Habitat Selection

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I. Habitat use, preference, selection
II. Some theory…
III. How do animals assess habitat
IV. Measuring habitat selection
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I. Use, preference, selection

Habitat use: Distribution of individuals across habitats/habitat types

Habitat selection: Actual *behavioral process* of animals choosing habitats

Habitat preference: The likelihood of a habitat being chosen if offered on an equal basis with others

I. Use, preference, selection

Habitat selection has both:

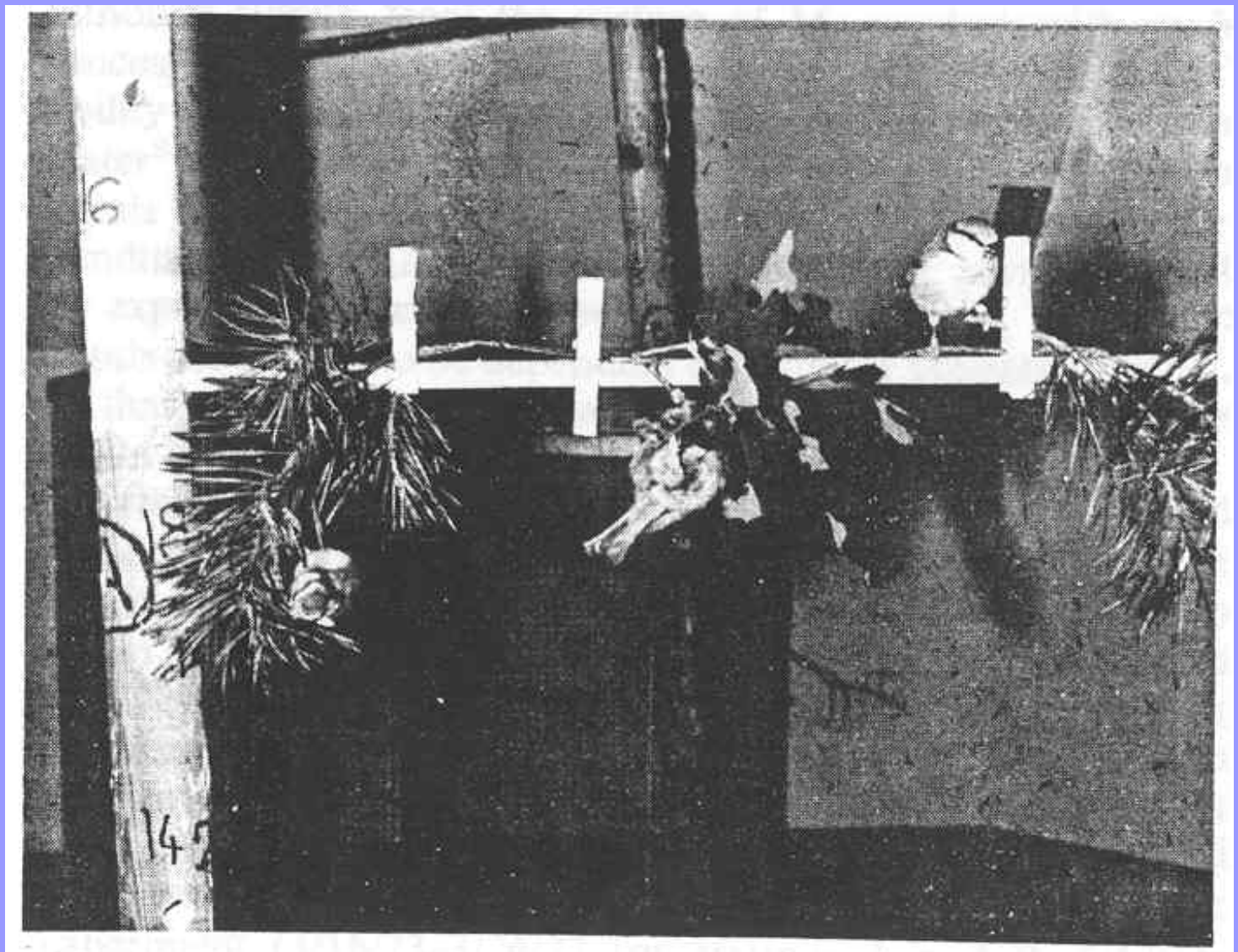
innate (genetic)
and
learned

components

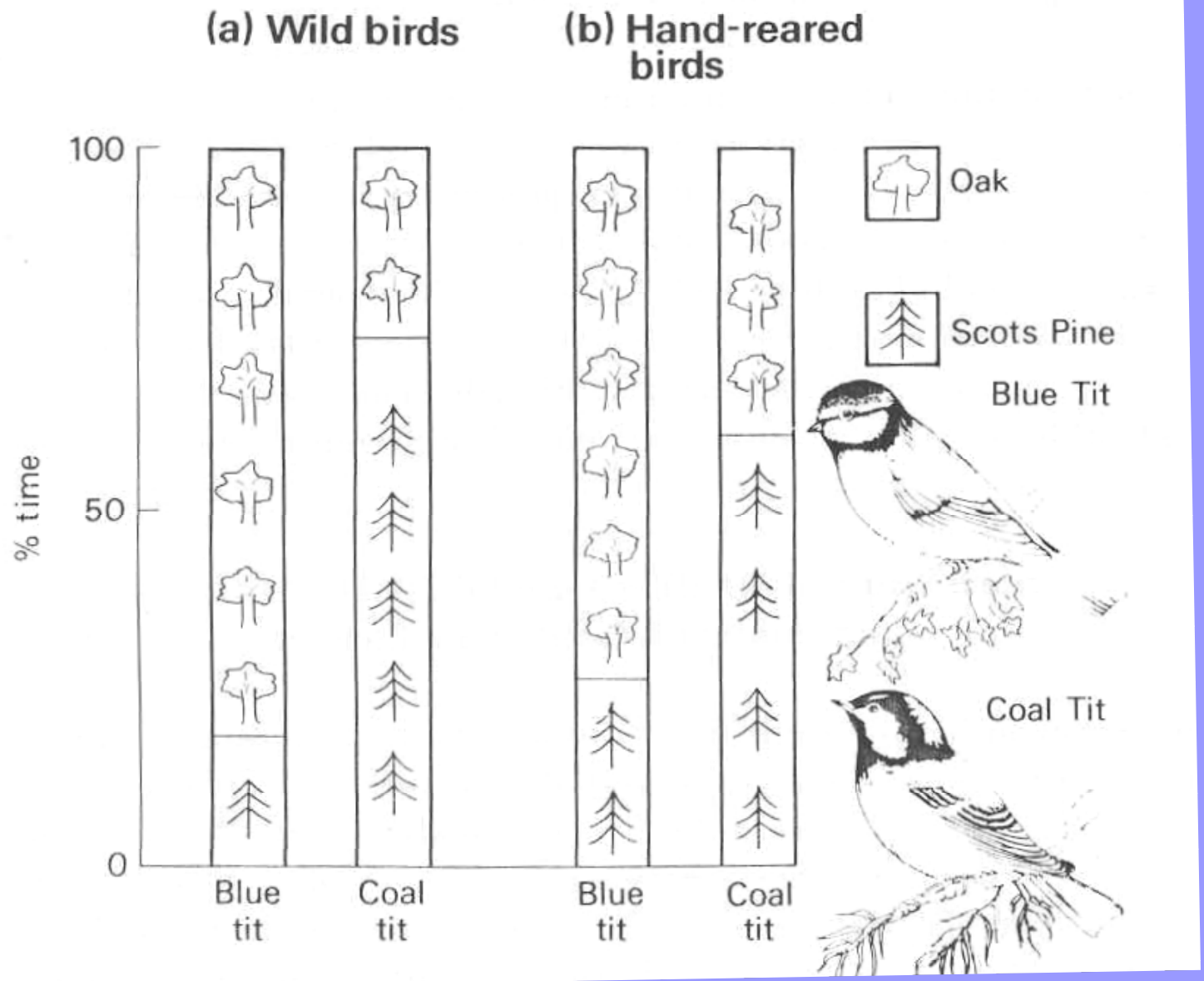
A genetic basis for habitat selection? (Partridge 1976)

Coal tits (occupy conifer forests)

Blue tits (occupy deciduous forests)



A genetic basis for habitat selection?



Naïve, Hand-reared 8-week old birds still preferred the tree type primarily used in the wild!

The role of learning in habitat selection:

1. Site tenacity

- Many species show site fidelity to particular locations, even if the habitat is altered


Nesting sea turtles


Elk calving grounds

The role of learning in habitat selection:

2. Imprinting onto the environment

- In some species, particular habitat attributes experienced at a young age may influence later habitat decisions

Ex) Bluebirds: tend to use the same nest type as that in which they were born!

The role of learning in habitat selection:

3. Experience

- Experiences acquired in later stages of life can also influence habitat selection

e.g.) Wild turkeys return to the same nesting areas when reproductive success was high

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The Ideal Free Distribution

Fretwell and Lucas (1970); for territorial species

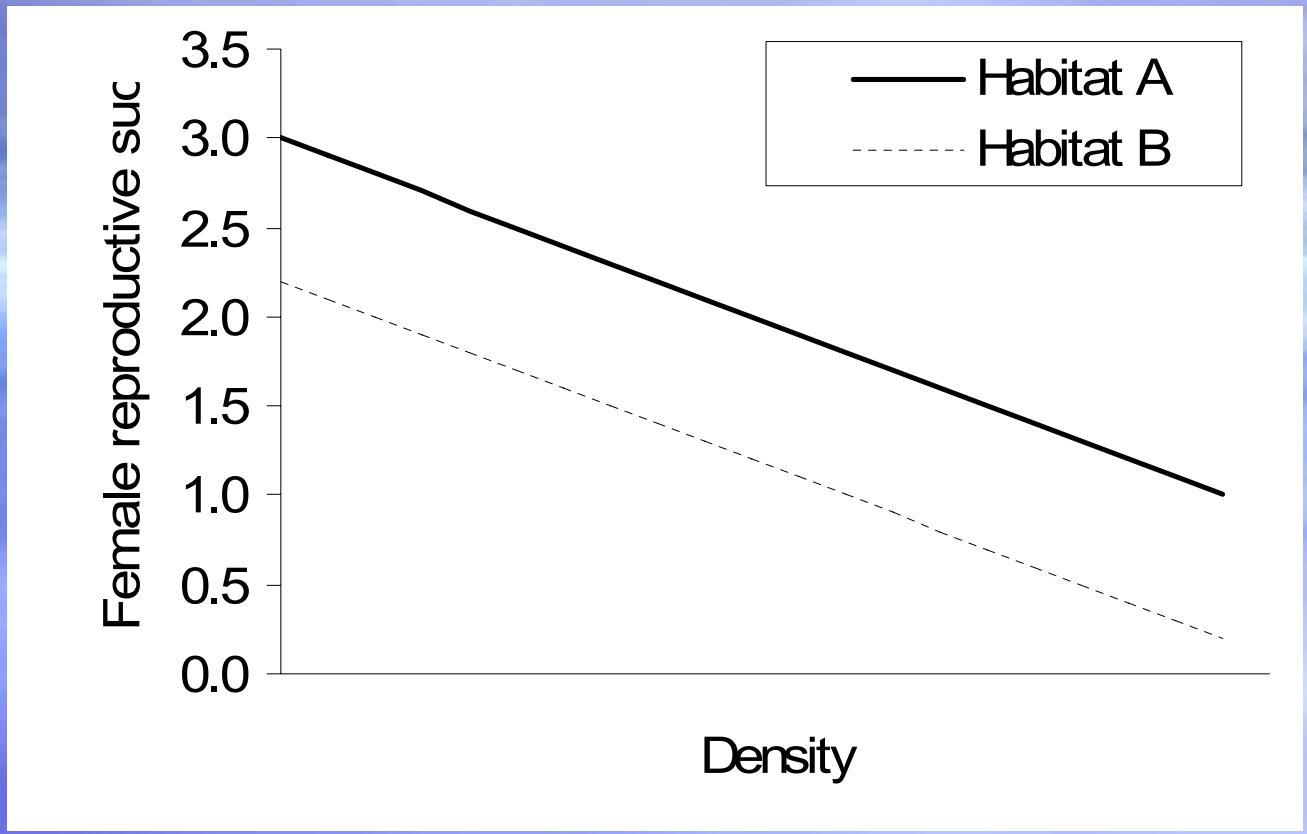
Assumptions:

1. Individuals are "ideal" in that they always select habitat that maximize fitness

2. Individuals are "free" to select any habitat (i.e., no social constraints)

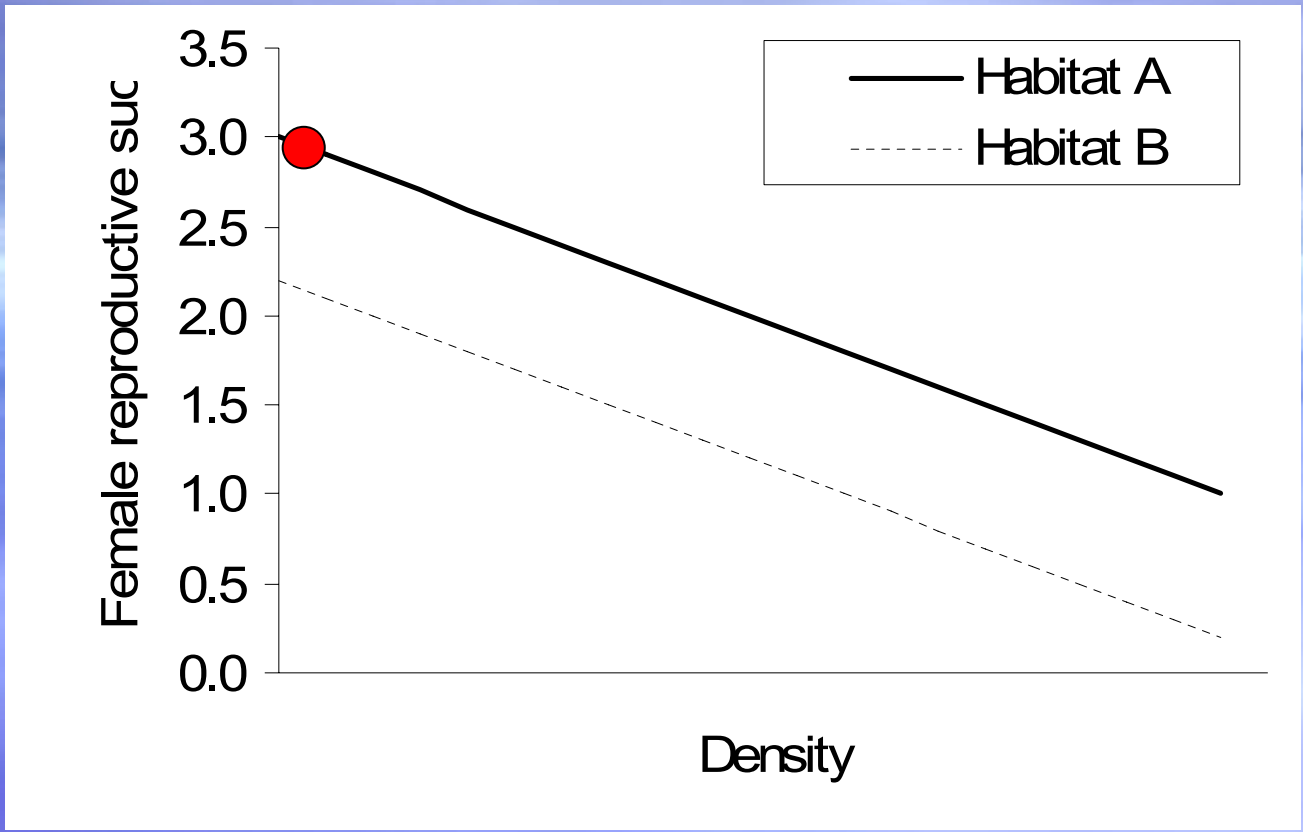
3. Density-dependence occurs:
   As # of individuals increases, fitness declines

Ideal-free distributions

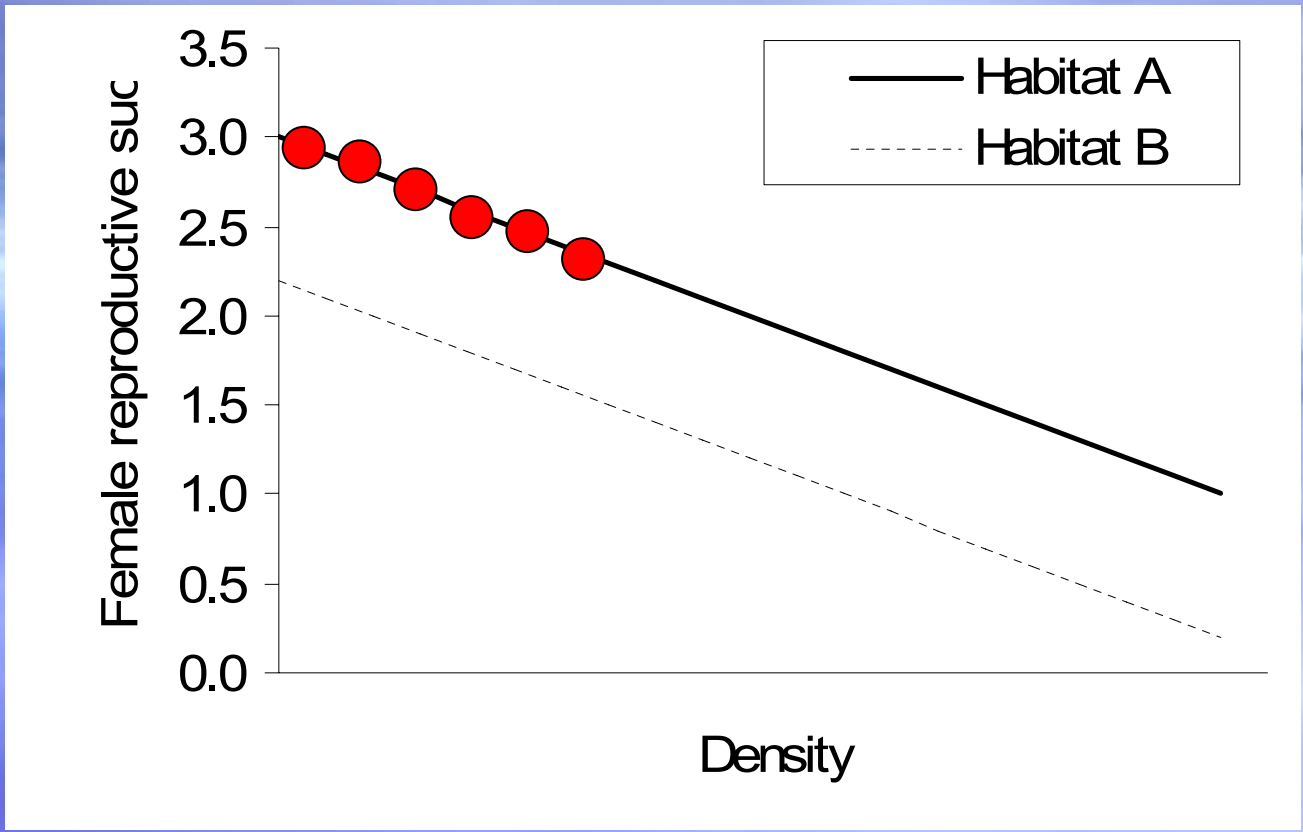


Imagine 2 habitat of different quality, both with density dependent fitness curves

Ideal-free distributions

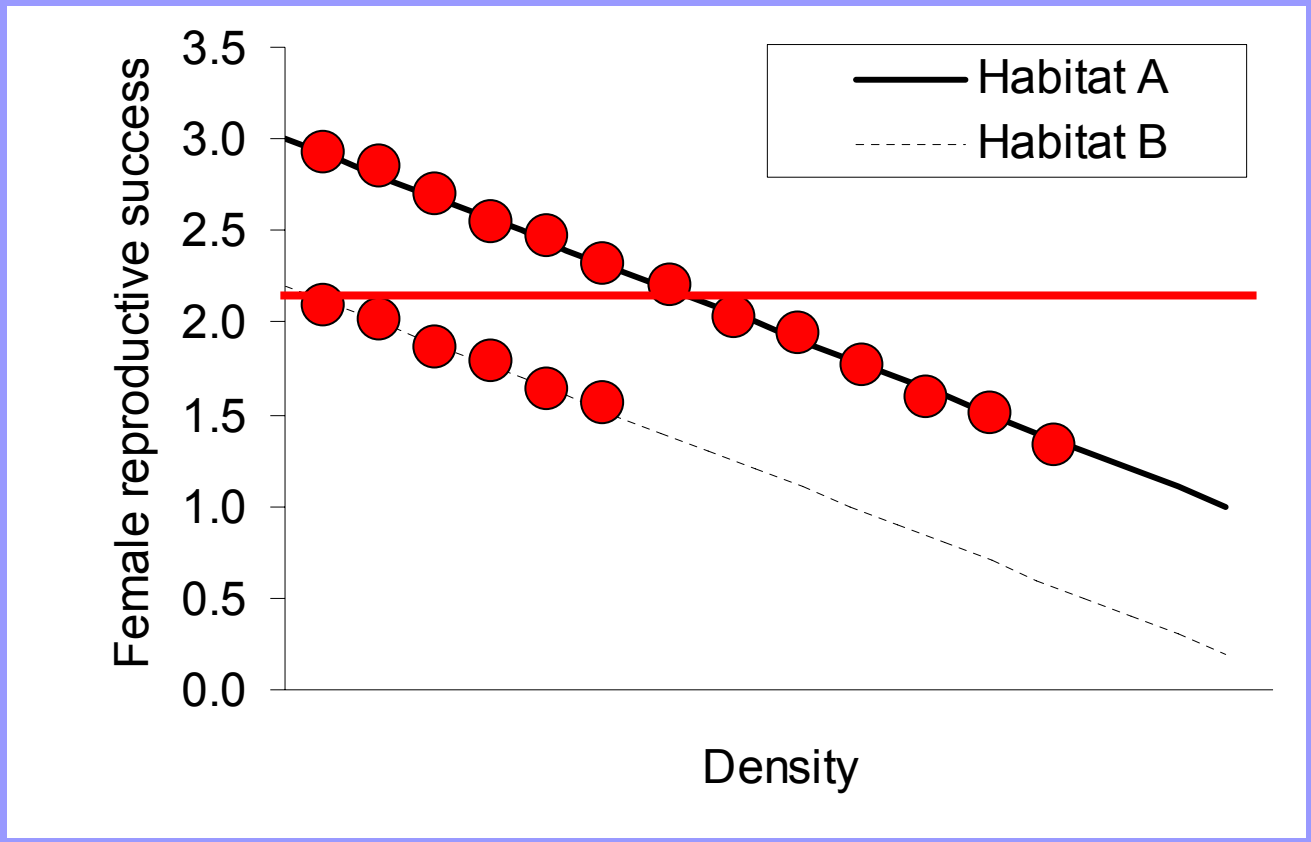


Ideal-free distributions



So at low densities, individuals should settle in the highest quality habitats

Ideal-free distributions

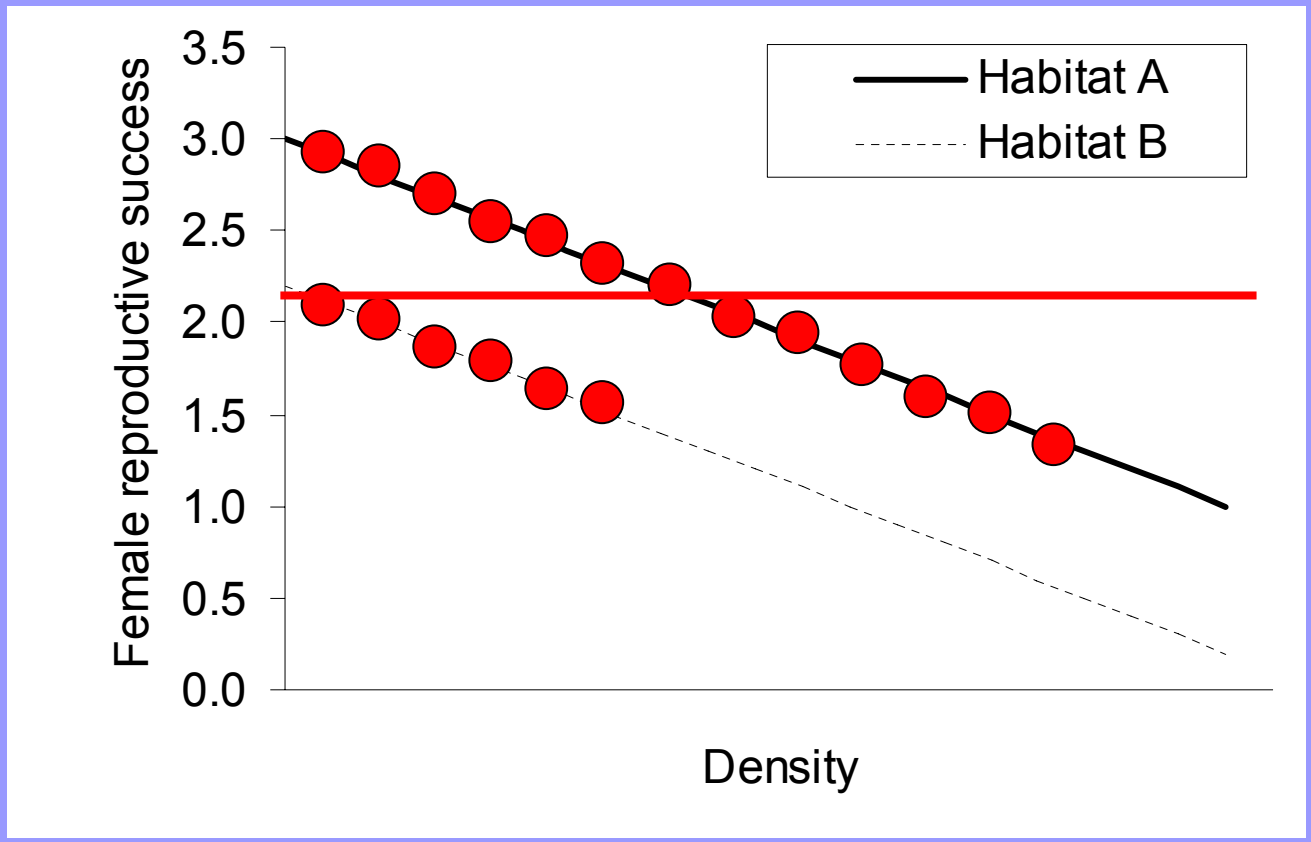


But as the higher quality habitat fill-up, settling in a lower quality Habitats yields equal or higher fitness

- But, how realistic are the assumptions?

- But, how realistic are the assumptions?
- Are all animals competitively equal?

Ideal-free distributions

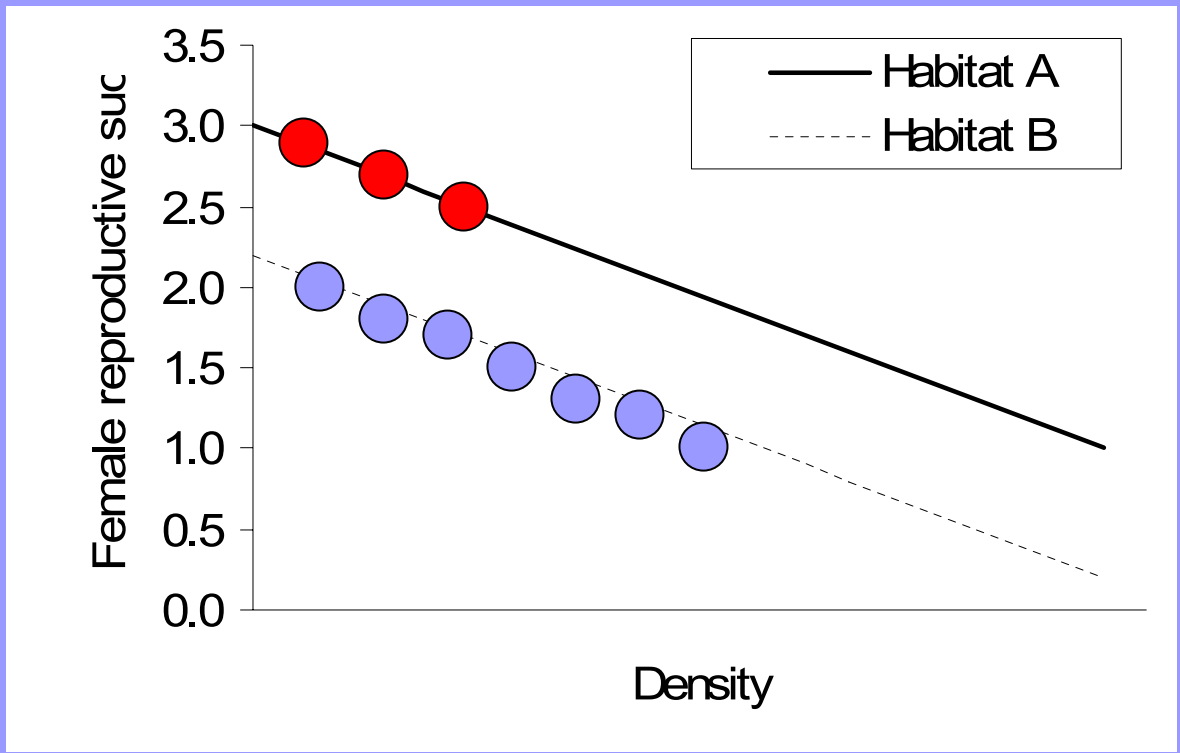


What happens if there are individuals that differ in competitive ability?

The Ideal Dominance Distribution

Fretwell and Lucas (1970)

- Here, assumption that all individuals are competitively equal is dropped



- Density is higher in low quality habitats because competitively superior individuals exclude inferior individuals

Ideal Free or Ideal Dominance?

Example of a test: Petit and Petit (1996)

<u>System:</u>

- Prothonotary warblers
- Wet vs. dry habitats

<u>Results:</u>

- Birds prefer wetter habitats
- Higher nesting success in wetter habitat

- <u>But</u>, densities similar in both types
- Wetter habitats contained dominant individuals

<u>Conclusion</u>:

In this system, IDD fit most accurately

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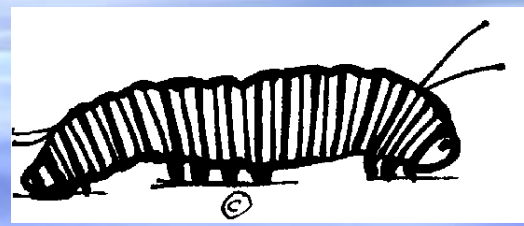
ORGANISM → CUE → CORRELATE



Proximate Cues Versus Ultimate Causation in Habitat Selection

Proximate: which **cues** individuals use to determine whether they are in an appropriate habitat

- i.e. How?

Ultimate: why it is selectively advantageous to use a subset of potentially acceptable habitats

- What is driving the evolution of habitat preferences?

Proximate Cues Used in Habitat Selection:

What cues might individuals use?

- Vegetation Structure
- Landscape structure
- Food
- Predators/parasites
- Conspecifics
- Heterospecifics
- Public information

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Traditional Methods for Measuring Preference

1. Use vs. Availability
2. Chronology of settlement
3. Which habitats occupied by dominants
4. Which habitats consistently occupied?

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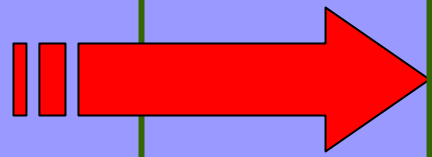


Note: individuals may not always be able to assess these directly!

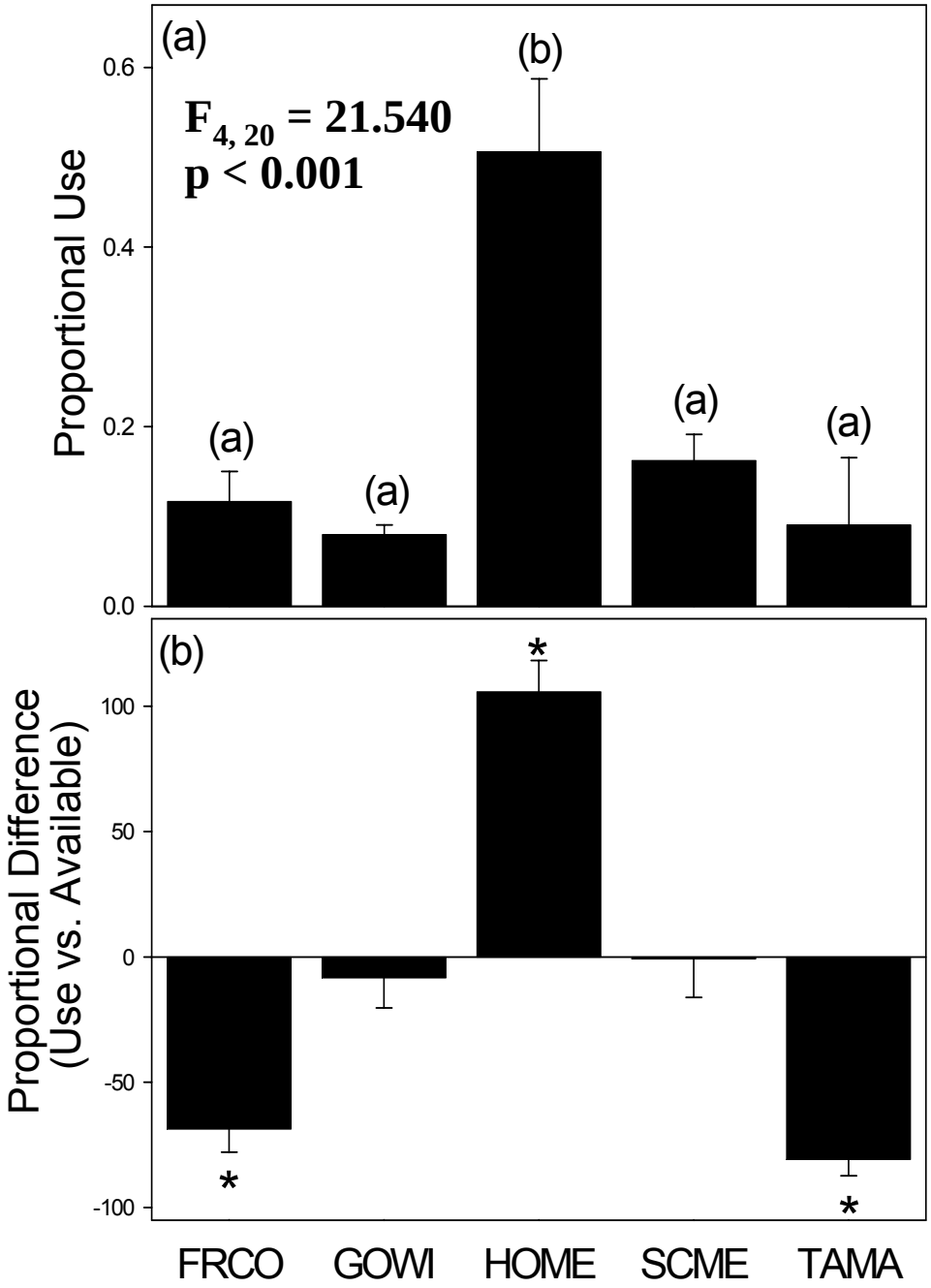
Food

- One of the most important ecological factors shaping species and communities
  - distribution
- Longstanding interest in avian ecology
- For example …

Selecting habitats with abundant food resources is important for successful migration

What cues do migrants use to assess food availability?

Tree species or phenology



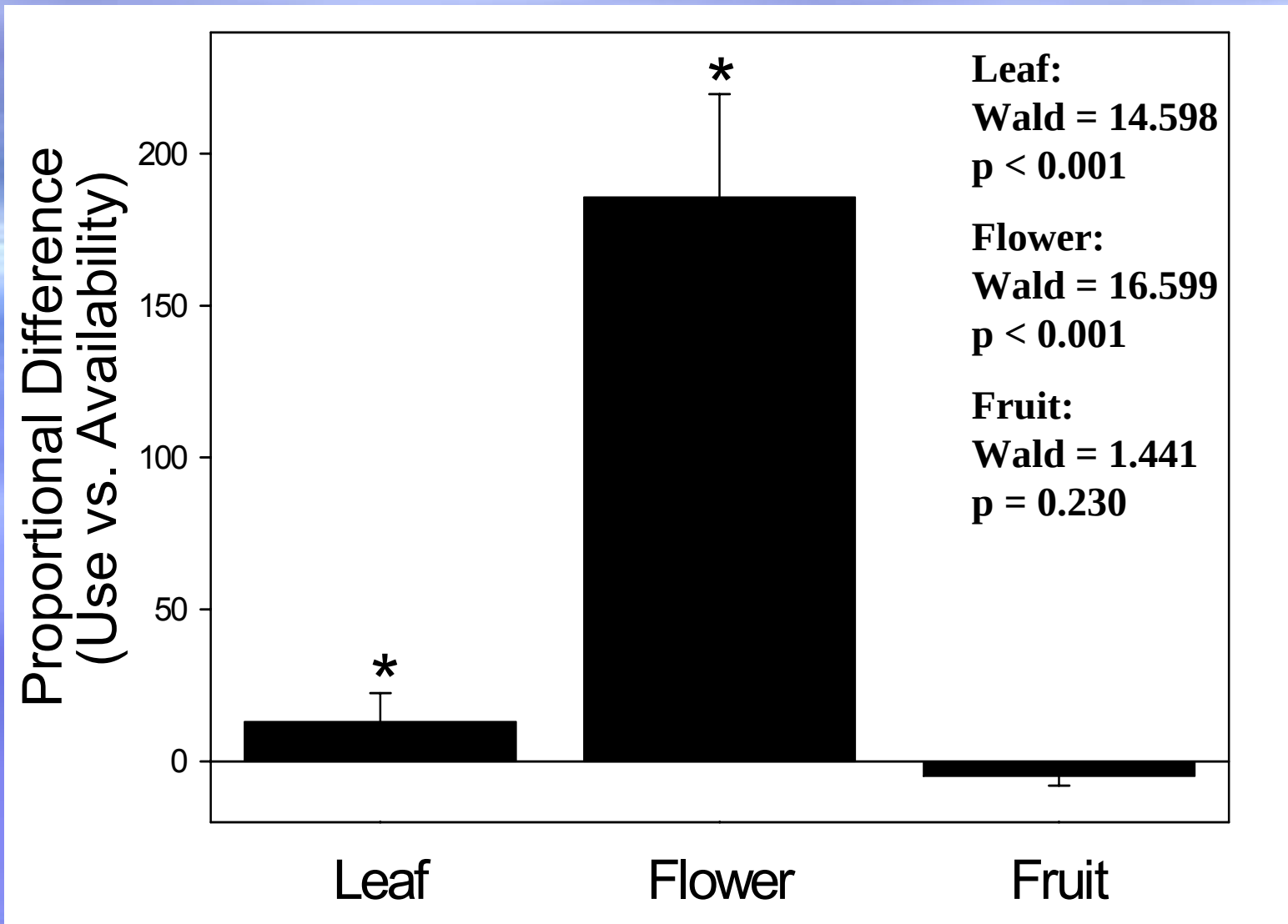
Migrants Forage Preferentially in Honey Mesquite

Honey Mesquite:
$t_3 = 5.299$, $p = 0.013$

Cottonwood:
$t_3 = -6.587$, $p = 0.008$

Tamarisk:
$t_3 = -7.087$, $p = 0.006$

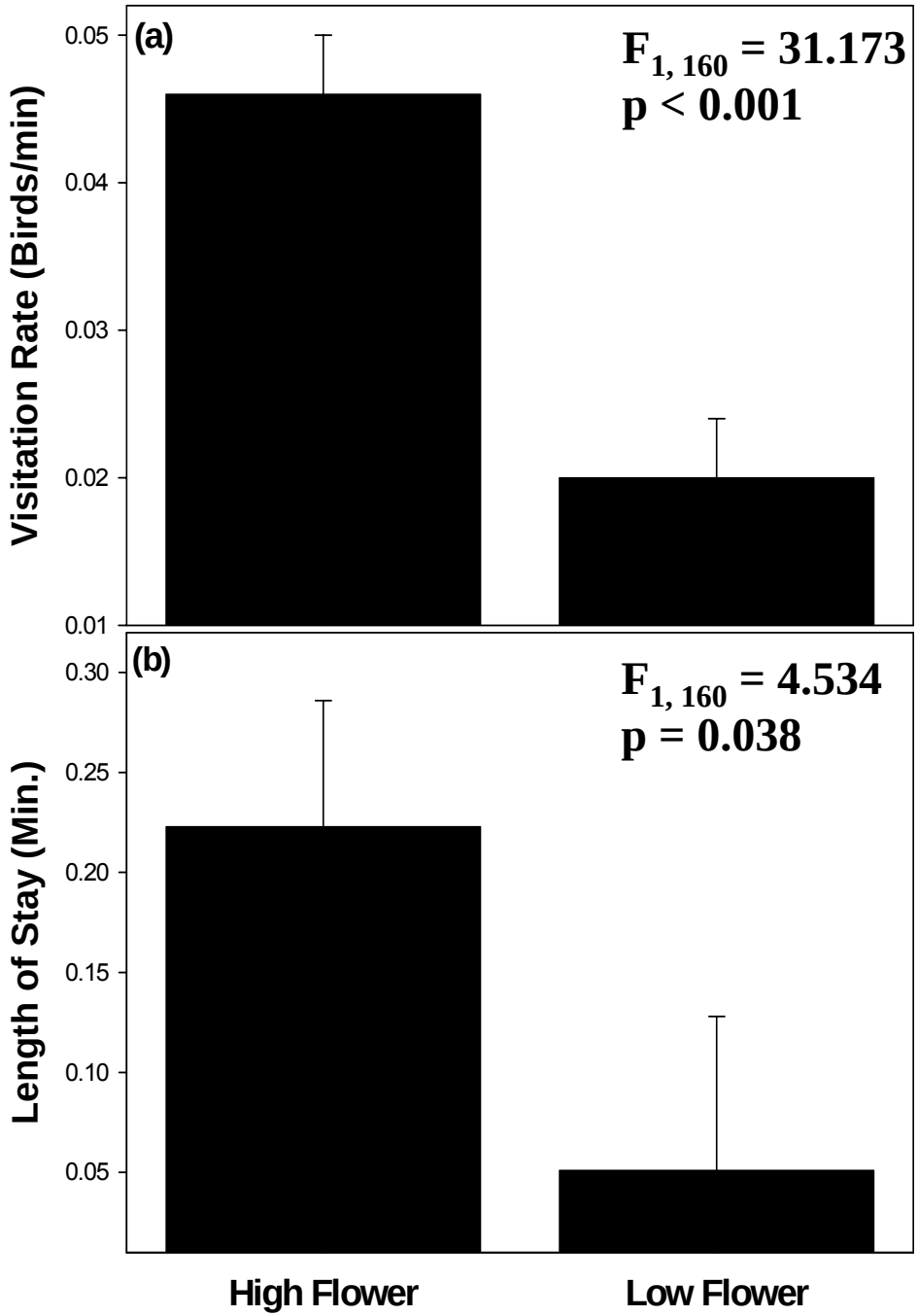
Migrants Forage Preferentially in Honey Mesquite with More Leaves and Flowers



Reduced Flower Phenology < 10 % Coverage

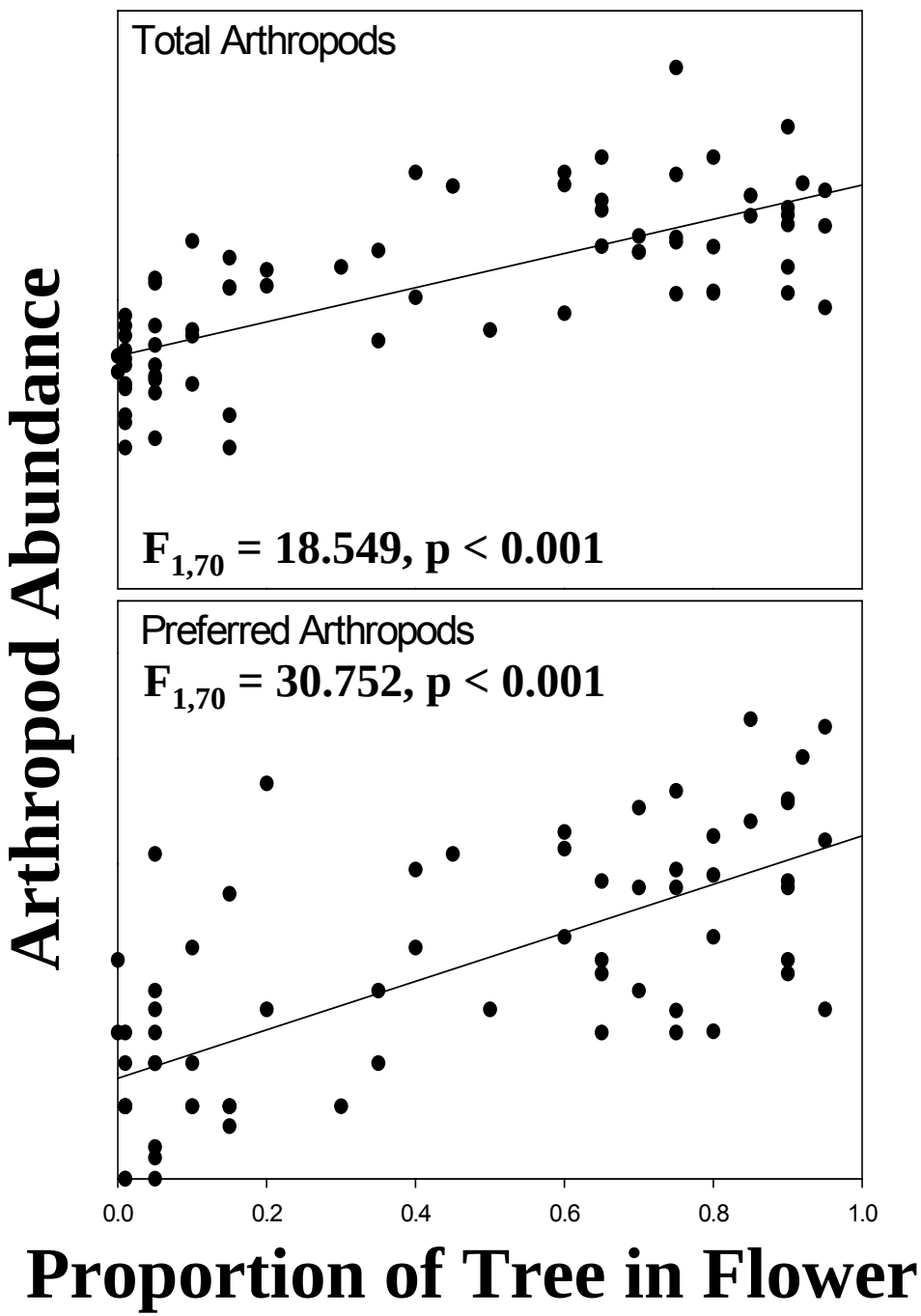
Vs.

Natural Flower Phenology > 30% Coverage



Migrants Prefer Honey Mesquite with more Flowers

Clearly migrants use the flowering phenology as a cue when selecting stopover habitats, but do they predict food availability?



Honey Mesquite Flowering Phenology Predicts Food Availability

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IV. Adaptive Habitat Selection

- **Habitat decisions can only be considered adaptive if they convey a fitness benefit**

IV. Adaptive Habitat Selection

But many studies don't measure fitness consequences…

Necessary Ingredients:

1. Measure habitat preference

2. Compare fitness among habitats

3. Ask whether preferred habitats convey the highest fitness?

IV. Adaptive Habitat Selection

Do birds assess nest predation risk when choosing nesting habitats?

IV. Adaptive Habitat Selection

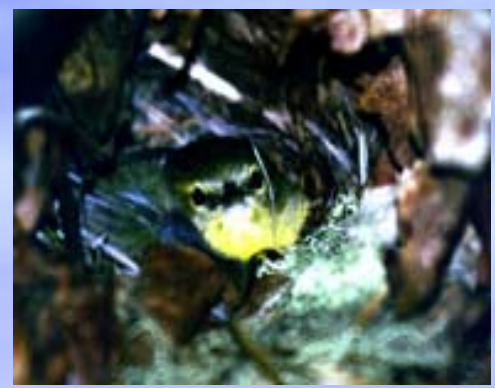
Necessary Ingredients:

1. Measure habitat preference
2. Compare fitness among habitats
3. Ask whether preferred habitats convey the highest fitness?

Reduced Nest Predator Abundance

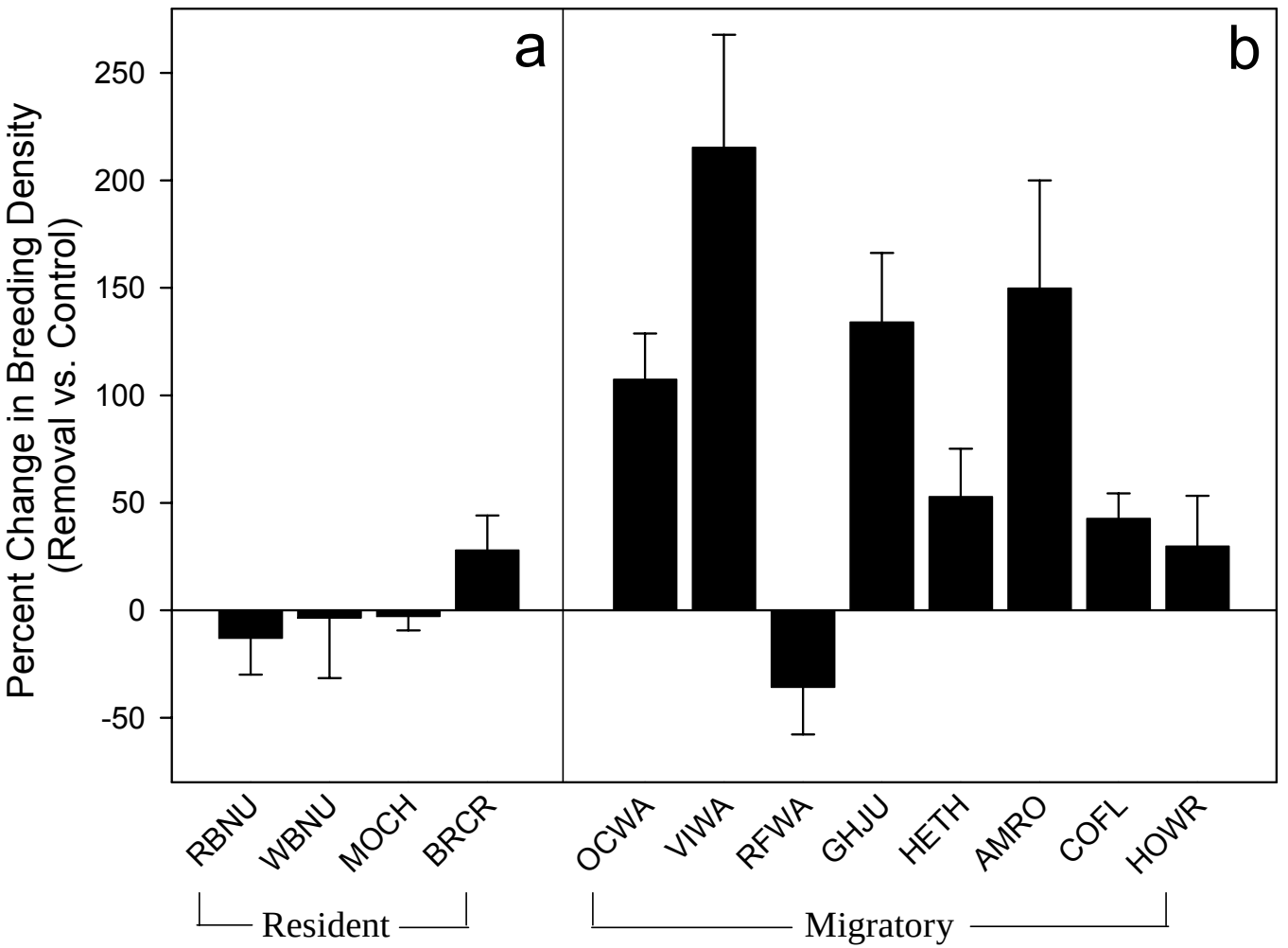
Vs.

Natural Nest Predator Abundance



IV. Adaptive Habitat Selection

(Fontaine and Martin 2006)



Birds settled at higher densities on plots with reduced nest predation risk.

IV. Adaptive Habitat Selection

Necessary Ingredients:

1. Measure habitat preference

2. Compare fitness among habitats

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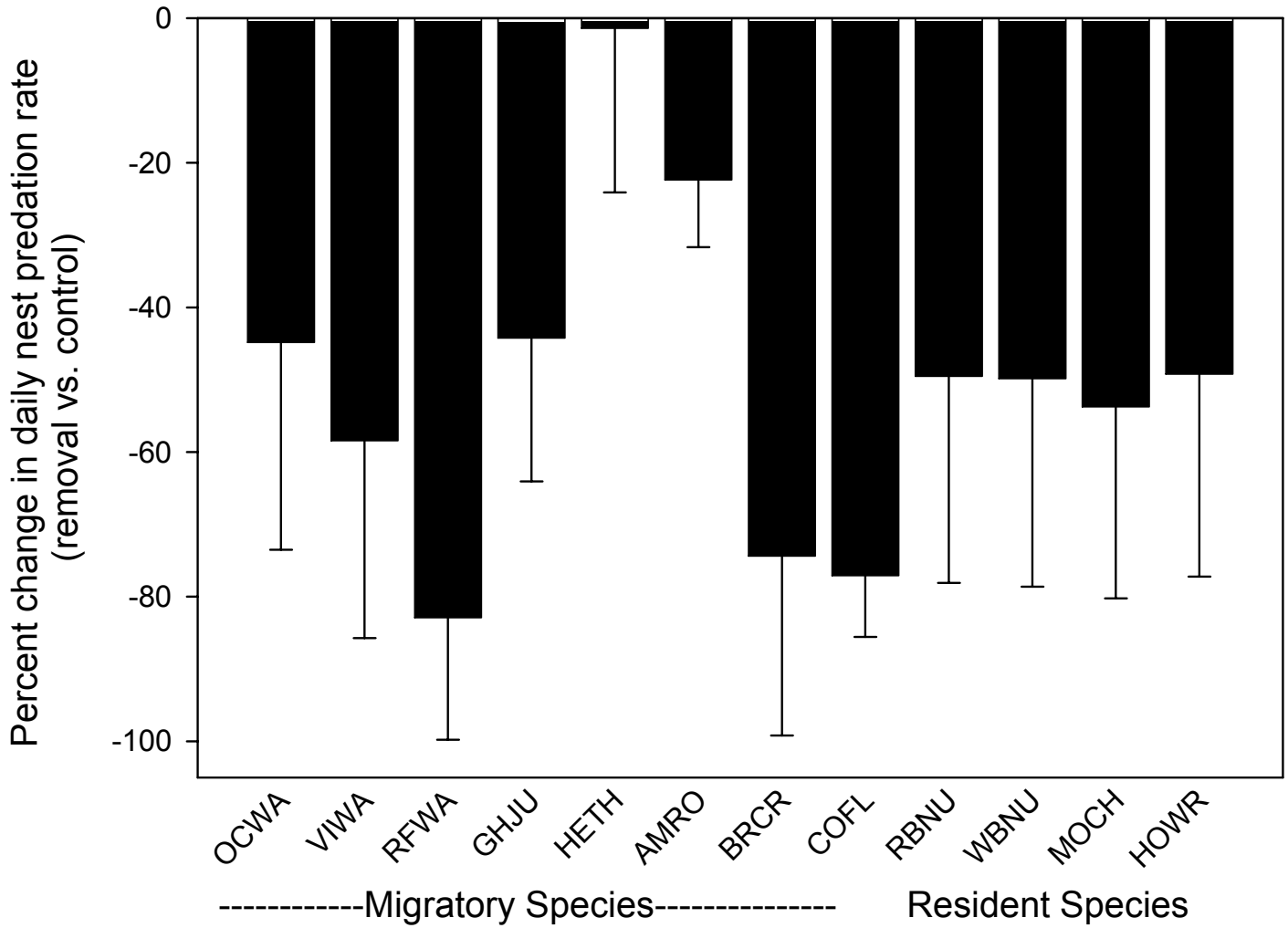
IV. Adaptive Habitat Selection

(Fontaine and Martin 2006)



Nest success higher on experimental removal plots

IV. Adaptive Habitat Selection

Necessary Ingredients:

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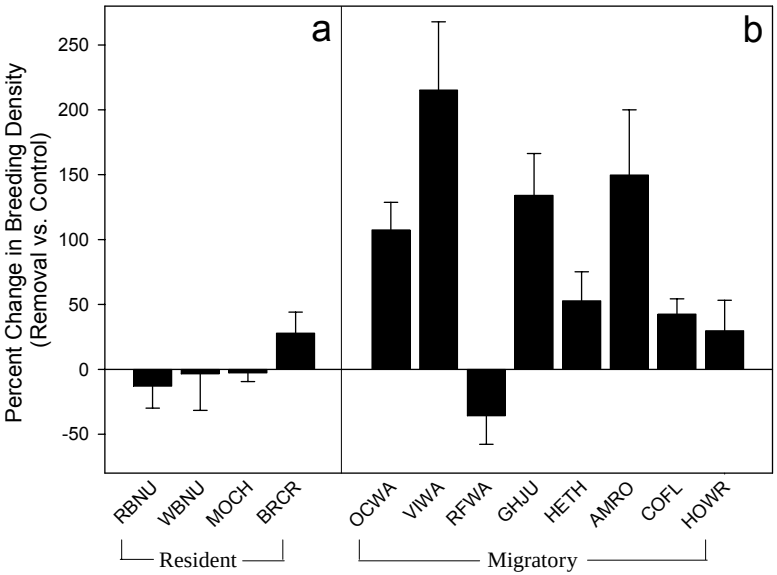
2. Compare fitness among habitats

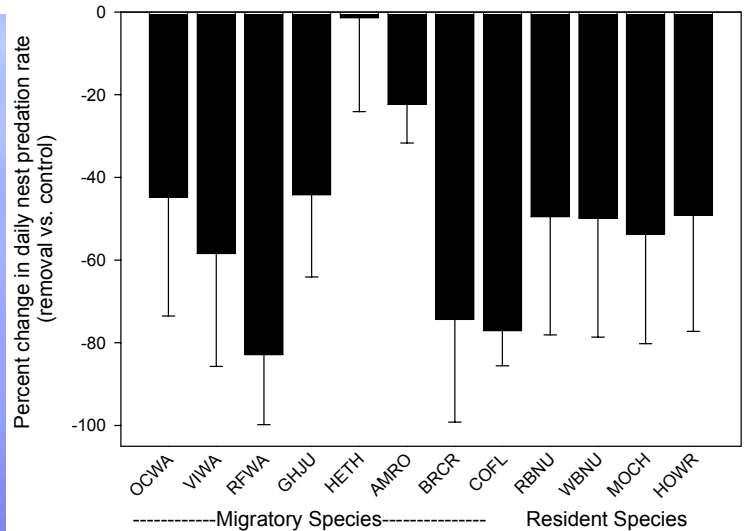
3. Ask whether preferred habitats convey the highest fitness?

IV. Adaptive Habitat Selection

(Fontaine and Martin 2006)



Nesting birds demonstrated adaptive habitat selection in response to nest predation risk



IV. Adaptive Habitat Selection

Necessary Ingredients:

1. Measure habitat preference

2. Compare fitness among habitats

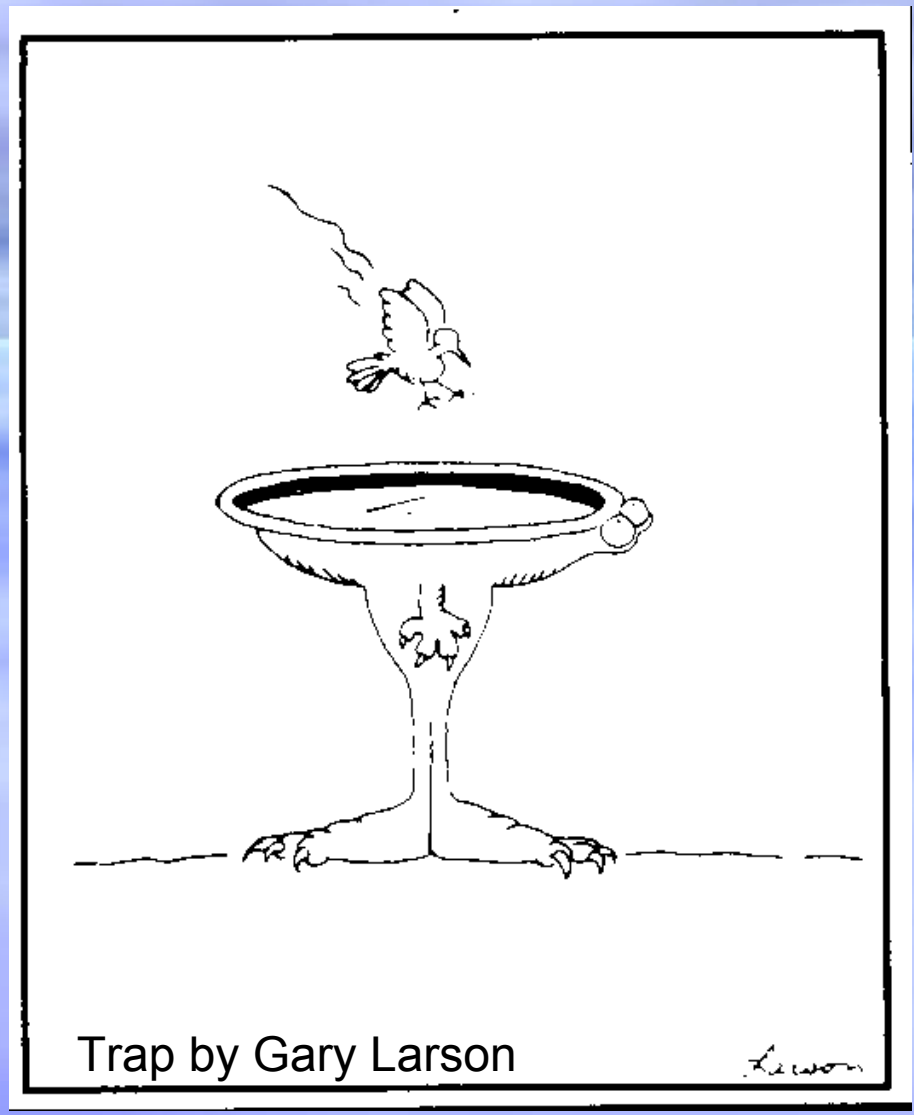
3. Ask whether preferred habitats convey the highest fitness?

IV. Adaptive Habitat Selection

But what if birds prefer habitats that lower fitness?

ECOLOGICAL TRAP

- Animals prefer poorer quality habitats because settlement cues no longer correlated with evolved fitness outcomes (Schlaepfer et al. 2002)

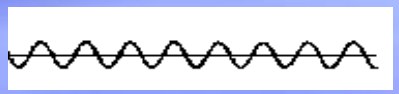


The general mechanism

NATURAL ENVIRONMENT

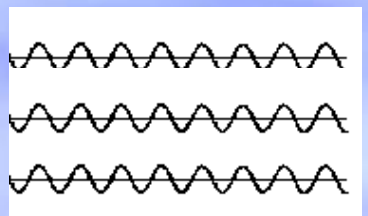
ECOLOGICAL TRAP

Attractiveness (behavioral cues) = Fitness outcome



CORRELATED

Attractiveness (behavioral cues) ≠ Fitness outcome



UNCOUPLED

Kriska et al. 1998

Selectively harvested forest is a trap for Olive-sided Flycatcher

Preferred!

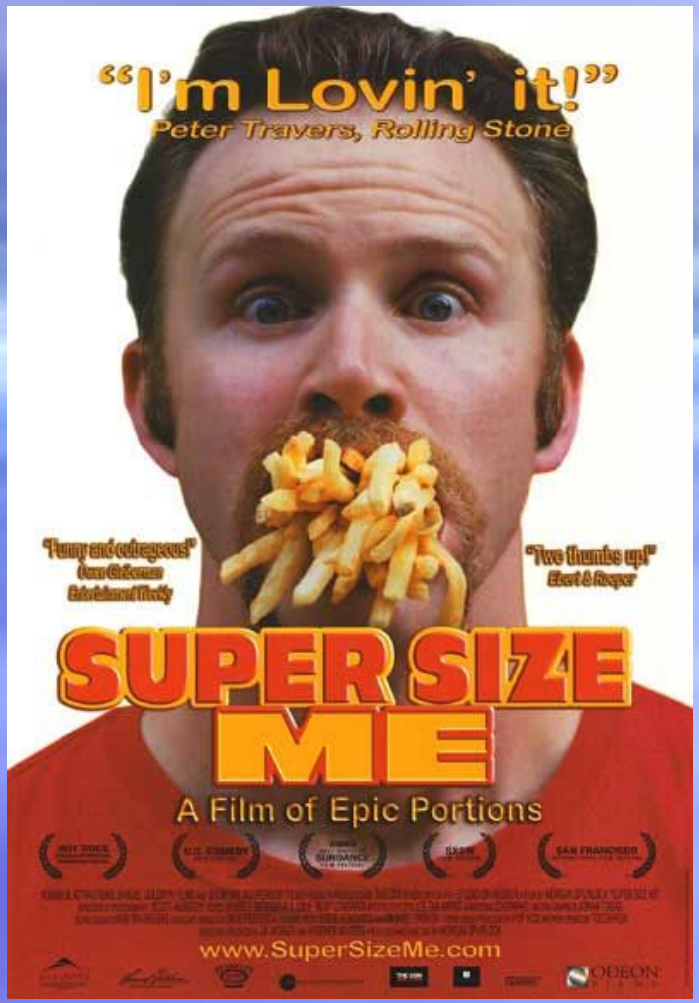
b/c of food availability?

But….3 times more nest predators!

Native habitat: burned forest

Novel habitat: selectively harvested forest

SUPER SIZE ME DUDE!



Humans have evolved to crave fatty foods because they were historically scarce, but fat's are readily available now which may explain the current obesity-related problems like diabetes and heart disease (Schlaepfer et al. 2002).

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SUMMARY:

1. Habitat selection has evolved and learned components

2. There are many habitat selection models but the extent to which they are realistic depends on the assumptions and the system

3. Animals use cues when making habitat choices

4. Habitat preference is usually determined via use vs. availability, but other indices may control for confounding factors (i.e. density-dependence)

5. Habitat preferences can only be considered adaptive if preference conveys fitness benefits