Buffelgrass Invasion in the Sonoran Desert: What do we stand to lose?

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ACES Conference
Dec. 7, 2010
Chandler, AZ
Facts About Buffelgrass

- Perennial C₄ bunchgrass from Africa/S. Asia
- Individuals can live 20 yrs
- Swollen stem bases allow it to store carbs & survive grazing, drought & fire
- Apomictic & rhizomatous, seeds viable for up to 4 yrs
- Susceptible to cold
- Introduced throughout subtropics; escapes readily
- Fire temperatures 1200-1600 F, 12-18’ flames
History of Buffelgrass Introduction

1940’s
USDA-SCS reintroduces T-4464 from Kenya into South Texas, where it becomes “wonder grass”

1940’s
USDA-SCS plants it at Plant Materials Center in Tucson

1958
USDA & UA range scientists convince Mexican gov’t to convert millions of acres in Sonora to “zacate bufel”

1970’s
discovery of sexual clone jumpstarts aggressive breeding by USDA-ARS & Texas Ag. Res. Station at Texas A&M

1973-1974
Planted at Caterpillar Company’s Proving Grounds

1979
Planted at USDA SCS Plant Materials Center in Tucson

1982-1986
Planted at USDA Santa Rita Exp. Range south of Tucson

1985-1995
USDA-ARS uses to reclaim abandoned farmland in S. AZ

2002-2005
USDA-ARS Crop Germplasm Unit & Texas A&M develop & release “Frio”, now planted in Cananea, Sonora
Ecological Impacts

- Threats to not just TER plant and animal species, but also more dominant & iconic ones (saguaro)
- Compromises to protected lands & conservation
- Undetermined impacts to food webs, nutrient cycling, and the transport, supply & quality of water and sediment
- Food & fiber provisioning (Tohono O’odham, etc.)
- Carbon sequestration in shrubland vs grassland
- Pollination Services
Social & Economic Impacts

• Immediate threats to life & property in urban and exurban areas that now have to plan around a fast-evolving fire risk

• Economic costs including market-based costs
  
  • *decreased property values in infested & increasingly fire-prone areas*
  
  • *losses in tourism revenues with decaying ecological backdrop*
  
  • *escalating weed control and fire suppression budgets across all jurisdictions*
Santa Catalina Mts

The Foothills - Tucson’s “Beachfront” Property
Southern Arizona Buffelgrass Strategic Plan

http://www.buffelgrass.org

- Minimize spread in areas where buffelgrass not yet established
- Implement control priorities based on actual & potential impacts
- Restore treated areas in ways that increase resilience against future invasion
- In areas where control is no longer feasible, mitigate fire risks to life & property
- Motivate legislation aimed at sustaining the control effort
- Create a template for invasive spp mgmt in AZ

Completed Jan 2008
NGO established Nov 2008

- Lindy Brigham, Executive Director, SABCC
- Sarah Smallhouse, Pres., T. R. Brown Foundations
- Jim Kiser, VP, So. Arizona Leadership Council
- Erik Bakken, VP, Tucson Electric Power
- Lisa Lovallo, VP, Cox Communications-SoAz
- Chuck Huckelberry, Pima County Administrator
- Claire Zucker, Pima Association of Govt’s
- Tom Brandhuber, Fire Chief, Pima Rural Metro
- Chuck Hutchinson, SNR, University of Arizona
- Marilyn Hanson, Sonoran Desert Weedwackers
- Rick Brusca, Arizona-Sonora Desert Museum
- Julio Betancourt, U. S. Geological Survey
- Darla Sidles, Supt., Saguaro National Park
- Jeanine Derby, Sup., Coronado National Forest
- Michael Taylor, Deputy Director, BLM, AZ
American bison, long a symbol of our national heritage, graze freely in Yellowstone National Park.

**Losing Ground: The War On Buffelgrass In The Sonoran Desert - April 10, 2010, Tucson**

**Panel 1**
- **Bert Frost**, Associate Director
  Natural Resource Stewardship & Science
  National Park Service
- **Faye Krueger**, Deputy Regional Forester
  Southwestern Region
  U.S. Forest Service
- **Dr. Ned Norris**, Chairman
  Tohono O'odham Nation

**Panel 2**
- **Sarah Smallhouse**
  The Thomas R. Brown Foundations
- **Chuck Huckelberry**
  Pima County Administrator
- **Dr. Richard Mack**
  Washington State University
- **Dr. John Brock**
  Brock & Associates
Buffelgrass Planning & Mitigation on Federal Lands

• Design, implement and monitor/evaluate buffelgrass control treatments across

• 14 national parks, monuments, forests, wildlife refuges & military reservations in 5 federal agencies

• 2-yr project will be used to develop 10-yr mitigation plan and inform annual budgeting and appropriations process for five federal agencies

• Data Management and Decision Analysis Framework in place to execute project and develop 10-yr mitigation plan
Science and Management Priorities for Mitigating the Impacts of Buffelgrass Invasion and Novel Fire Regimes in the Sonoran Desert

First Annual Workshop, May 4-6, 2010 Tucson
### SABCC Data Entry Form

**To Form List | To Project Information**

#### Date of the observation

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<td>Comments:</td>
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#### Location information

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<tr>
<td>Latitude²:</td>
<td>Required</td>
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<tr>
<td>Accuracy³ (meters):</td>
<td>Required</td>
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¹ X coordinate; data must be in decimal degrees and should contain at least 5 decimal places. (Example: -72.99999)

² Y coordinate; data must be in decimal degrees and should contain at least 5 decimal places. (Example: 41.99999)

³ Approximate uncertainty of your GPS unit in meters. We only accept data below 50 meters in accuracy

#### Site Characteristics

<table>
<thead>
<tr>
<th>Diameter of point</th>
<th>The recorded diameter of the area (e.g., buffelgrass point)</th>
<th>Meters</th>
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#### Organism Information

<table>
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<tr>
<th>Buffelgrass (Pennisetum ciliare) ()</th>
<th>Presence</th>
<th>Percent Cover</th>
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<td></td>
<td>Select ...</td>
<td>%</td>
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#### Treatment Information

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<th>Rodeo (glyphosate)</th>
<th>Active ingredient glyphosate (glyphosate)</th>
<th>To control: Not used</th>
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Vulnerability, Risk, & Priority Assessment Associated with Buffelgrass Invasion in the Tucson Basin

**Buffelgrass Suitability**  
**Cumulative Risk**  
**Pathways for Further Spread**

**Treatment Difficulty**  
**Highest Health & Safety Risk**  
**Highest Priority**

**Landcover**  
**Ecological impacts**
State and Transition modeling

Current and previous vegetation state. (with remote sensing and field sampling)

State in time T:
- A: uninvaded
- B: Invaded
- C: Established
- D: Burned

State at time T+1:
- A: uninvaded: T11, T12, T13, T14
- B: Invaded: T21, T22, T23, T24
- C: Established: T31, T32, T33, T34
- D: Burned: T41, T42, T43, T44

Supporting modeling:
- Control techniques and effectiveness
- Habitat suitability modeling
- Fire risk modeling (with HFire)

Iterate through multiple time steps to forecast future state; which will inform adaptive management techniques.
1. Vegetation Dynamics Development Tool (VDDT) state and transition models describing succession and control dynamics for invasive plants
2. Habitat suitability map, including potential spread rates within different habitat suitability classes
3. Map of the initial distribution of the invasive plant(s)
4. Map of planning zones: where and how much management can be distributed across space
5. Map of spread vectors to identify probabilities of new infestations from outside the area
6. Dispersal kernel that describing probability distribution of annual dispersal distances
7. Relative propagule pressure for each invasive plant state defined in state and transition model
8. Mean number of new infestations arriving from outside of study area each year.
9. Spatial prioritization of management actions towards either the largest or smallest known infestations on the landscape
10. Annual budget for each type of management activity stratified by spatial planning zone
View E-NE across the Tucson Basin to the south slope of the Catalina Mountains where 11 buffelgrass patches were measured for rate of spread using aerial photographs taken in different years.
Buffelgrass spread mapped from aerial photographs on south slope of Catalina Mountains

Legend
- Yellow: Plots
- >22 years
- 20-22 years
- 17-20 years
- 16-17 years
- 12-16 years
- 10-12 years
- 8-10 years
- 7-8 years
- 4-7 years
- <4 years

Olsson et al
In Review
Buffelgrass Spread Rates at 11 sites South slope Catalina Mts

Olsson, Betancourt, Marsh & Crimmins, submitted 2010, Biological Invasions
Invasion- determined spatially from neighbors or long distance

Growth- need to determine rate or timing

Seedbank resurgence in absence of maintentance

Probability of Mortality after 3 yrs in seedbank

Inventory- dashed means failure to detect

Detection or spraying, dashed means failure

Markov Chain Model for Buffelgrass Succession & Treatment Dynamics
2060 Simulation Scenarios for Buffelgrass Invasion in the Catalina Mts

MapClass
- Seedbank - <5%
- Undetected - <5%
- Undetected - 5-50%
- Undetected - >50%
- Detected - <5%
- Detected - 5-50%
- Detected - >50%

No Management

Intermediate Management Worst Case

Intermediate Management Best Case

Unlimited Management Worst Case

Unlimited Management Best Case
Decisions, Decisions…

Do we save the deserts or resign ourselves to these combustible grasslands?

Which species do we control and which spots do we save?

Who makes this decision, with what consensus and authority?

How much will this cost and what are we willing to pay?

Who bears the cost and responsibility?

What framework do we use to organize ourselves?

How do we know if we are failing or succeeding?

How long is our commitment?

If we fail or decide to do nothing, what do we stand to lose?
Economic evaluation of invasive plants using dispersal models

Frid et al. 2009. Final Report For Invasive Species Council of British Columbia
One man’s weed is another man’s pasture

South Texas

Sonora, Mexico

Aerial spraying in Tucson Mountain Park
Is the emphasis on economic services a matter of valuation or last resort to manage Nature in a nonstationary world?

Is this akin to focusing on adaptation to climate change as carbon stabilization looks more and more unattainable?

The approach we take to invasive species management will depend largely on how we answer these questions.