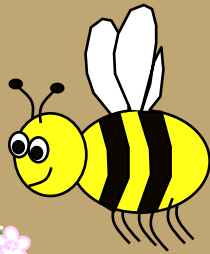


# Effects of plant invasions on invertebrate diversity and feeding guilds: A meta-analysis & review

Denise Knapp, Karen Stahlheber, & Tom Dudley  
Cal-IPC Symposium, October 2015



A photograph of a dense forest with a path, overlaid with text. The forest is lush and green, with many trees and undergrowth. The path is visible in the center, leading into the woods. The text is overlaid on the image in a semi-transparent grey box.

# **Biological invasions: A major source of global change**

**But also an opportunity...**

**Cape Ivy at Mount Davidson**

photo by  
Margo Bors

# *Invertebrates*: Important indicators, ecosystem components

**Nutrient cycling**



**Pollination**



**Seed dispersal**



**Predation**

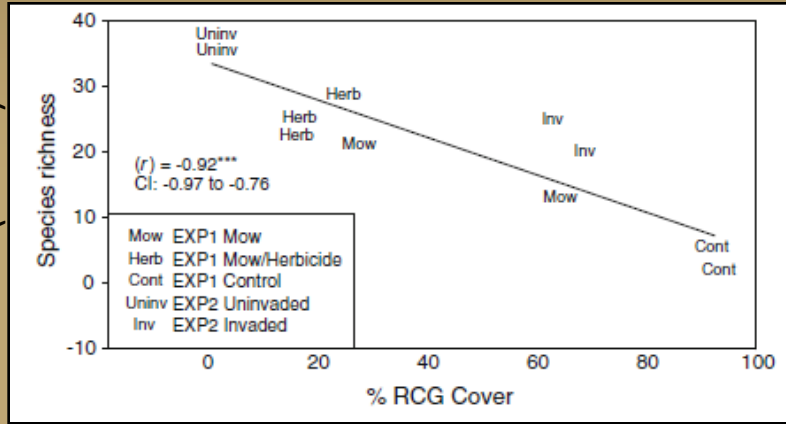


**Parasitism**



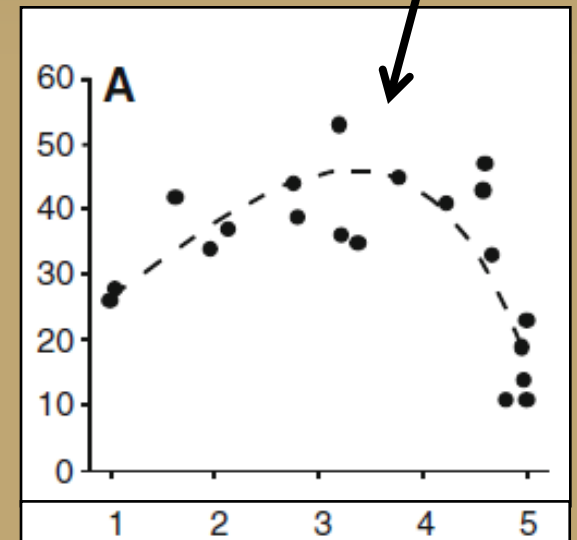
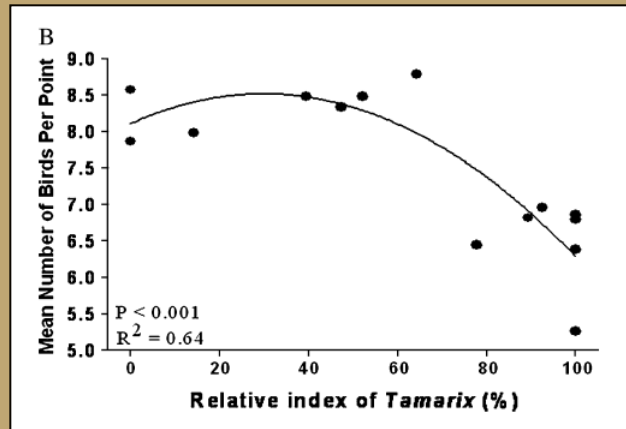
**Herbivory**

# Invader cover should be important, but the effects are unclear



Spyreas et al. 2010  
*Biological Invasions*

Van Riper et al. 2008  
*Restoration Ecology*



Almeida-Neto et al. 2011  
*Oecologia*

# When determining impact, restored sites are a good comparison

Parksconservancy.org



- They have disturbance in common
- Also, it tells us how we are doing!

# Meta-analytic synthesis and review of literature

- What are the effects of plant invasions on invertebrate diversity?
  - How important is invader cover?
- How do restoration sites compare as a control?
  - How do responses differ between different feeding guilds?

# Methods

54 studies reported the parameters needed.

Effect size = Natural log (LN) of  $X_{\text{exotic}} / X_{\text{native}}$   
(Response Ratio)

ES also determined for two **descriptor variables**:

1. Invader cover

1. <10%, 10-30%, 30-50%, 70-90%, 90-100%

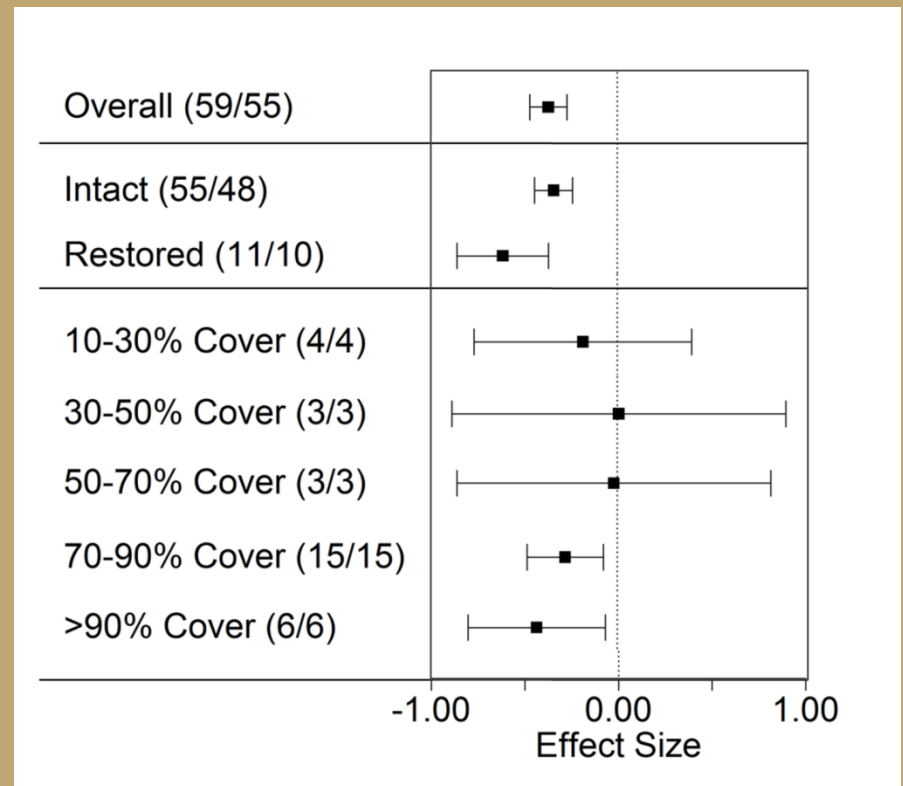
2. Intact or restored control

# Results

Species richness 31% lower in areas dominated by non-native plants

Restored areas even richer than intact habitat

*Negative effects strongest after 70% cover of invader*



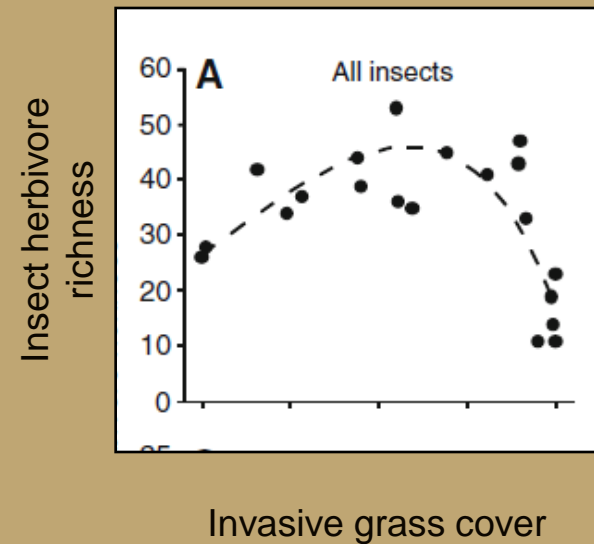


# Discussion: Invader cover

Threshold of ~70%.

*Potential mechanisms:*

- Plant diversity →
- Vegetation structure
- Abiotic variables
- Coincidental relationship with disturbance?



# Discussion: Restoration

**Restored plots richer!**

*Potential mechanisms:*

- Early-colonizing invertebrates
- Higher plant richness and cover



# High residual heterogeneity: *Other variables?*

- Plant diversity & cover, habitat structure, plant litter, abiotic variables
- Changes in other trophic levels



***These are invader-specific,  
vary in importance by feeding guild***

# **Feeding Guild Responses: A Review**

# Herbivores

- *Respond directly to host plant diversity*
- *90%+ of all insect herbivores are specialists*



***Hypotheses:*** *Richness reduced; Composition changed;  
Higher or lower abundance*

# *Surprise!*

Only fifty percent of studies found a decrease in herbivore richness (7 vs. 7).

## *Nuances:*

- Level of specialization
- Scale of comparison
- Cover of the invader



# Predators and Parasitoids

More generalists



More specialists



*Both kill other organisms, respond positively to prey and habitat diversity*



*Invaders should have a negative effect*



# Results were equivocal for both predators and parasitoids. *Why?*

*Perhaps because they respond to aliens indirectly through multiple factors:*

- Abundance/diversity of herbivore prey
- Structure of plants, habitats, & landscapes(complexity)
  - Differs by foraging strategy
- Supplementary foods





# Pollinators

**Pollinators such as bees tend to use whatever is abundant**

Williams et al 2011, Basic & Applied Ecology

Rollin Coville



Rollin Coville

*But: Species richness lower,  
composition changed*



# Pollinator Results



## **Eight of nine studies found aliens reduced pollinator richness**

- Rare/ specialists most negatively affected

### *Studies found:*

- A negative effect on flower visitation of natives
  - Lowered native seed set
- Greater impact with ↑ alien cover, trait overlap
  - Invader removal typically restores pollinators

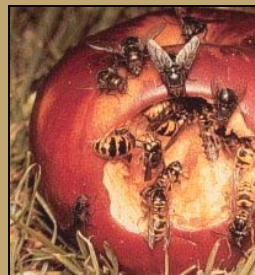
# Invader detritus and detritivores

*Highly invaded habitats =  
dense plant litter*



IF detritivores not as specialized as herbivores (Srivastava et al. 2009), THEN

→ More litter = more detritivores?



# Detritivore Results

Many studies have found detritivores more abundant in invaded habitats

- Effects on richness less explored
- Of five studies, results equivocal

(2 richer /1 less rich /1 no difference)

*Wolkovitch 2009 (Oecologia): most detritivores declined with high grass invasion –may be more specialized than we thought*



# Conclusions

- Invasive plants are decreasing invertebrate diversity
- Impacts are greatest at cover >70%
  - Restored areas looking good
- Effects differ by feeding guild, level of specialization, hunting mode
  - Likely mechanisms:

Changes in plant cover, diversity, habitat structure, litter biomass, abiotic variables

