn (*Rhamnus cathartica*) does not reduce reinvasion. Ecological Restoration, 31 (2013) 264-273.

Gassmann, A. and I. Tosevski. 2014. Biological control of *Rhamnus cathartica*: is it feasible? A review of work done in 2002–2012. J. Appl. Entomol., 138 (2014) 1–13.

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Research Objective

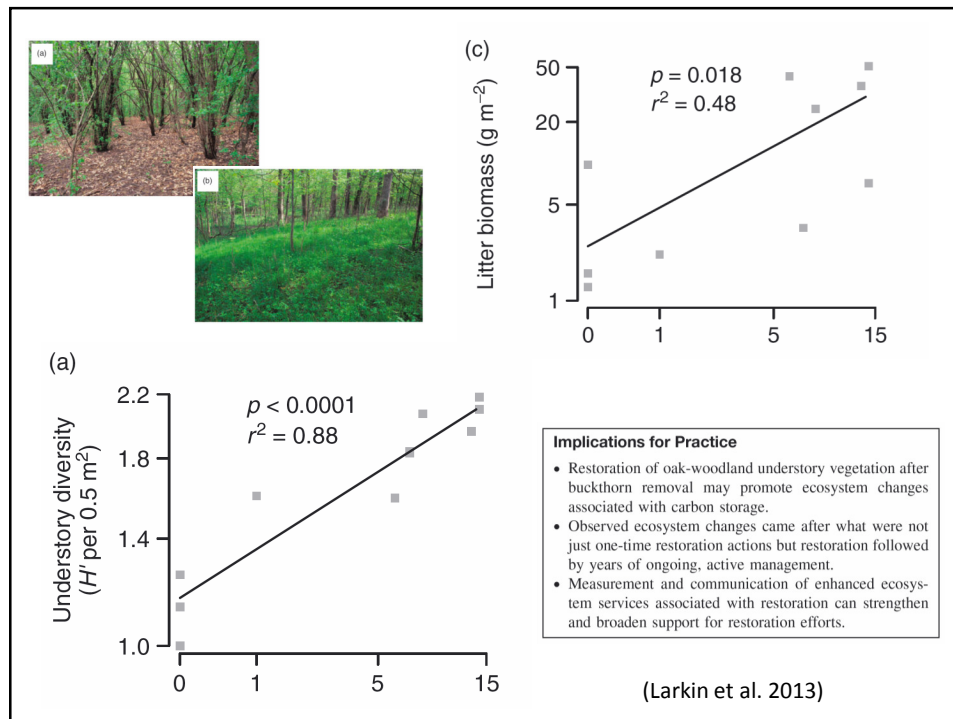
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Restoration Research

- **Restoration** (Is it possible to bring it back?)
 - Studies examine invasion after 15 years
 - Higher understory plant diversity and cover
 - Higher litter mass
 - Slowed rates of organic matter turnover
 - Evidence of reduced soil erosion

(Larkin et al. 2013)



Restoration Research

- Invasion/reinvasion potential
 - Existing bare soil
 - Overhanging trees for bird perches
 - Plenty of light availability
 - Open canopies or gaps in canopies
 - Edge effects (construction/disturbance)
 - Low diversity of native plant species
 - Especially grasses for glossy buckthorn

(Fiedler et al. 2012, Whitfeld et al. 2013, Liu & Swanson 2014)



Restoration

Fiedler, A.K. and D.A. Landis. 2012. Biotic and abiotic conditions in Michigan prairie fen invaded by glossy buckthorn (*Frangula alnus*). *Natural Areas Journal*, 32 (2012) 41-53.

Whitfeld, T.J.S., A.G. Lodge, A.M. Roth and P.B. Reich. 2013. Community phylogenetic diversity and abiotic site characteristics influence abundance of the invasive plant *Rhamnus cathartica* L. *J. Plant Ecol.* (2013) doi: 10.1093/jpe/rtt020

Larkin, D.J., J.F. Steffen, R.M. Gentile, and C.R. Zirbel. 2014. Ecosystem changes following restoration of a buckthorn-invaded woodland. *Restoration Ecology*, 22 (2014) 89-97.

Liu, M. and D.L. Swanson. 2014. Physiological evidence that anthropogenic woodlots can substitute for native riparian woodlands as stop over habitat for migrant birds. *Physiological and Biochemical Zoology*, 87 (2014) 183-195.

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