

# Controlling Non-native Cool-season Grasses (NCGs)

in

Prairie Remnants and  
Restorations



# What is a cool-season plant?

- C3 photosynthetic pathway
- Prefer moist and cool conditions
- Most plant species



# What is a warm-season plant?

- C4 photosynthetic pathway
- Efficient in hot and dry conditions
- Relatively few plant species



# Photosynthesis



Sugar = chains of carbon

C3 plants = make 3-atom carbon-chain sugars

C4 plants = make 4-atom carbon-chain sugars





# C3 plants

most efficient at making sugar under

- Cool temperatures  
(heat reduces efficiency of their enzymes)
- Moist conditions  
(transpire more water per sugar made)
- Moderate light levels  
(high light reduces their enzyme efficiency)

Productive in spring and fall



# C4 plants

more efficient under high light and heat conditions

- Extra enzyme
- Faster photosynthesis at high light and heat
- Therefore, less water loses per calorie of sugar made

Productive in heat and drought of summer



# Invasive, non-native, cool-season grasses

- Kentucky bluegrass (*Poa pratensis*)
- Smooth brome (*Bromus inermis*)
- Quack-grass (*Elytigia* [*Agropyron*] *repens*)
- Red-top, bent-grass (*Agrostis* spp.)
- Reed canary-grass (*Phalaris arundinacea*)
- Timothy (*Phleum pratense*)

Not foxtails



# Using Fire



Photo by R. Oberle



Photo by K. Agee

# To Control NCGs





# Direct Effects of Fire

- Kills above ground tissue
- Removes accumulated litter layer (sun light)
- Volatilizes N & S
- Leaves behind P, K, and other nutrients



# Indirect Effects of Fire

- Reduced soil moisture
- Increased soil/micro-climate temperature
- Shortened cool-season
- Lengthened warm-season
- Reduced available N over time



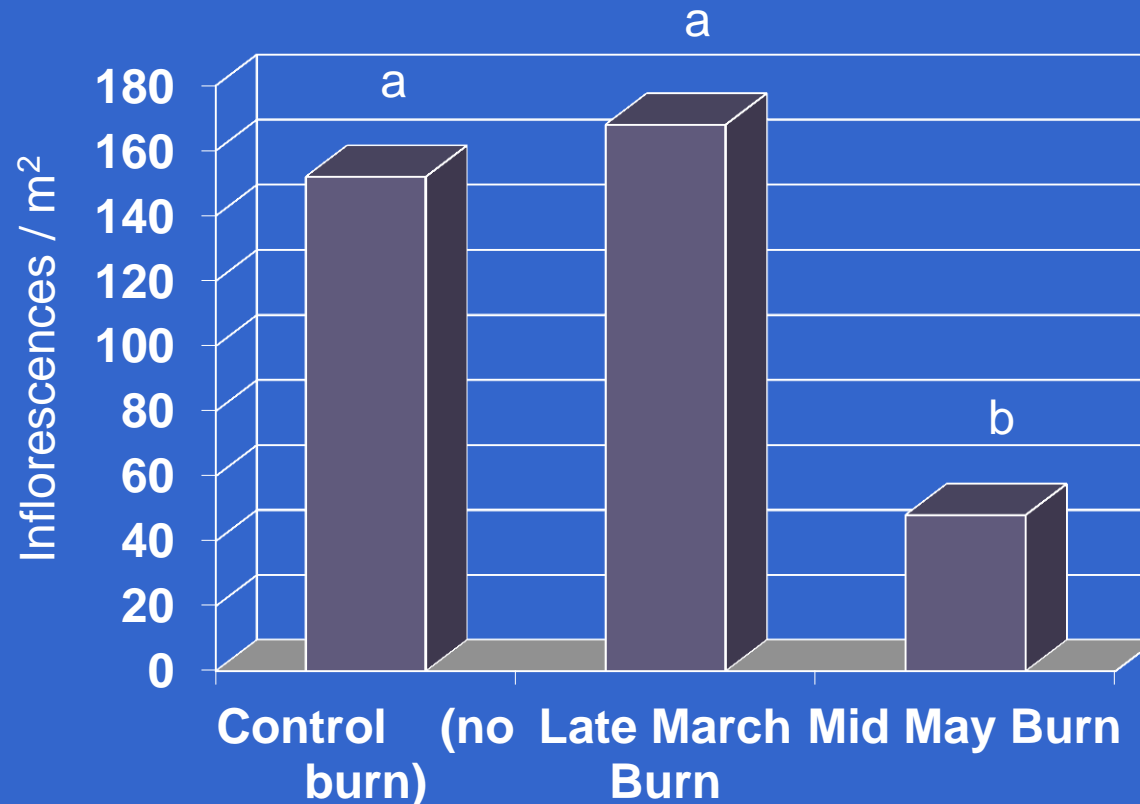
# Fire Variables that Determine Fire Effect

- Intensity
- Frequency of Occurrence
- Seasonal Timing



# Kentucky bluegrass **Flowering**

after one burn in a dry-mesic prairie



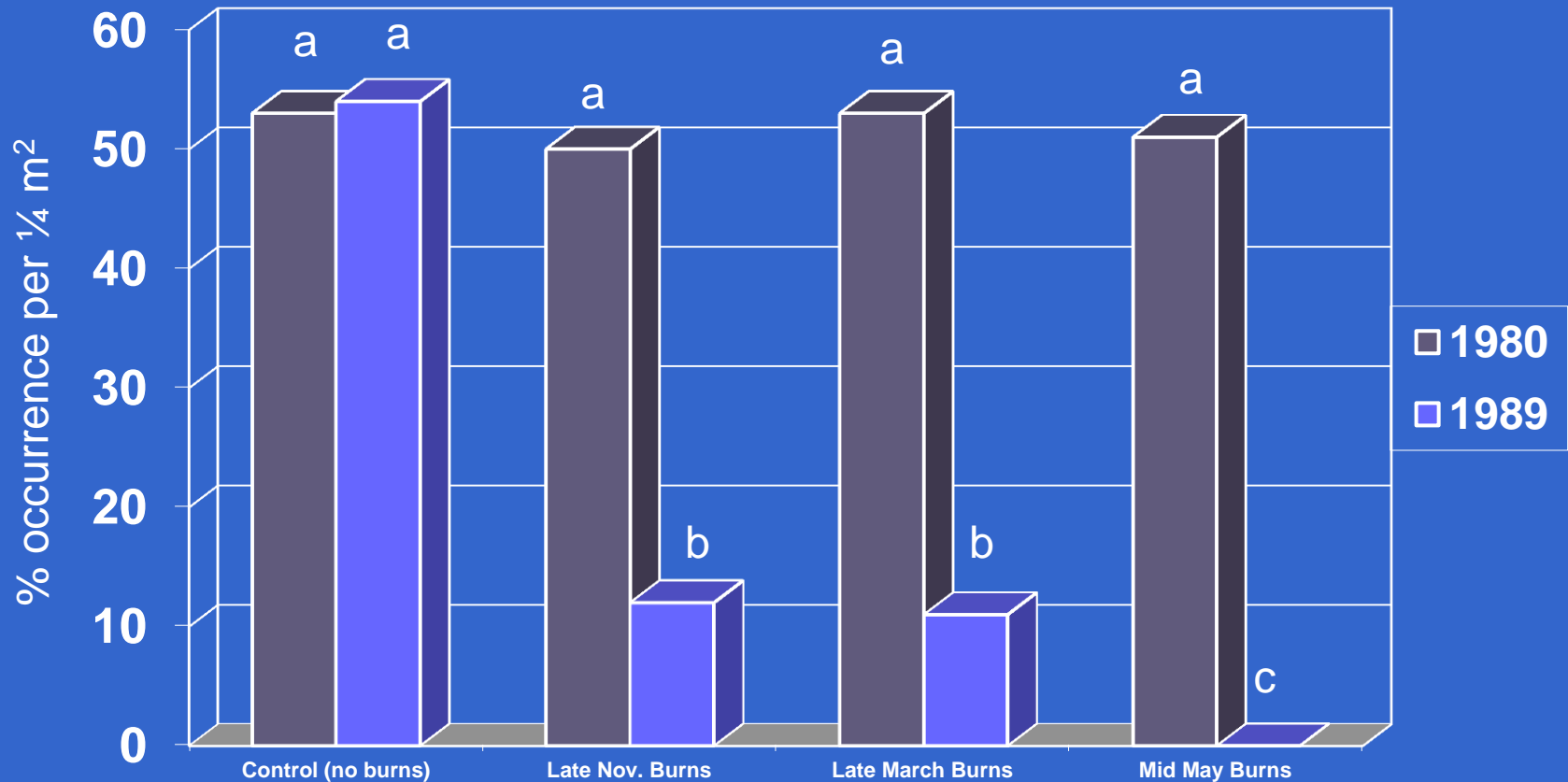
(Henderson et al. 1982)





# Kentucky bluegrass Frequency

after burning 8 out of 10 years in a dry prairie



(Henderson 1990)



# Smooth Brome after an Early-May Burn



Burned

Un-burned





# Reed canary-grass

- early-spring burns
- annually
- 20 years
- cord-grass invading
- @ 6" per year



October 24



# Reed canary-grass after a late-spring burn

Un-burned



August 5

Burned June 3



# Caution

There are many native cool-season species in prairie

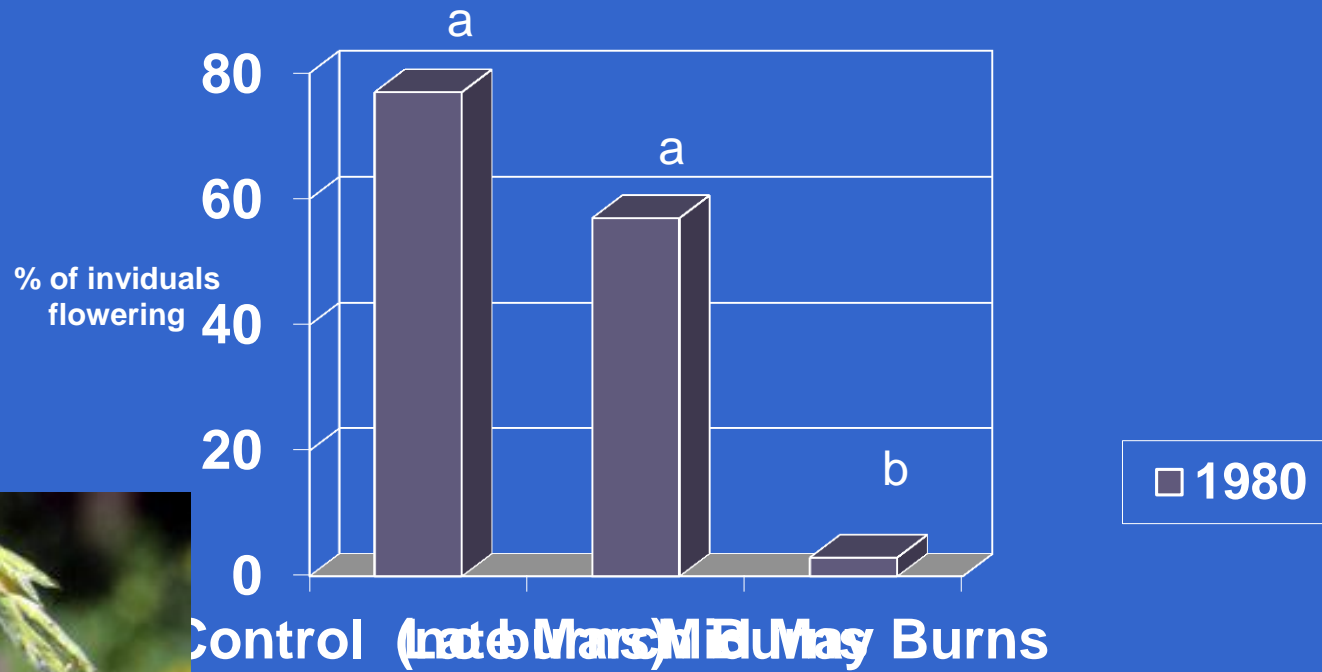
All sedges, most forbs, and some grasses

They too can be harmed and eliminated  
by mid- and late-spring fire



# *Bromus kalmii* Flowering

after one burn in dry-mesic prairie



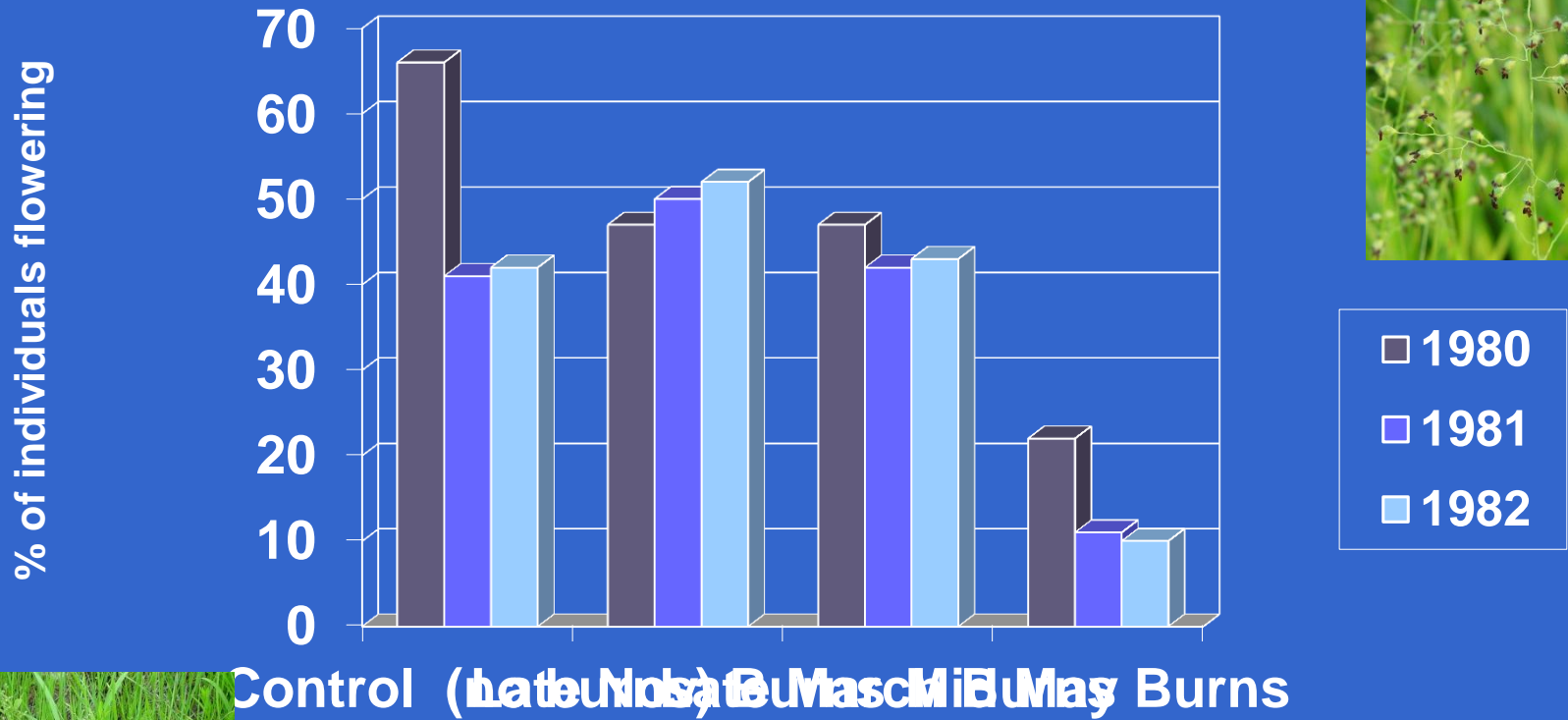
Prairie Restorations, Inc.

(Henderson 1981)



# *Panicum leibergii*-*oligosanthes* Flowering

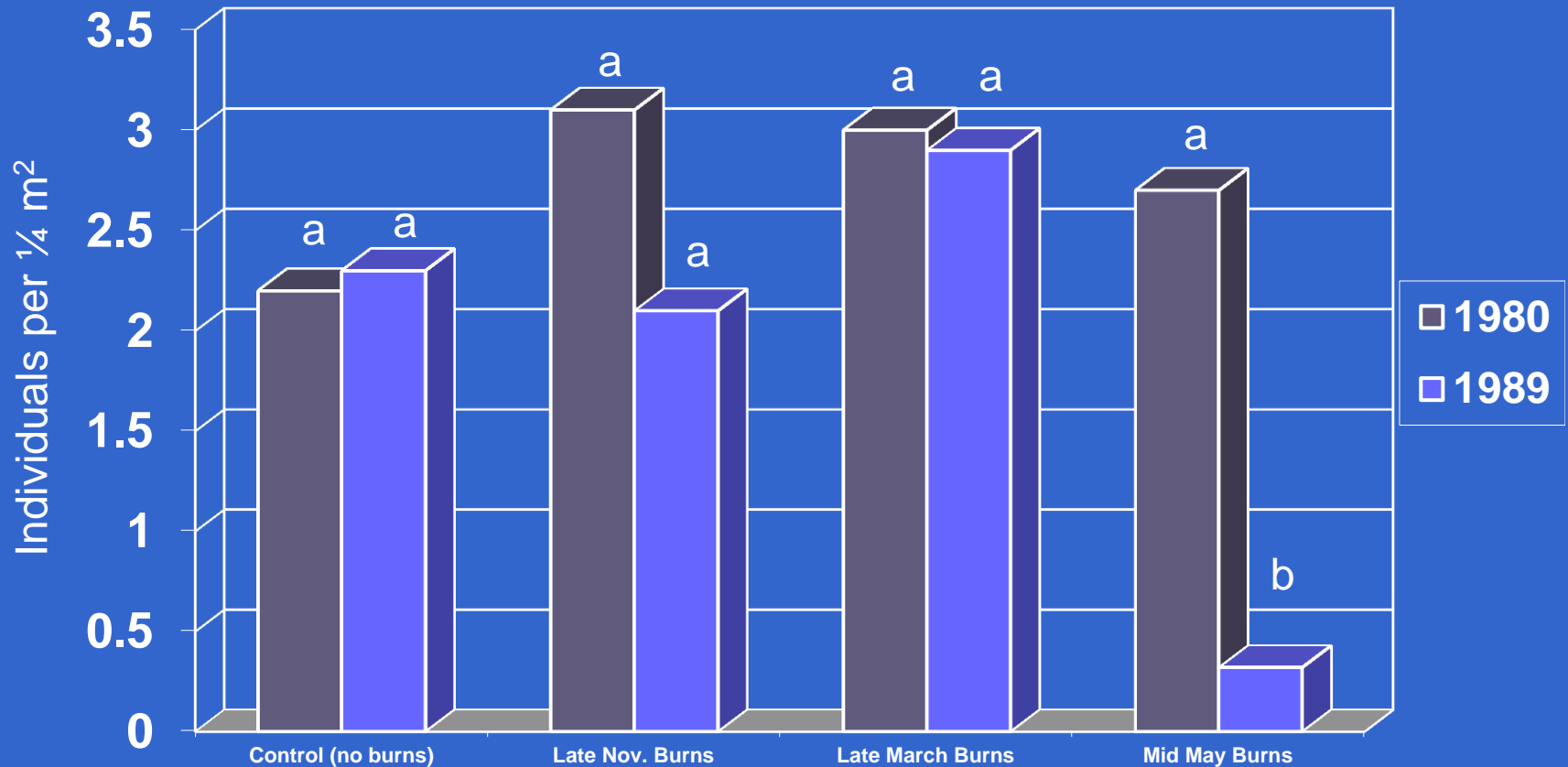
annual burning for 3 years





# *Panicum leibergii-oligosanthes* Density

after burning 8 out of 10 years in a dry prairie



(Henderson 1990)





# Mid Summer Fires?

- Greatest stress to trees & shrubs
- Suppress/weaken warm-season grasses
- Can increase growth/vigor of cool-season species: native & non-native

July 27 burn



\*Releases suppressed, non-native, cool-season grasses



# Herbicide Application

## Glyphosate

- Can release natives when timed right & natives hidden under NCGs and litter
  - Prairie remnants over taken by invasive cool-season grasses
  - New plantings affected by non-native cool-season grasses
- May kill early-season natives
  - Some natives over winter with green leaves
  - Some natives green up with the non-native cool-season grasses



# Example early-season natives

overwintering with green rosettes or leaves

- *Antennaria* spp. (pussy-toes)
- *Geum triflorum* (prairie smoke)
- *Panicum* spp. (panic-grasses)
- *Stipa spartea* (needle-grass)
- *Valeriana edulis* (valerian)
- *Viola pedata* (bird's-foot violet)



# Example early-season natives

with early green-up, but no overwintering leaves

- *Bromus* spp. (native brome grasses)
- *Camassia scilloides* (wild hyacinth)
- *Carex* spp. (sedges)
- *Dodecatheon meadia* (shooting star)
- *Pedicularis candensis* (wood betony)
- *Ranunculus* spp. (buttercups)
- *Zizia* spp. (golden Alexanders)



# Fire vs. Timed Herbicide

- Fire can be as effective, but slower (takes years)
- Fire has less risk to early-season natives



# Grazing

To control cool-season grasses

- In simple systems?
- In remnants & diverse restorations?



# Restoration by Inter-Seeding

- Requires weakening of invasive cool-season grasses by fire
  - facilitates establishment of native seedlings
  - stimulates/releases latent/suppressed plants
- Requires repeated burning
- Requires repeated seeding
- Seasonal timing of fire is important





# Sugar River Savanna

A 30-year trial case  
of  
inter-seeding

The  
Prairie  
Enthusiasts





# Sugar River Savanna - 1975

- Never plowed
- Grazed hard for 130 years
- 85% of the native plant species either gone, or only a few individuals remaining
- Dominated by non-native cool-season grasses
  - Kentucky bluegrass
  - Quack-grass
  - Red-top
  - Timothy
  - Smooth brome



# Inter-seeding Experiment Begins 1976

- Burned in early spring – annually for 33 years  
(missed 1 out of 33)
- Seed scattered by hand
  - seed planted, as collected or some held over to next spring, after each burn
  - repeated seeding over 15 years
- No herbicide
- No raking the soil
- No mowing
- Hand pulling of parsnip and sweet-clover





30 years later



































3 8 2004





- Keystone species?
  - Wood betony (*Pedicularis canadensis*)
  - Northern bedstraw (*Galium boreale*)
  - False toadflax (*Comandra umbellata*)
- Stop burning and non-native cool-season grasses will come back!
- But, does not have to be annual burning to maintain.





Controlling non-native  
cool-season grass is the  
first step in bringing back  
prairie & savanna

3 8 2004

