



# Invasive Plant Biology and Ecology

San Joaquin Valley Livestock  
Symposium



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# Invasive Plants

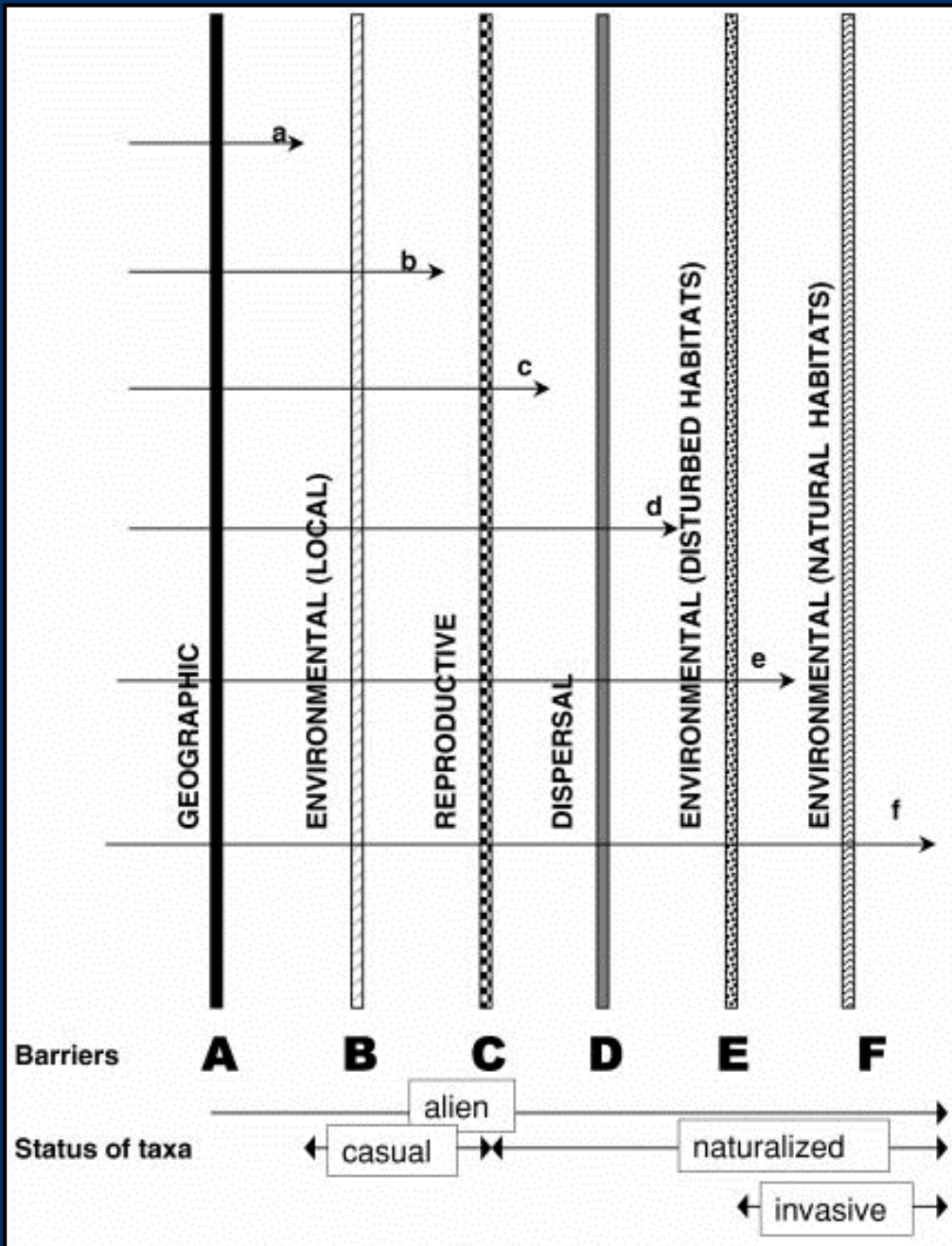
Not necessarily “weeds”

No inherent environmental or economic impact

Time and space dependent

- Alien
- Casual
- Naturalized
- Invasive

Subset are “transformers”



# Compare with definition of weeds

The term “weed” is often anthropocentric (and outdated)

- Undesirable location (WSSA 1956)
- Competitive with more valuable plants (Brenchley 1920)
- Unwanted or with undiscovered virtues (Bailey & Bailey 1941, Emerson 1878)
- Anything we didn't plant (Brenchley 1920, Harper 1944)
- Unsightly (Thomas 1956)

***“... weeds are little more than plants that have aroused a certain level of human dislike at some particular time or place”***

**Not useful in helping explain:**

- **Why and where weeds exist**
- **How they interact with crops**
- **How to manage them effectively**

# A more useful definition

Any plant species that interferes with the *management objective* for particular *time* and *place*

Usually very:

- Prolific
- Competitive
- Harmful/destructive
- Difficult to control

Not all weeds are invasive... (and vice versa)

# **Invasiveness and Invasibility**

**Ecology of plant invasion = interaction of biology and environment**

**Invasiveness (biological component)**

- **Capacity of a plant species to spread beyond introduction site and establish at new sites**

**Invasibility (environmental component)**

- **Susceptibility of habitat to colonization and establishment of new species**

# Invasiveness: biological characteristics

- **“General purpose” – high fitness over range of environments**
- **Plants that grow and reproduce quickly**
- **Easily dispersed by humans & animals**
- **Vegetative propagation**
- **Alien status (absence of enemies?)**
- **Not dependent on mutualisms**
- **Persistent seed banks**



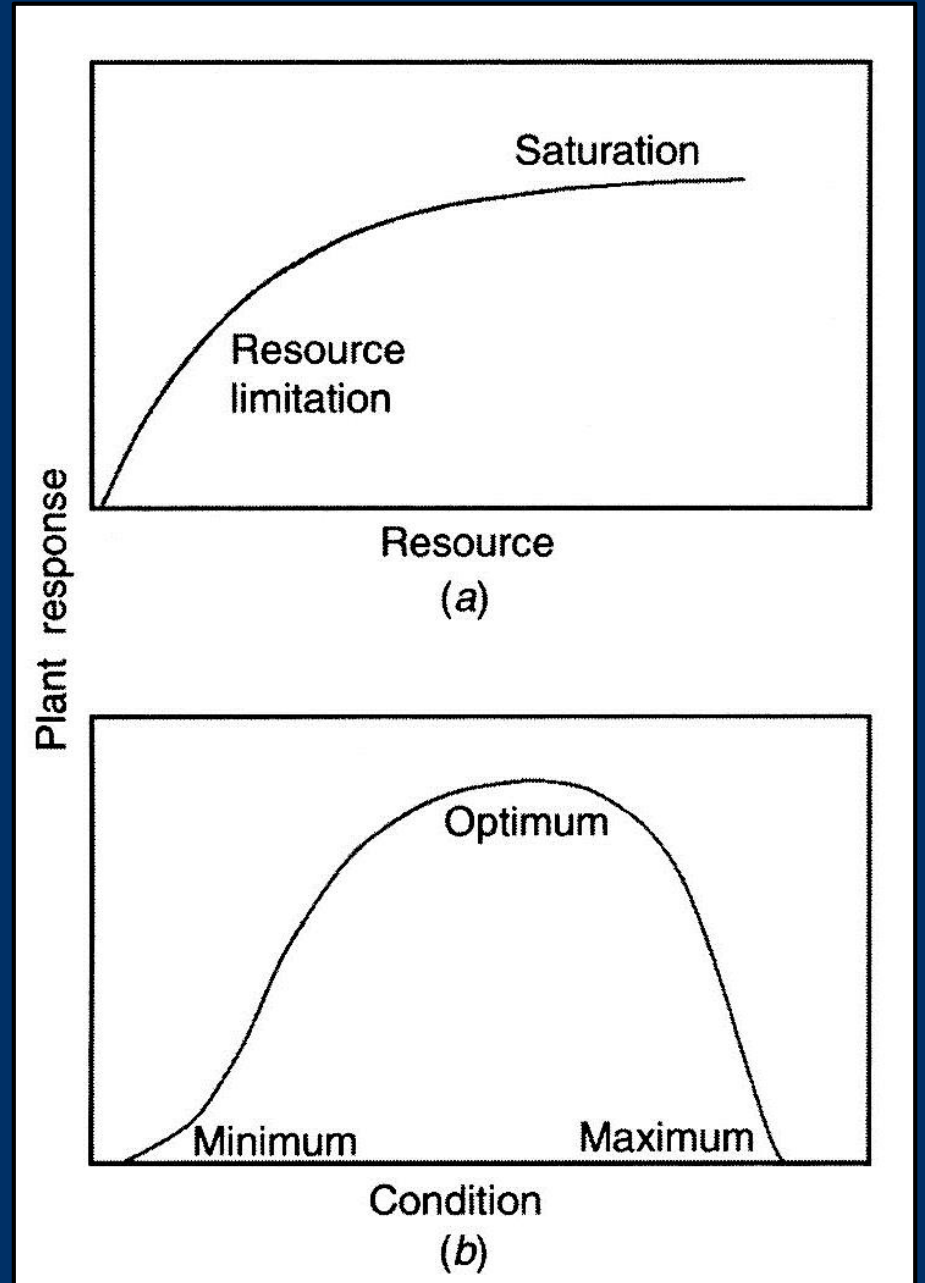
# Invasiveness: the environment

## Resources (consumable)

- light
- water
- nutrients

## Conditions (not consumed)

- temperature
- frequency of fire
- soil pH





# The concept of “niche”

**Niche = the environment and resources of a particular site used by a species**

**Competitive exclusion principle (Guase, 1934):**

- **Multiple species cannot coexist indefinitely in the same niche competing for the same resources**
- **Differential specialization between species allows species to avoid direct competition**

# Concept of "safe site"

**Most species fail to germinate, most that do fail to survive**

**Safe sites provide:**

- **Stimuli for breaking seed dormancy**
- **Conditions for germination to proceed**
- **Resources for seedling growth**
- **Absence of hazards**

# **Inter-relationship of Invasiveness and Invasibility**

## **Invasibility linked to resource availability**

- **Spatial – resources available in specific locations on landscape**
- **Temporal – resources available only at certain times**

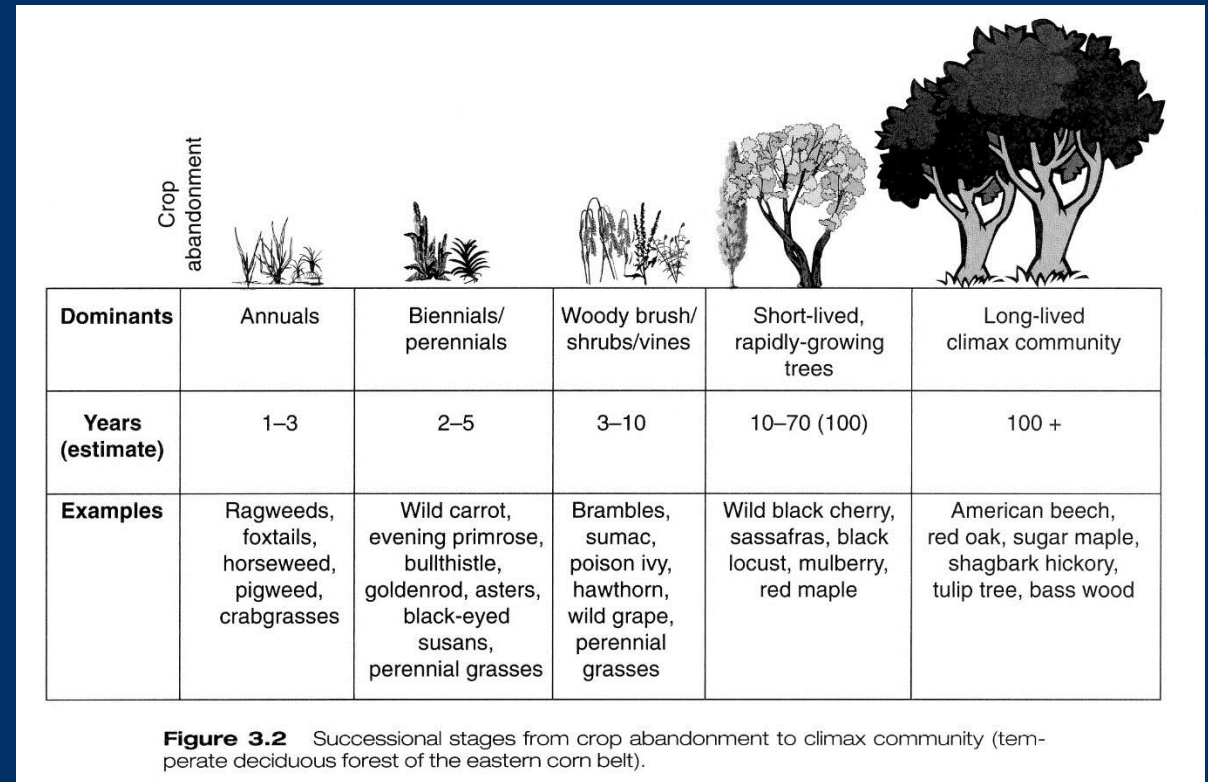
## **Invasive species life history components**

- **Seed dispersal and propagule pressure**
- **Niche matches safe sites present**
- **Shared life history with plants currently present**

# Role of disturbance: succession

**Disturbance = total or partial destruction of vegetative cover**  
**Stops succession or otherwise modifies plant community diversity or complexity**

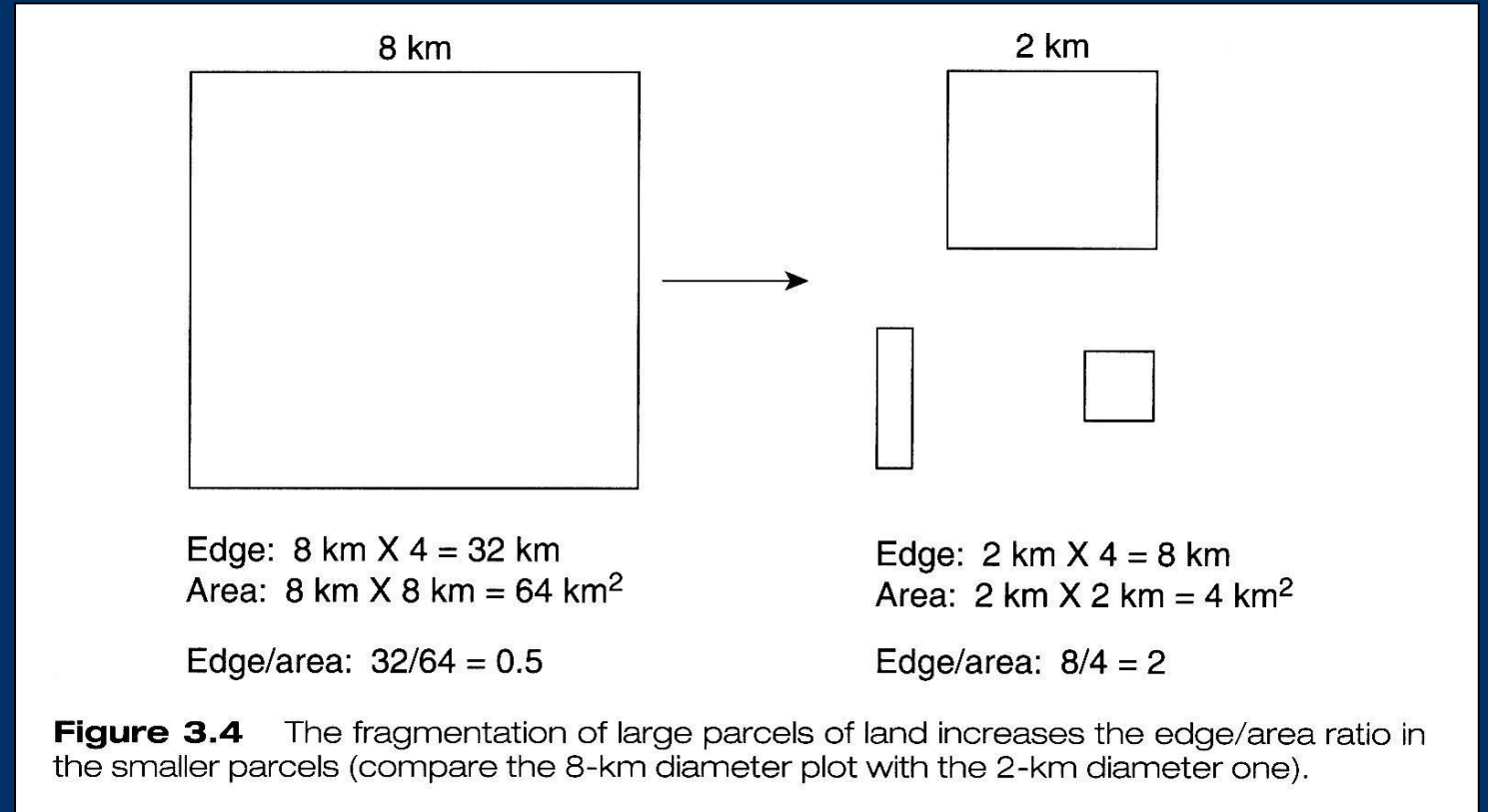
- **Invasibility often increased during recovery period**
- **Creates safe sites**
  - Reduces impact of high plant densities
  - Increases probability of finding safe site



# Role of disturbance: fragmentation

## Edge effects

- Pathways for propagule or seed dispersal
- Roads, utility corridors, waterways
- Gaps in natural vegetation (grazing/browsing)



# Invasibility and stress

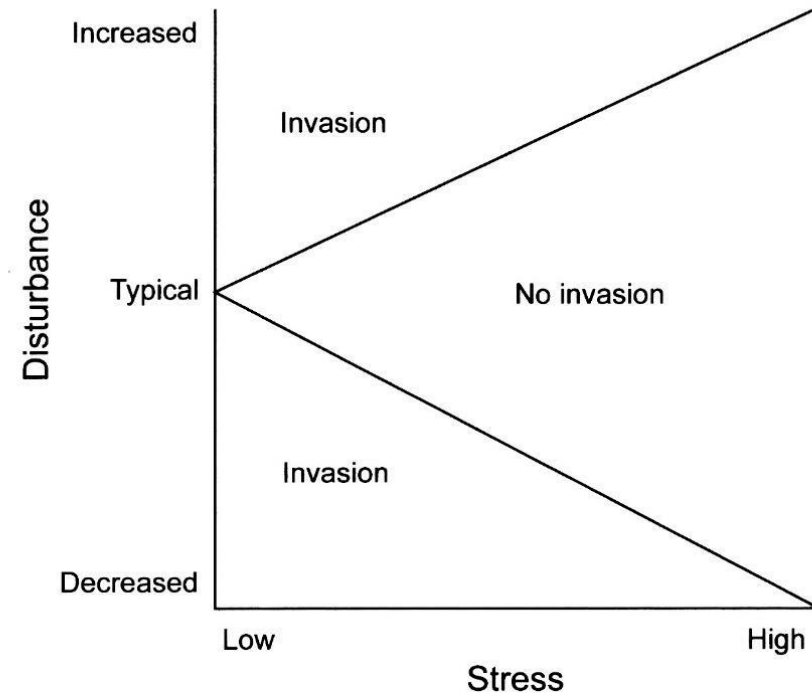
**Stress reduces physiological functioning below maximum level**

- 1. Low resource availability (light, water, nutrients)**
- 2. Conditions that limit resource acquisition (e.g., extreme temperature)**
- 3. Toxins**

# Interaction between disturbance and stress

Invasion may occur when:

1. Stress is low
2. Disturbance departs from natural levels
3. Low stress is combined with disturbance



**Figure 3.3** Model of interactive effects of stress and disturbance on habitat invasibility. (From Alpert et al. 2000. *Perspect. Plant Ecol. Evol. Syst.* 3:52–66. Copyright 2000 with permission from Elsevier.)



# Typical invasion process

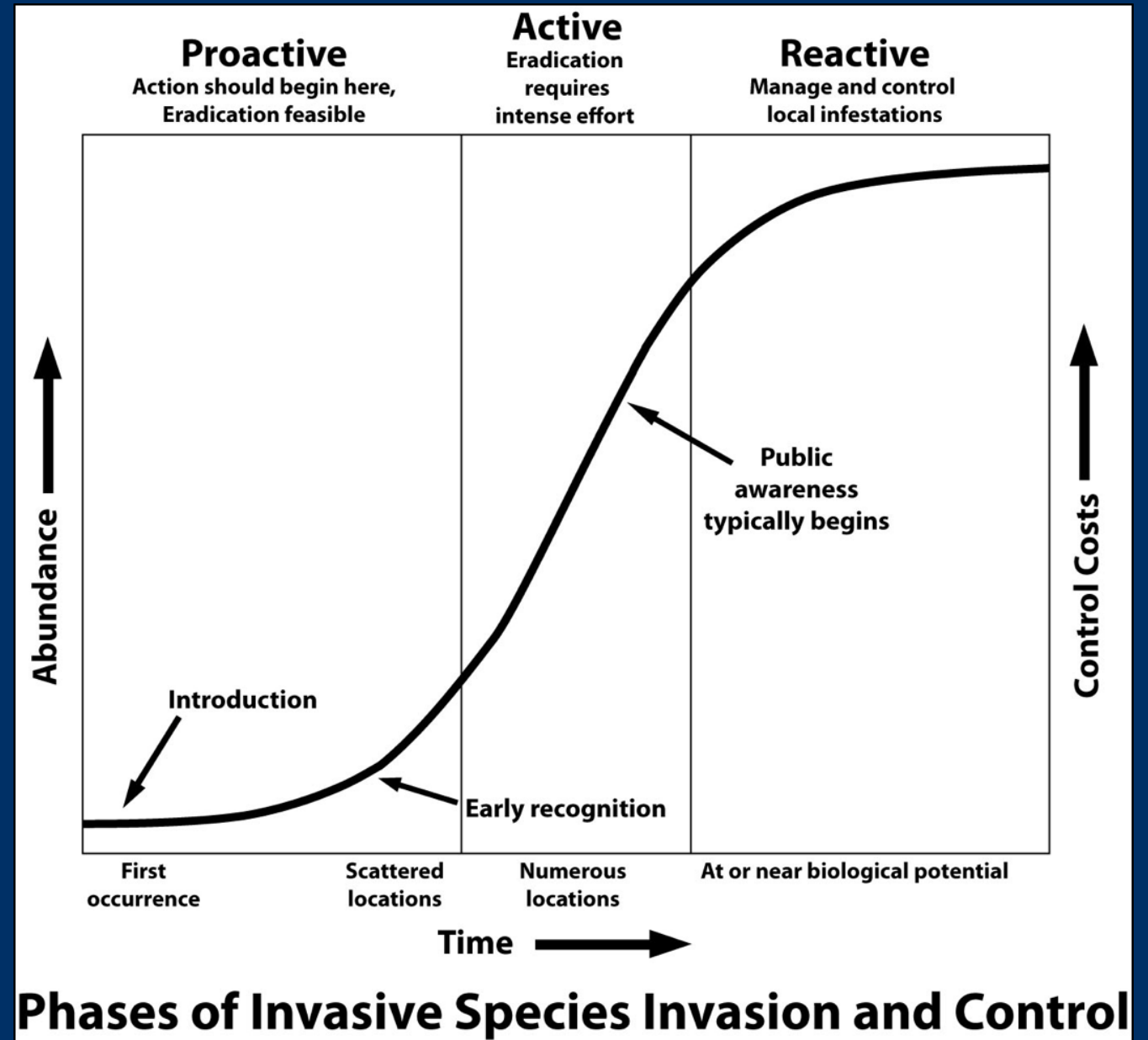
Introduction

Colonization

- Lag Phase

- Exponential growth

Naturalization



# Case study: buffelgrass

## Sonoran Desert

- **Hot - 99.3°F JJA mean max temp for Tucson**
- **Dry - 12.6 in/yr, bimodal with summer monsoon**
- **Sparse - 25 to 35% canopy cover**
- **Long-lived dominant plants**



# Buffelgrass history and biology

- Multiple introductions into AZ starting in 1930s
- Native to Africa, Madagascar, and the Middle East
- C4 perennial bunchgrass
- Drought tolerant and resistant to heavy grazing
- Invasive in subtropical regions worldwide, including Australia, Hawaii, Mexico, Brazil, Argentina
- Often considered a desirable forage species





# Buffelgrass invasion ecology

Patches double in size every 3-5 yrs

Outcompetes natives for water resource

- Progressive elimination of adults; suppressed seedling recruitment
- <10-15 yrs, only adult saguaros remain embedded (Olsson *ea* 2012)

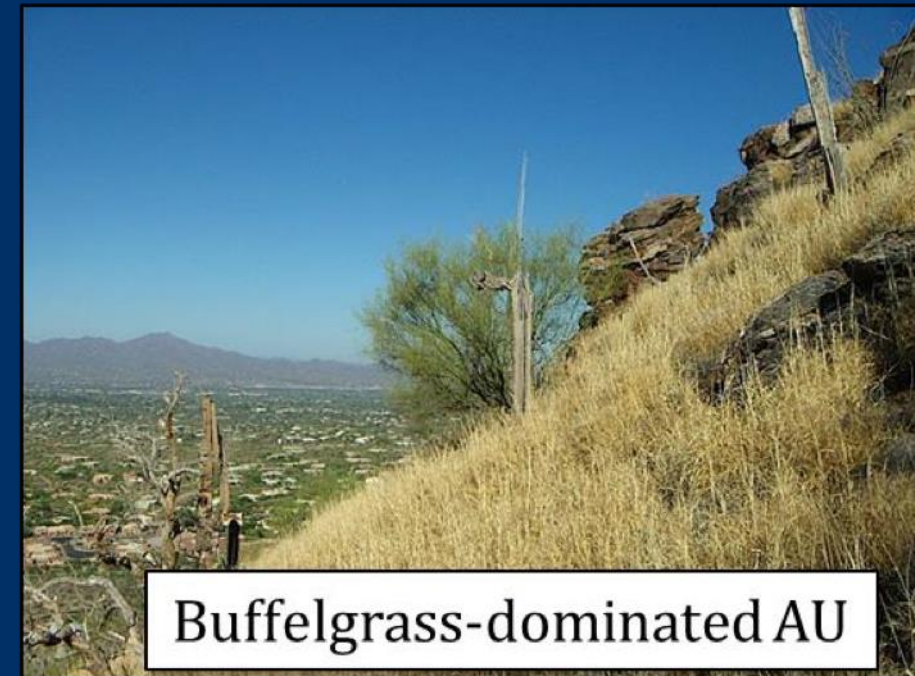
Grass-Fire Cycle

- Fuel loads @ 7000 lb/ac
- 1,300 to 1,600°F
- Fuel linkage btw desert and forest

Ecosystem transformation



Native Arizona Upland (AU)



Buffelgrass-dominated AU





# Questions?

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## Useful Textbooks:

**Radosevich SR, JS Holt, CM Ghera. 2007. Ecology of Weeds and Invasive Plants, 3<sup>rd</sup> Ed. John Wiley and Sons, Inc.**

**Ross MA and CA Lembi. 2008. Applied Weed Science, 3<sup>rd</sup> Ed. Prentice Hall.**