Sea Walnut (Mnemiopsis leidyi)
Catford Quiz Questions

1. Why do Catford et al. argue that a more unified framework of invasive species success is needed?

2. Describe one other invasion hypothesis mentioned by Catford et al. that we didn’t cover in class.

3. Describe the proposed PAB framework.
Catford Quiz Questions

4. Give two examples each of abiotic characteristics and biotic characteristics that might influence invasion.

5. Pick one invasion hypothesis and describe how it would fit in a PAB framework.
Propagule Bias

- People select for some specific traits/qualities when introducing species
- Those traits do not necessarily cause invasiveness – our starting sample is biased

![Bar chart showing percentage of invasive plants in N. America by category: Grasses, Forbs/Herbs, Shrubs, Trees, Vines.]
Propagule Bias

- COMPARISON THAT DOES NOT ACCOUNT FOR PROPAGULE BIAS: Invasive plants vs. all plants

![Bar chart showing comparison between invasive plants and all plants in North America. The chart categorizes plants as Grasses, Forbs/Herbs, Shrubs, Trees, and Vines.](image)
Propagule Pressure as a Null Hypothesis

• FIRST: Account for propagule pressure/biases before concluding that other factors explain invasion success.

Compare:
Invasive plants vs. all introduced plants
Invasive flowering plants vs. all flowering plants
Consistent Results from Invasion Hypotheses?

- Most hypotheses were focused on invasive plants
  
  e.g., Novel weapons (allelopathy) of Spotted knapweed (*C. maculosa)*
Consistent Results from Invasion Hypotheses?

• Most hypotheses were focused on invasive plants
• Most studies focused on European species introduced to N. America
Consistent Results from Invasion Hypotheses?

• Most papers supported the hypothesis
  – Does this mean that every hypothesis is likely to lead to invasion success for most plants?

Are the following true for all invasive plants:
Released from enemies, novel weapons, evolving increased competitive advantage, successful in areas with lower resistance ... ?
Publication Bias is Common in Science

AAAARGH!

What's wrong?

What's wrong? I've been testing this stupid protocol for over a year now and it doesn't work! I've wasted my entire grant and I have nothing to show for it!

Let me see that.

Hey, I remember this! I tried it over a year ago but it gave me negative data. Since I couldn't publish, I just filed it away and never told anyone.

NEGATIVE DATA IS STILL DATA. PUBLISH IT.
(For everyone's sake)
Consistent Results from Invasion Hypotheses?

• Most papers supported the hypothesis
• BUT, hypotheses tend to be tested where there is *a priori* reason to expect a certain advantage for the invader
• AND, non-significant results are less likely to be published
A Unifying Framework?

- Catford et al. suggest a PAB framework for understanding the causes of invasion
  
  \[ P = \text{Propagule Pressure} \]
  
  \[ A = \text{Abiotic characteristics} \]
  
  \[ B = \text{Biotic characteristics (of the invader } B_i; \text{ of the recipient ecosystem } B_c) \]
A Unifying Framework?

- Catford et al. suggest a PAB framework for understanding the causes of invasion
  
  \[ P = \text{Propagule Pressure} \]
  
  \textit{Volume of introduction, frequency of introduction}
  
  \[ A = \text{Abiotic characteristics} \]
  
  \[ B = \text{Biotic characteristics (of the invader } B_i; \text{ of the recipient ecosystem } B_c) \]
A Unifying Framework?

• Catford et al. suggest a PAB framework for understanding the causes of invasion

  P = Propagule Pressure
  A = Abiotic characteristics
  Physical environment (climate, soil) + Geography
  B = Biotic characteristics (of the invader $B_i$; of the recipient ecosystem $B_c$)
A Unifying Framework?

- Catford et al. suggest a PAB framework for understanding the causes of invasion
  
  P = Propagule Pressure
  
  A = Abiotic characteristics
  
  B = Biotic characteristics (of the invader $B_i$; of the recipient ecosystem $B_c$)

  $B_i$: Invader traits, other invader advantages (e.g., novel weapons)
A Unifying Framework?

• Catford et al. suggest a PAB framework for understanding the causes of invasion
  
  P = Propagule Pressure
  A = Abiotic characteristics
  B = Biotic characteristics (of the invader $B_i$; of the recipient ecosystem $B_c$)

  $B_c$: Recipient ecosystem traits
What contributes most to invasion?
What contributes most to invasion?

Most research focus:
- Enemy Release
- EICA
- Novel Weapons
- Biotic Resistance

Some research focus:
- Propagule pressure

Some research focus:
- Fluctuating Resources
- Empty Niche
- Disturbance

Not much
What contributes most to invasion?

Invasions are caused by propagule pressure and traits/advantages of the invading species

Invasions are caused by susceptibility of the recipient ecosystem

No way of knowing because all factors rarely tested
How do we test a unified framework?

Experimental setup to test invader success
How do we test a unified framework?

Experimental setup to test invader success
Species of the day

NATURE

STINKS
## Quantifying Cat Impacts in the U.S.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Estimate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of cats owned</td>
<td>84 Million</td>
</tr>
<tr>
<td>Percent with outdoor access</td>
<td>40-70%</td>
</tr>
<tr>
<td>Active outdoor hunters (pets)</td>
<td>50-80%</td>
</tr>
<tr>
<td>Number of feral cats</td>
<td>30-80 Million</td>
</tr>
<tr>
<td>Active outdoor hunters (feral)</td>
<td>80-100%</td>
</tr>
<tr>
<td>Bird kills per cat</td>
<td>3-13/year</td>
</tr>
<tr>
<td>Mammal kills per cat</td>
<td>9-22/year</td>
</tr>
</tbody>
</table>

Loss et al., 2013 *Nature Communications*
Estimated cat kills per year in U.S.

At least 1 billion birds (best guess 2.4 billion)

At least 5 billion mammals (best guess 12.3 billion)
Indoor cats are healthier

- Indoor cat lifespan: 12-20 years
- Outdoor cat lifespan: 1-5 years