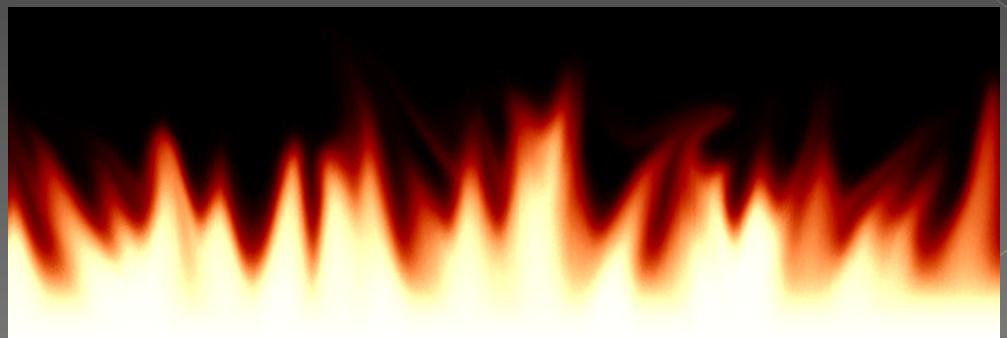
Fire and Invasive Plants

Ellen M. Jacquart
The Nature Conservancy of Indiana



Fire and Invasive Plants Interactions

1. Effects of fire on invasive plants
2. Effects of invasive plants on fire
3. Spread of invasive plants through fire operations.

Impact of Fire on Invasive Plants

- In general, fire does not recognize any difference between native and non-native plants
- Many native species experience increased recruitment and growth in response to fire – expect the same for invasives (Glasgow and Matlack 2007)

Impact of Fire on Invasive Plants

- In a survey of fire research around the world, D'Antonio (2000) found 54 studies in which fire influenced distributions of non-native species. The great majority reported an increase in non-native species abundance following fire; in only 11 cases did fire reduce or eliminate the invasive species.

Impact of Fire on Invasive Plants

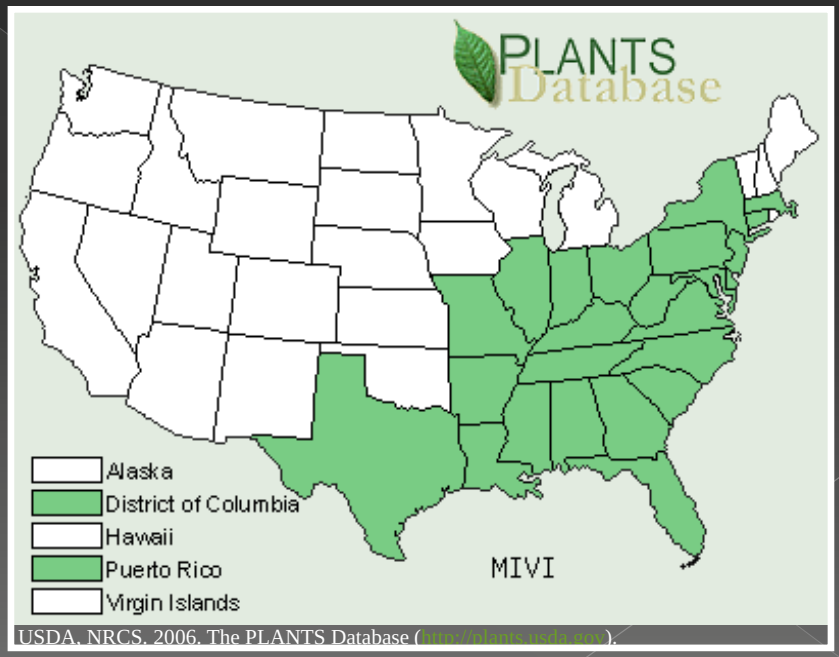
- Size / Age of individual is important
- Growth stage is important
  - Dormant
  - Actively growing
- Growth habit is important
  - Annuals and biennials
  - Perennials – grasses and forbs
  - Perennials – woody

Annuals and Biennials

- Thrive on disturbance, particularly one that clears a seed bed and increases light availability.
- Examples:
  - Japanese stiltgrass
  - Garlic mustard
  - Sweet clovers

Microstegium vimineum (Japanese stiltgrass)

- Annual grass
- High seed production
- High density growth

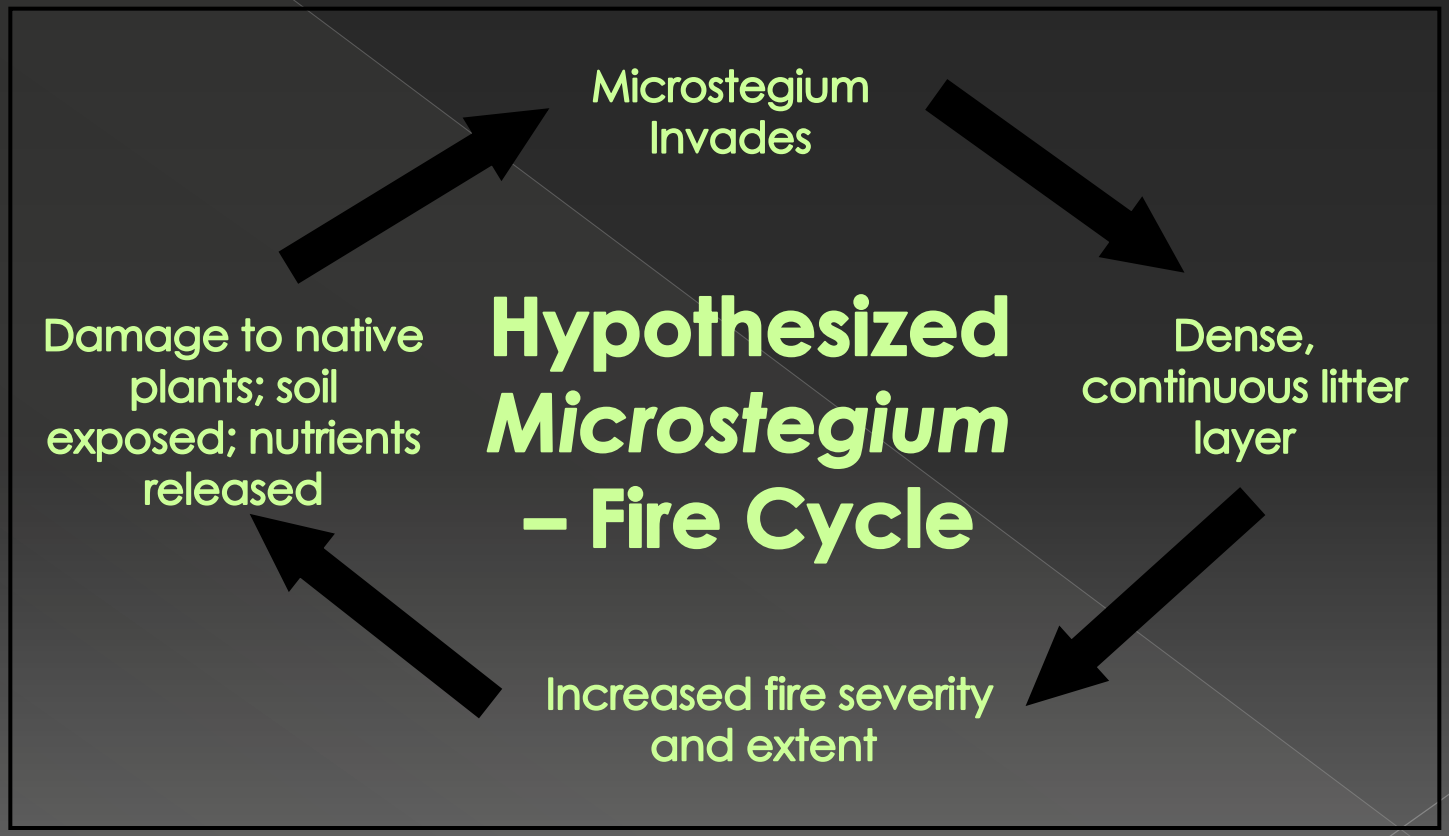


USDA, NRCS. 2006. The PLANTS Database (http://plants.usda.gov).

Impact of Fire on Japanese stiltgrass

- Spring fires increased stiltgrass germination.
  - Glasgow and Matlack, Glenn R. 2007. Forest Ecology and Management. 238(1-3): 319-329.
- Spring burns decreased seedling and adult plants, and fall burns decreased seed set; however, both were short term effects with no impact on population growth in the second year.
  - Emery, Flory, et al Forest Ecology and Management, 2013
- No research on growing season fire impacts was found.

Impact of Japanese stiltgrass on fire



Flory et al. 2008 Presentation at Midwest Invasive Plant Network Meeting

Impact of Japanese stiltgrass on fire temperature

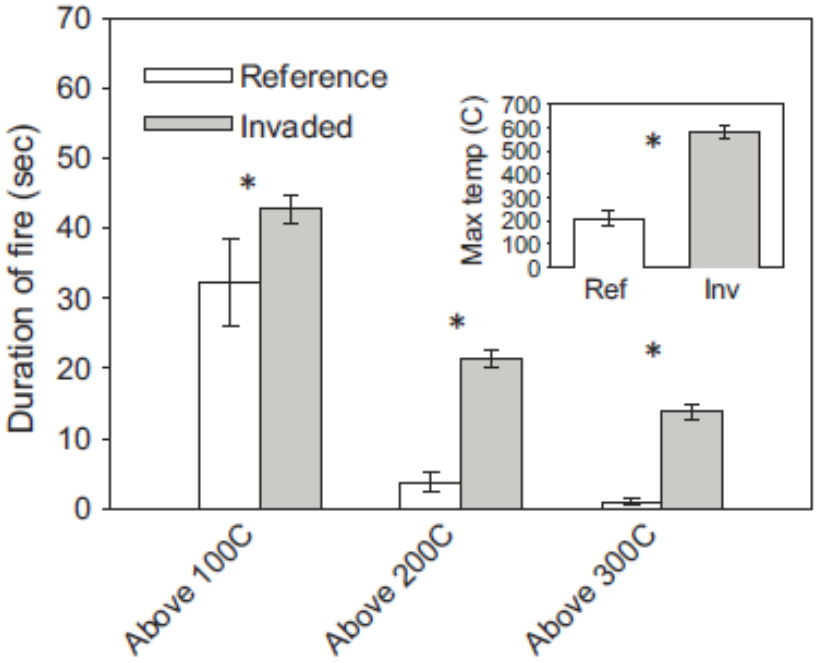


Fig. 2. Duration of prescribed fire temperatures at 100, 200, and 300 °C, and maximum temperature values (inset) in invaded and reference (uninvaded) sites. Asterisks (*) indicate significant differences at the $p = 0.05$ level. Error bars represent ± one SE.

Emery Uwimbabazi and Flory Forest Ecology and Mgmt 2011

Impact of Fire on Garlic Mustard

- Mixed results .
- Several studies have found that mid intensity dormant season fires can top kill garlic mustard rosettes; however, there are dormant buds below the surface that can later resprout.
- “The alien herb garlic mustard also persisted and had greater abundance in burned plots, apparently by re-colonizing from unburned microhabitats and adjacent forest.”
  - Bowles et al. 2007 Journal of the Torrey Botanical Society 134(2), 2007, pp. 223–237

Impact of Garlic Mustard on Fire

- If garlic mustard is dense enough, fire will not carry.
  - Nuzzo 1991. Natural Areas Journal. 11(3): 158-167.

Perennials – Grasses and Forbs

- Grasses
  - Cool season –
    - Reed canarygrass
    - Smooth brome
    - Kentucky bluegrass
    - Tall fescue
  - Warm season –
    - Phragmites
- Forbs
  - Canada thistle
  - St. John's wort

Fire has the most impact on perennials when root resources are the lowest.

Impact of Fire on Reed Canarygrass

- Dormant season fire will top kill reed canarygrass, but it appears only high intensity fires will kill the rhizomes.
- If fire occurs when plants have greened up, it may decrease the vigor of the plants (but too much green will stop the fire)
- Fire appears to trigger seed germination.
  - Adams, Carrie Reinhardt; Galatowitsch, Susan M. 2006. Restoration Ecology. 14(3): 441-451.

Impact of Fire on Reed Canarygrass

- Fire will remove the dead biomass and make chemical treatment more effective.

Perennials - Woody

- Trees
  - Tree of heaven
- Shrubs
  - Asian bush honeysuckle
  - Glossy buckthorn
- Vines
  - Oriental bittersweet
  - Japanese honeysuckle

Impact of Fire on Woody Perennials

- Fires at anytime of year may kill above ground woody tissue, depending on
  - Stem diameter
  - Bark thickness
  - Fire intensity (flame length and duration)

Impact of Fire on Tree of Heaven

- The thin bark allows for top kill of even mid-sized trees.
- Thin and spring burn treatment increased tree of heaven from scattered trees to thousands of stems (17.1 stems/100m2)
  - Hutchinson et al. 2004, Proceedings, 14th central hardwood forest conference

Impact of Fire on Tree of Heaven

- Spring burn treatment greatly increased tree of heaven seedlings in WV.

Tree-of-heaven abundance before and after the prescribed March fires [196]

Site	Density (stems/ha)		Importance value*		Basal area (m^2/ha)	
	prefire	postfire year 1	prefire	postfire year 1	prefire	postfire year 1
Heavener Mountain, lower-northeast section, seedlings	0.00	0.00	0.00	0.00		
Heavener Mountain, upper-northeast section, seedlings	0.00	277.78	0.00	0.93		
Dunkle Knob, lower-southwest section, seedlings	0.00	277.78	0.00	0.56		
Dunkle Knob, upper-southwest section, seedlings	0.00	833.33	0.00	2.04		
Dunkle Knob, upper-southwest section, overstory	2.22	2.22	0.56	0.56	0.09	0.09
Dunkle Knob, upper-northeast section, seedlings	277.78	6,388.89**	0.23	14.78**		

*Importance value=(relative density + relative basal area)/2

**Significant difference between years ($P<0.05$). Cells are blank where information is not available.

Marsh, Michael A. 2005.Morgantown, WV: West Virginia University. 278 p. Thesis.

Impact of Fire on Asian Bush Honeysuckle

- Most studies show significant resprouting after one or a few fires.
- Significant reduction of Asian bush honeysuckle and common buckthorn (and all other woody understory species) with repeated, low intensity spring fires (17 years of annual burns).
  - Bowles et al. 2007 Journal of the Torrey Botanical Society 134(2), 2007, pp. 223–237

Impact of Asian Bush Honeysuckle on fire

- Depending on stem density, can be difficult to get fire to carry through unit.

Impact of Fire on Oriental Bittersweet

- In Massachusetts, dormant burns decreased cover.
  - Polatin, Christopher C. 2006. Antioch University New England. 52 p. Thesis.

Mean percent difference (SD) in Oriental bittersweet cover (%) on early- and late-season treatments from cover on control treatments on Naushon Island [126]

Treatment	Early season	Late season
Control	6.3 (11.6)	14.6 (6.0)
Burn	-8.3 (6.7)	-25.0 (5.9)
Mow	-8.3 (9.7)	+8.3 (6.8)
Herbicide	-50.0 (6.4)	-72.9 (9.0)

Impact of Fire on Oriental Bittersweet

- At Indiana Dunes N.L., spring dormant burn and cut and burn significantly decreased cover, and significantly increased number of stems <2.5cm.
  - Pavlovic et al. 2011 Report to the Joint Fire Science Program.

Summary

- It all depends.
- Fire can sometimes help reduce invasive plant cover if timed appropriately and repeated frequently (Asian bush honeysuckle).
- For some invasive plants, fire of any kind appears to greatly increase cover (Japanese stiltgrass, tree of heaven). For these, control should take place before managing with fire.