IPM Techniques

Concrete ways to use less herbicide but still get similar control
Why should we even care?

- **Mission statements**
  - Florida Park Service: to provide resource-based recreation while preserving, interpreting and restoring natural and cultural resources.
  - Florida Forest Service: to protect and manage the forest resources of Florida, ensuring that they will be available for future generations.
  - Florida Fish and Wildlife Conservation Commission: to conserve fish and wildlife resources for their long-term well-being and the benefit of people.

- **Public perception**
- **Good stewardship**
Basic Procedural Changes

- General theme: trade sweat for herbicide, and think small
- Smallest delivery device possible
- Don’t be a vector!
- Catch it small(er)!
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From: Lastinger and Enloe
Basic Procedural Changes

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From: Invasive Species Decontamination for Field Operations in Michigan
Basic Procedural Changes

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  - 50% of time could be devoted to monitoring (Maxwell et al 2009)

Figure 4. An example of a simulated meander (Model 10 in Table 5).
Figure 6. Histograms depicting the mean (red line) and standard error (blue dotted lines) of 100 simulations under each of the 12 models of invasive plant cover and sampling effort. Management zone invasive plant cover is listed on the right y-axis, and the sampling effort (number of random points) is on the top x-axis.

The spread of invasive plant cover values decreases as sampling effort increases, indicating an increase in accuracy of invasive plant cover estimates.
Basic Fire Overview

• Global herbivore to remove vegetation (Bond and Keeley 2005)
  • Access to survey
  • Access to treat

• Actual control of invasives really varies by species (Brooks and Lusk 2008, Gordon 1998, Zouhar et al 2008)

• Two general types of interactions between invasives and fire:
  • the effects of the invasive plant on fire regime
  • the impacts of fire on the invasive plant itself

• Resources
  • Fire Effects Information System
  • Southern Fire Exchange’s Terrestrial Invasive Plants and Fire
Chinese tallow- what does the literature say?

- Growth rate: 2.8 m tall (from seed) and more than 5.5 m (resprouts) in the first two years (Scheld and Cowles, 1981)
- Impacts to fire: altering the fuel bed structure and moisture content, decreasing the chance that fuels will ignite and carry fire (Meyer 2011, Zouhar et al 2008).
- Grass and forb cover declines by half in the 6-10 year age class of tallow (Bruce et al 1995).
- Flatwoods are more invadable than savanna (Fan et al 2021)
- All this translates into needing to treat the tallow within first 5 years of infestation to reduce its impact to fire regime.
Data on how size classes are affected by fire

- Adaptations to fire: thicker bark, rapid re-growth in the season following fire and root sprouting (Grace 1998, Meyer 2011)
- Mature trees typically survive prescribed fire, but some mortality
  - Less than one inch in diameter (Meyer 2011)
  - Less than 2 m tall= 70% (top) killed the SECOND growing season (Grace 1998)
    - Not much effect from dormant season fire
  - Up to 2 meters of re-growth in a single growing season, root suckers up to 5 meters away with both fire and mechanical treatment (Grace 1998)
Data on how fire affects recruitment

- Variable effects on germination - Some studies show a decrease from a recent burn or very frequent fire (Burns and Miller 2004, Yang et al 2019) but some indicate an increase from regular fire (Samuels 2004, Yang 2019).
- Fire-damage increases invasion risk, but only in areas that already had higher invasion levels (Gann et al 2009)
- Translation: effects on recruitment probably depend heavily on fire behavior and frequency. Severe fires (e.g. a disturbance to our normal disturbance regime) likely promote tallow, but frequent, lower intensity fires do not
Chinese tallow - take home points

• Use growing season fire to kill smaller plants (less than 2m tall or 1 in dbh)
• Burn at the lower end of your FRI for the natural community and try to target windows where you can safely burn hot without damaging natives
• First year post-fire: hack-n-squirt surviving trees 1-3 months post fire
• Second year post-fire: Hand removal of new germinants before herbicide treatment of resprouts
Chinese tallow - example scenario

Basal bark, no fire = 5-10 gal triclopyr  Hack and squirt following fire = 27 oz imazapyr

- 100-acre field
- 50% cover in patches
- 2.5 infested acres
- Sm = juvenile trees
- Med = 100 3-in trees
- Lg = 60 6-in trees and 1,000 3-in trees
Brazilian pepper- what does the literature say?

- Reduces fire temps by up to 200 degrees C (Stevens and Beckage 2009)
  - ~50% chance of mortality on stems less than 1 cm, 25% for 2 cm.
  - None of sites with more than 2 fires in 20 years had been invaded by pepper.
- Most individuals > 1 m in height resprout following fire (Loope and Dunevitz 1981)
- Seeds are not heat tolerant at all (Nilsen and Muller 1980)
- Low density populations can be eliminated w/ FRI of 4 years or less (Stevens and Beckage 2010)
  - Fire reduced number of fruits produced for 2 years, but individual resprout quickly
Brazilian pepper - take home points

- Use growing season fire to kill smaller plants (less than 1m tall or 1-2 cm dbh)
- Burn at the lower end of your FRI for the natural community and try to target windows where you can safely burn hot without damaging natives
- First year post-fire: foliar or basal bark of all individuals
- Second year post-fire: survey and do hand removal project if needed
- Smaller window to effectively use fire, so frequent surveys are even more important in BP management
Climbing ferns - what does the literature say?

- Can potentially increase fire intensity or spread (Hutchinson 2010)
- Spores are killed by anything over 110 degrees C for 5 or more seconds (Sebesta 2016)
- Existing individuals are top-killed (Munger 2005)
Climbing ferns- what does the literature say?

- Japanese climbing fern (JCF) growth was greater in the year immediately after fire, there was no significant difference at two years (Leichty et al 2011)
- Higher fuel load reduced number of JCF fronds at 6 months, but no difference at 12 months (Carmichael 2012)
- Old world climbing fern (OWCF) recovers in 12-24 months (Hutchinson 2010)
  - Following up with regular herbicide treatment reduced cover by 99% after three years
- Burning OWCF-infested marsh after treatment increased species richness and diversity but most of these increases came from non-native species (Hutchinson and Langeland 2010)
Climbing ferns - take home points

- Short term reductions on growth, but they recover by the second season
- Follow up fire w/herbicide treatment w/in first year to maximize impact, continue w/ annual treatments
- Hotter burns If safe to do so, but only if ladder fuels aren’t a concern (e.g. natural community type is tree-limited or the infestation is small enough)
Cogon grass—what does the literature say?

Cogon has several well documented impacts on fire regimes, primarily through increasing fuel loads and fire intensity and decrease fire return intervals:

- Increases fire temperatures by 150 degrees C (Howard 2005, Jose et al 2002)
- Halves soil moisture (Jose et al 2002)
- Increases biomass by 1.7 times (Platt and Gottschalk 2001)

From: xkcd web comics
Cogon grass- what does the literature say?

• Extensive rhizome structure allows it to rapidly resprout after a fire (Howard 2005, MacDonald 2004).
• Double the vegetative spread in burned vs. unburned plots in Mississippi (Yager 2007)
• Tiller growth after simulated logging disturbance was 4.5 times than in undisturbed plots (Prevost et al 2010).
• Double the seedling survival rate in burned areas than unburned (King and Grace 2000)
  • Seed viability- about 3 months in natural conditions (Shilling et al 1997)
• Fire alone can reduce coverage in first year, but no effect by second year (Enloe et al 2013).
  • Herbicide treatment of cogon grass reduced its coverage to less than 4% by end of study
• Fire is considered a major factor in cogon grass spread in many parts of the world (Howard 2005)
• Better competitor than native species (Ramsey et al 2003, Daneshgar and Jose 2009)
Cogon grass - how can we use this information?

- Survey - 4 to 12 weeks after fire
  - Especially for late winter/early growing season
  - Shorter window later in growing season
- Hold off on fire if you’ve got lots of small scattered patches (especially if in otherwise good habitat)
- When you do burn, don’t burn when natives are dormant
  - Don’t burn if/when cogon seed source is nearby
Cogon grass - how can we use this information?

- Pre-treatment for older, large/well-established patches, esp in disturbed settings
  - Burn
  - Broadcast
  - Disc
  - Broadcast (thinking about secondary invasions)
  - Spot treatments
Cogon grass- take home points

- Top priority: follow up/spot treatments in regularly burned areas
- Survey just burned areas to catch smaller patches of cogon (4-12 weeks post fire)
- Plan herbicide treatments around your burn schedule to minimize the nearby presence of potential seed sources (means thinking about a year ahead) OR schedule prescribed burns at least 3 months after the season of high seed production (think about what’s across the fire line too)
- Complete fire exclusion usually isn’t an option, so burn at largest FRI you can for the habitat, even pushing a little past max FRI, until you get the cogon under control.
- Burn a little later in growing season for better native response
Basic Hand Removal

Overview

- Regular and systematic surveys are critical to make this effective
- Good volunteer programs are also critical (survey AND treatment)
  - ‘Herd management’ to avoid trampling any desirable species
- Focus on outlier/edge populations, or protecting rare species
- Minimize soil disturbance by getting to them as small as possible
- Candidate species/sizes (both plant and population)
  - Annuals (before they go to seed), small root mass, or seedlings/juveniles
  - Disposal can be an issue
  - Target size should be something that can be finished up in < one day event
  - Considerations: density, extent, # of people, disposal methods, access
<table>
<thead>
<tr>
<th>Species</th>
<th>Survey</th>
<th>Treat</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brazilian pepper</td>
<td>Year round</td>
<td>March- May (most germ in Jan-Feb, so this should cover most of that year’s crop)</td>
<td>Watch for flocks of robins during fruiting. BP will grow faster in open areas than in shaded, so visit those more frequently.</td>
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<tr>
<td>Chinese tallow</td>
<td>Summer and fall</td>
<td>April on (most germ Jan-May with peaks in April or March)</td>
<td>Wider range of germination dates</td>
</tr>
<tr>
<td>Natal grass</td>
<td>Year round</td>
<td>Year round</td>
<td>Weekly visits. Bag all plant material with seeds</td>
</tr>
<tr>
<td>Wright’s nutrush</td>
<td>Late winter/very early spring after dry down</td>
<td>Spring</td>
<td>Wear gloves and long sleeves. Seed banks for a couple years, so need multiple years of visits. Early and late season events to catch any late germinants but prevent seed development in early germinants.</td>
</tr>
</tbody>
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Basic Mechanical Overview

• There is a lot happening belowground that we don’t really understand yet
• Removing aboveground biomass reduces belowground biomass
• Finding that sweet spot between enough leaves to absorb sufficient herbicide to kill roots, and not letting the leaves replenish all the lost below ground biomass
Chinese tallow- what does the literature say?

- More than 2 inches of mulch reduces germination rates (Donahue et al 2004)
- Mechanical treatment in spring, foliar treatment in fall, and growing season fire in second year reduced TPA by >95% (Pile et al 2017)