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Sexual selection in an ecological context: Insights from amphipods

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Sexual selection in an ecological context: Insights from amphipods

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Department of Biological Sciences


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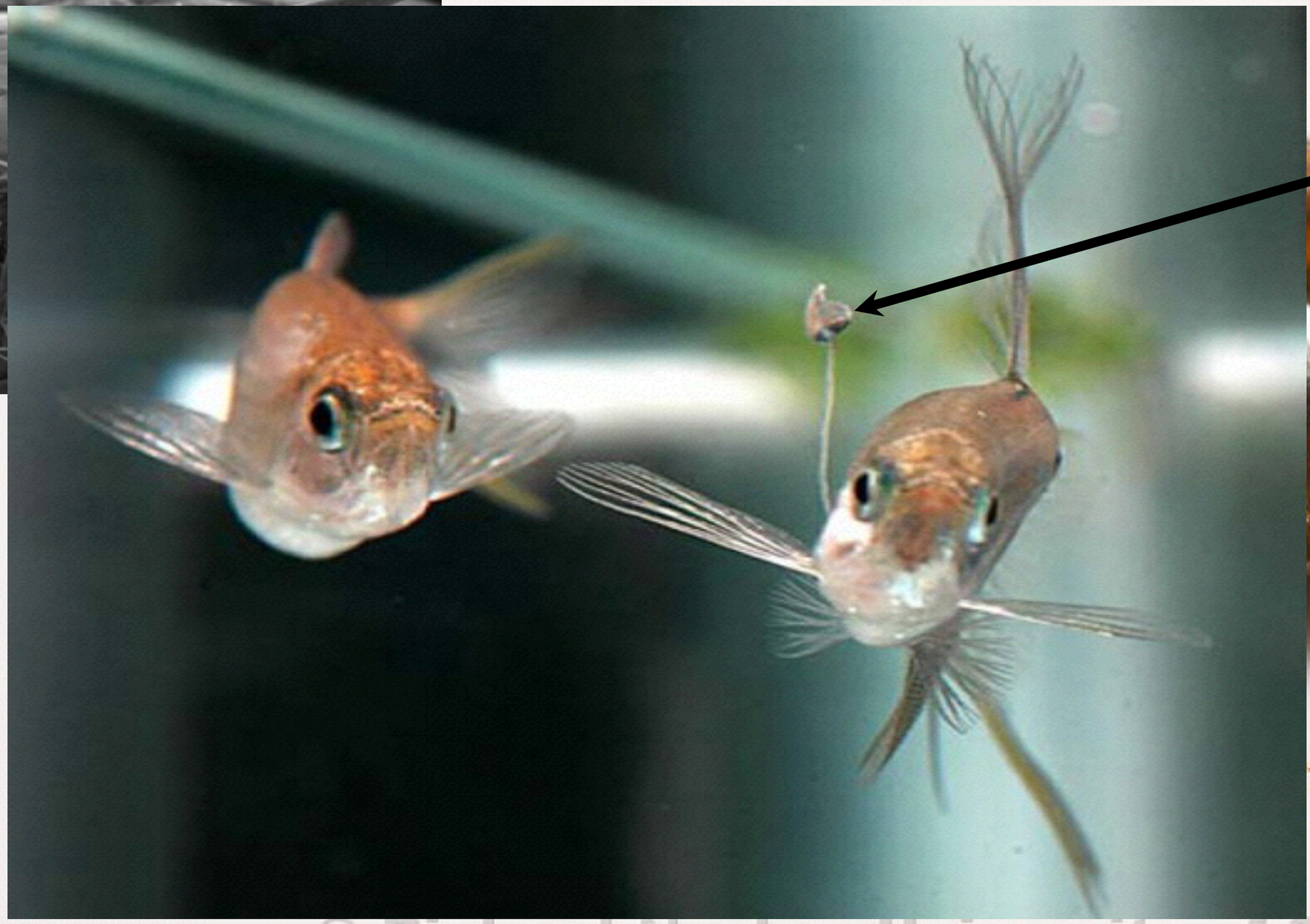
Intrasexual selection

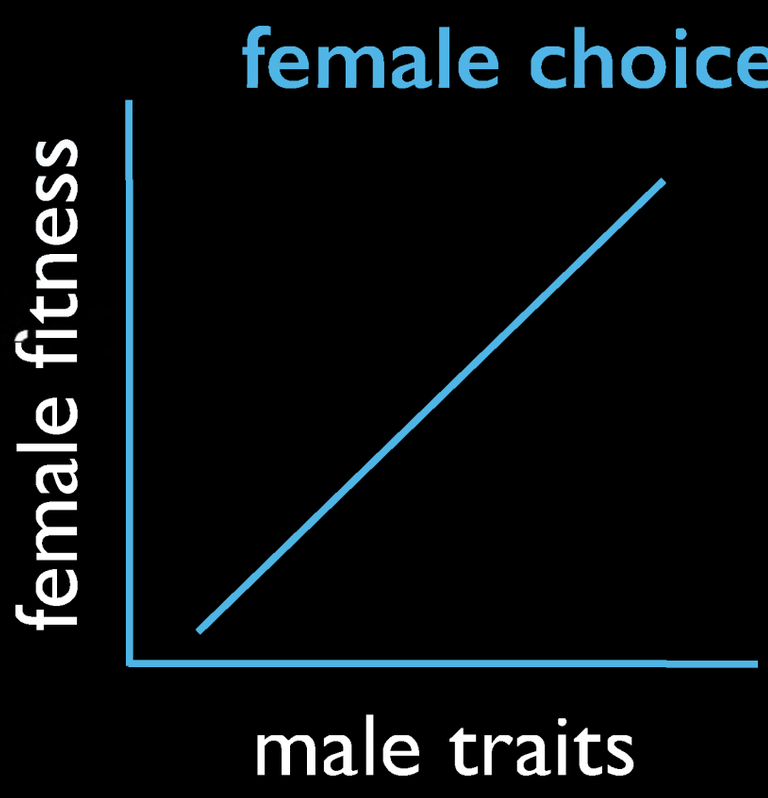
Intersexual selection

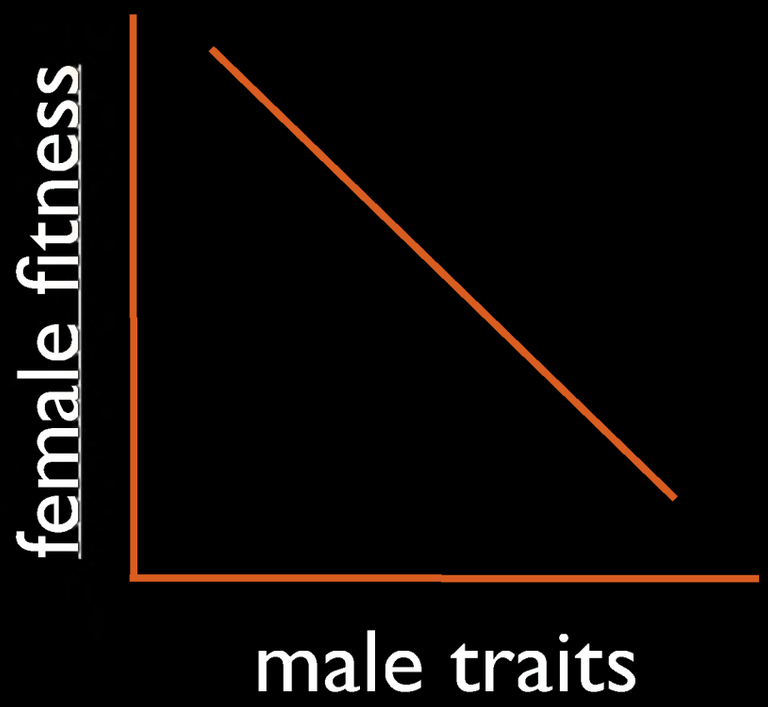
Sexual conflict



Why does understanding the mechanism of sexual selection matter?

Population-level consequences of sexual selection



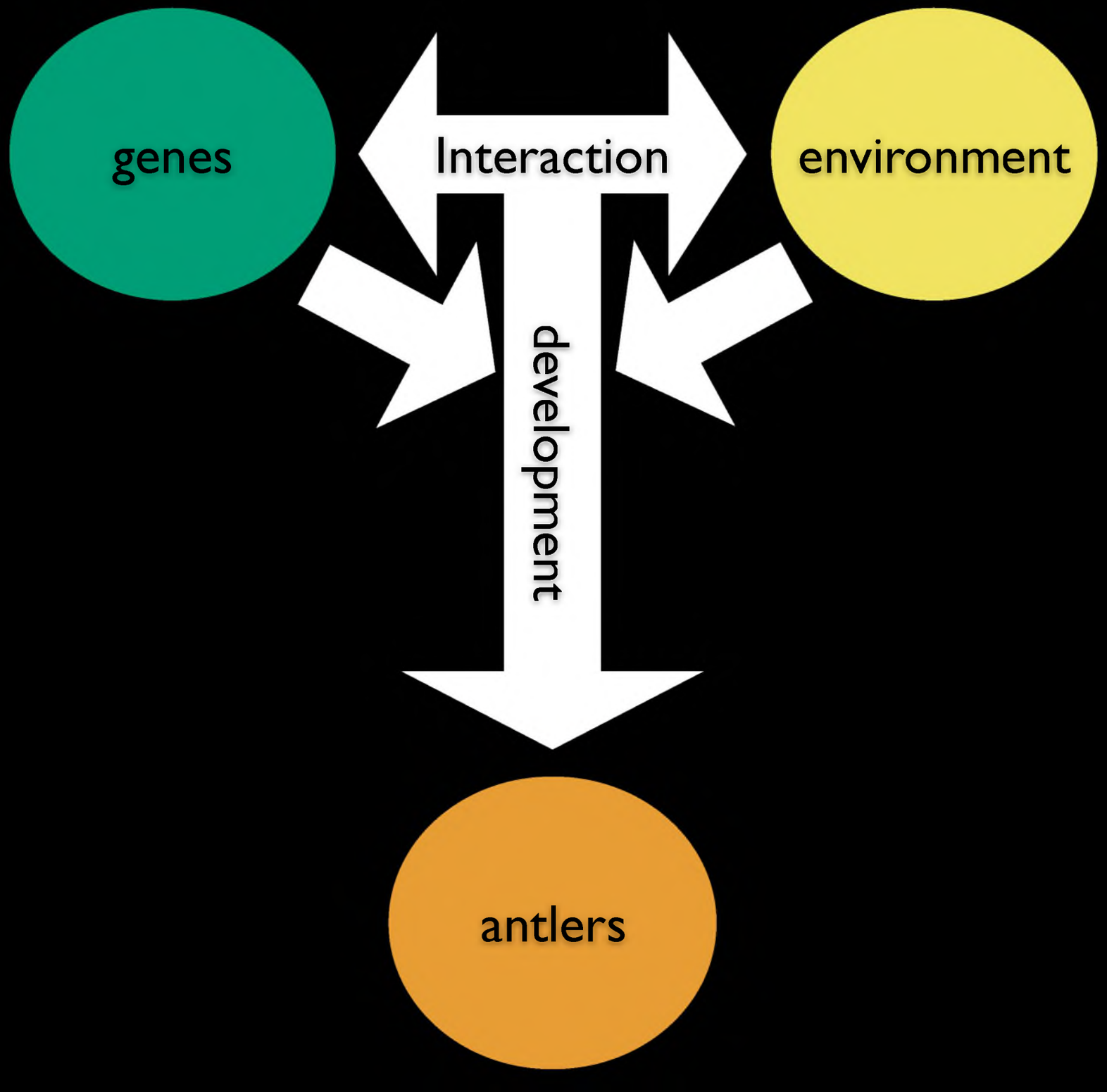


How might the ecological context affect sexual selection?

The environment can affect costs and benefits of mating

photo by Christian Ziegler

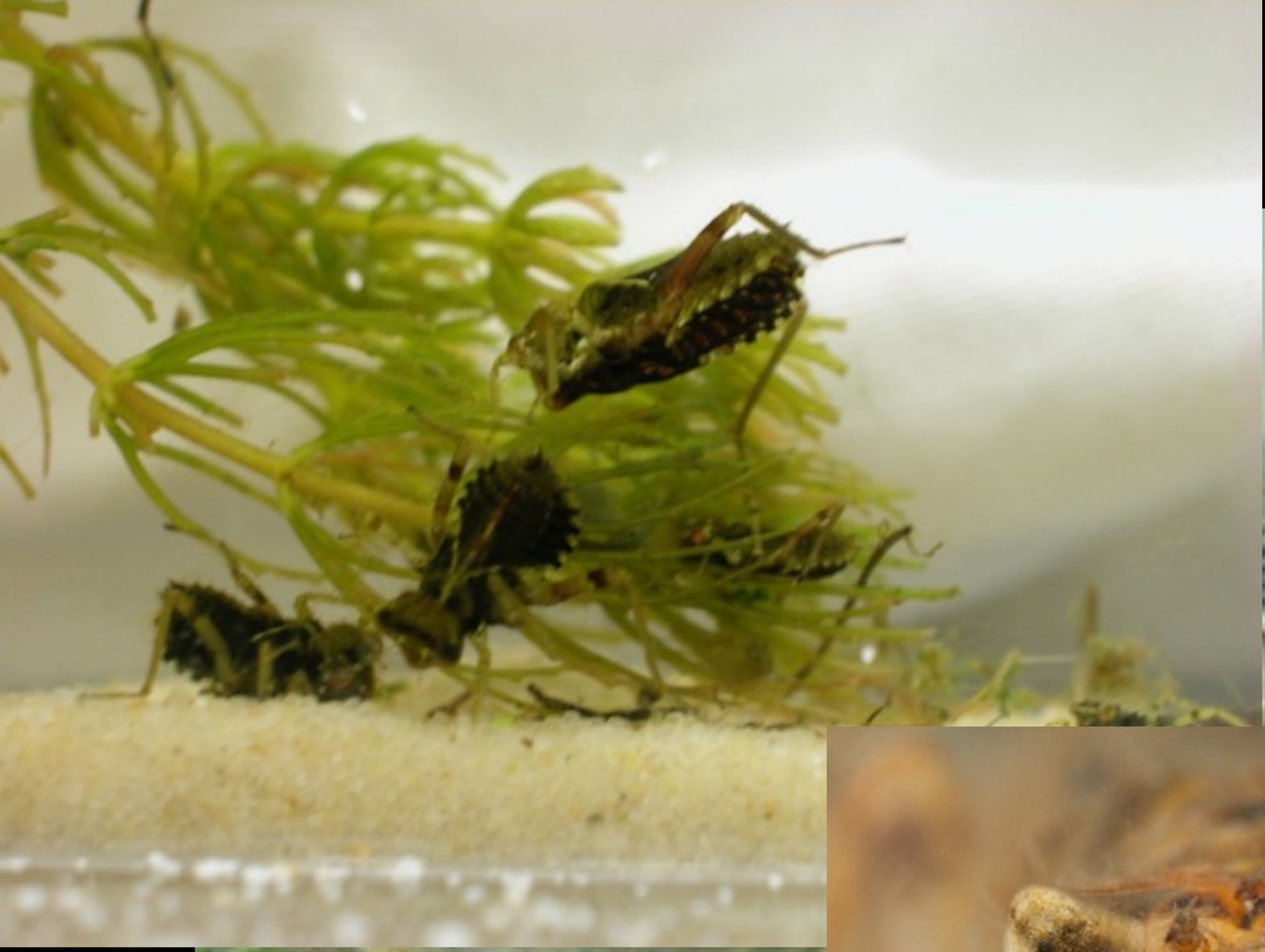
The environment can affect development of mating traits



Humans are rapidly changing the environment:
Consequences for sexual selection?

Amphipod natural history & ecology

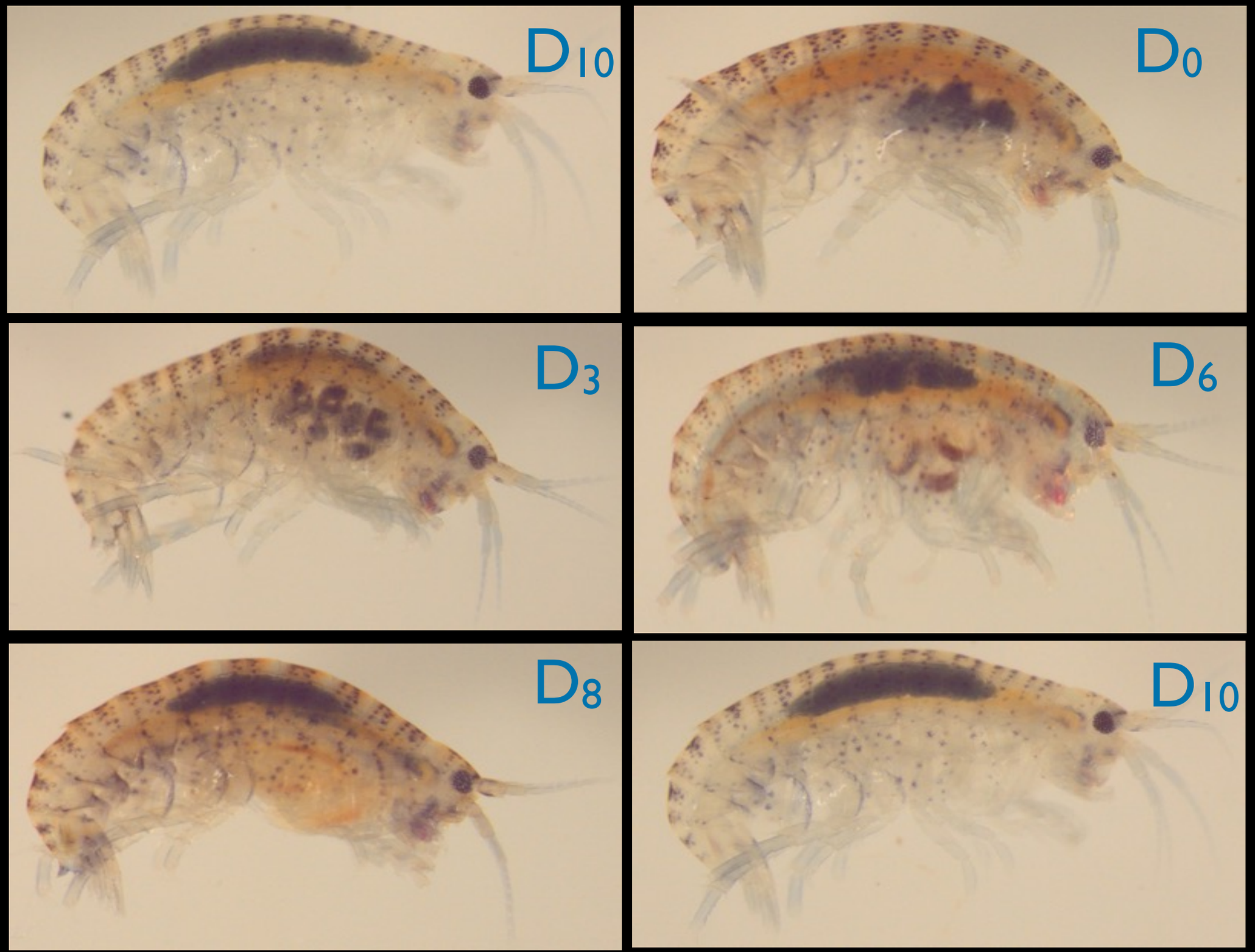
Hyalella amphipods




AQUATIC INSECT . NET
jan hamrsky

Amphipod mating biology

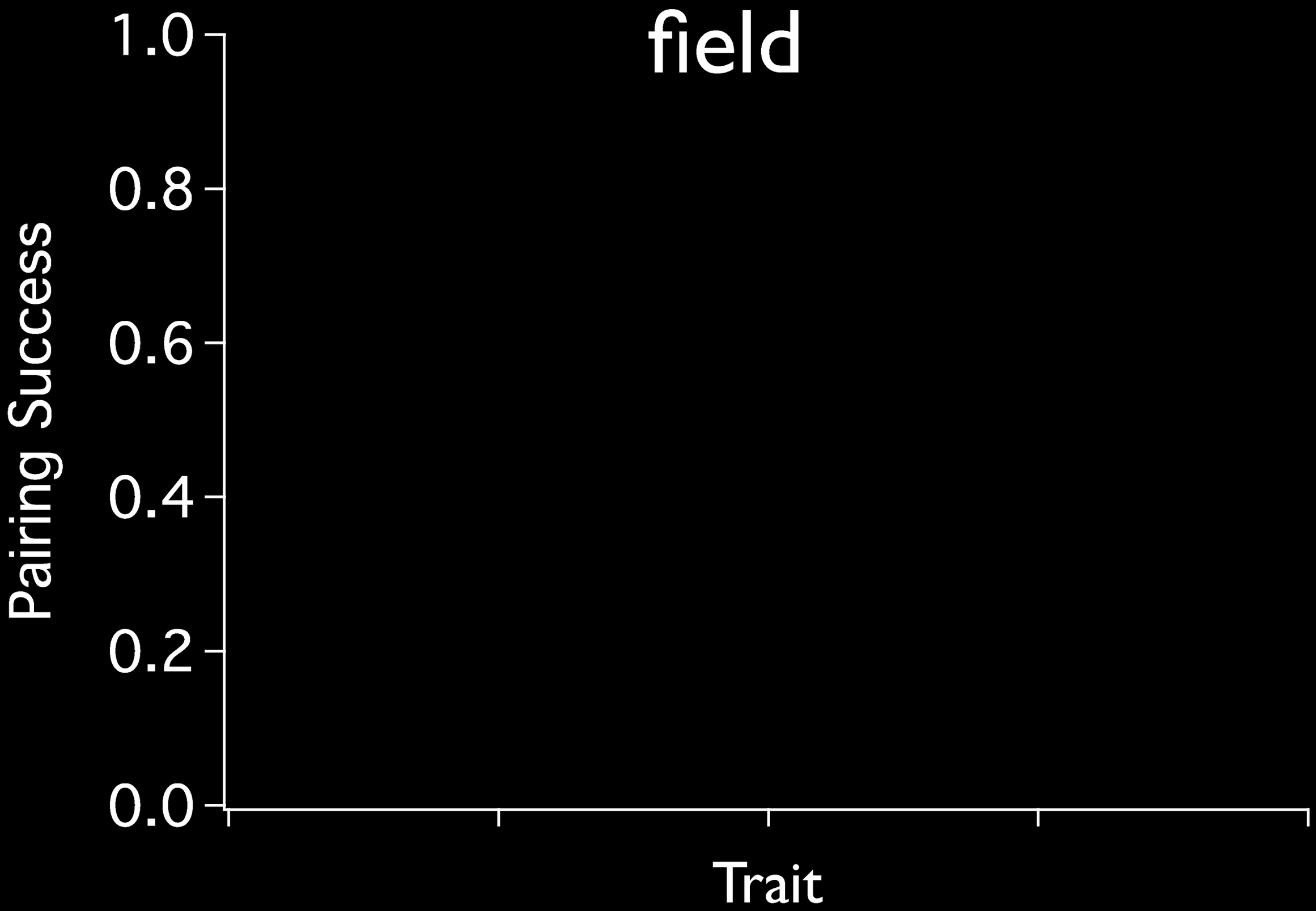
Mating biology tightly linked to the female molt cycle



Consequences of time-limited female receptivity

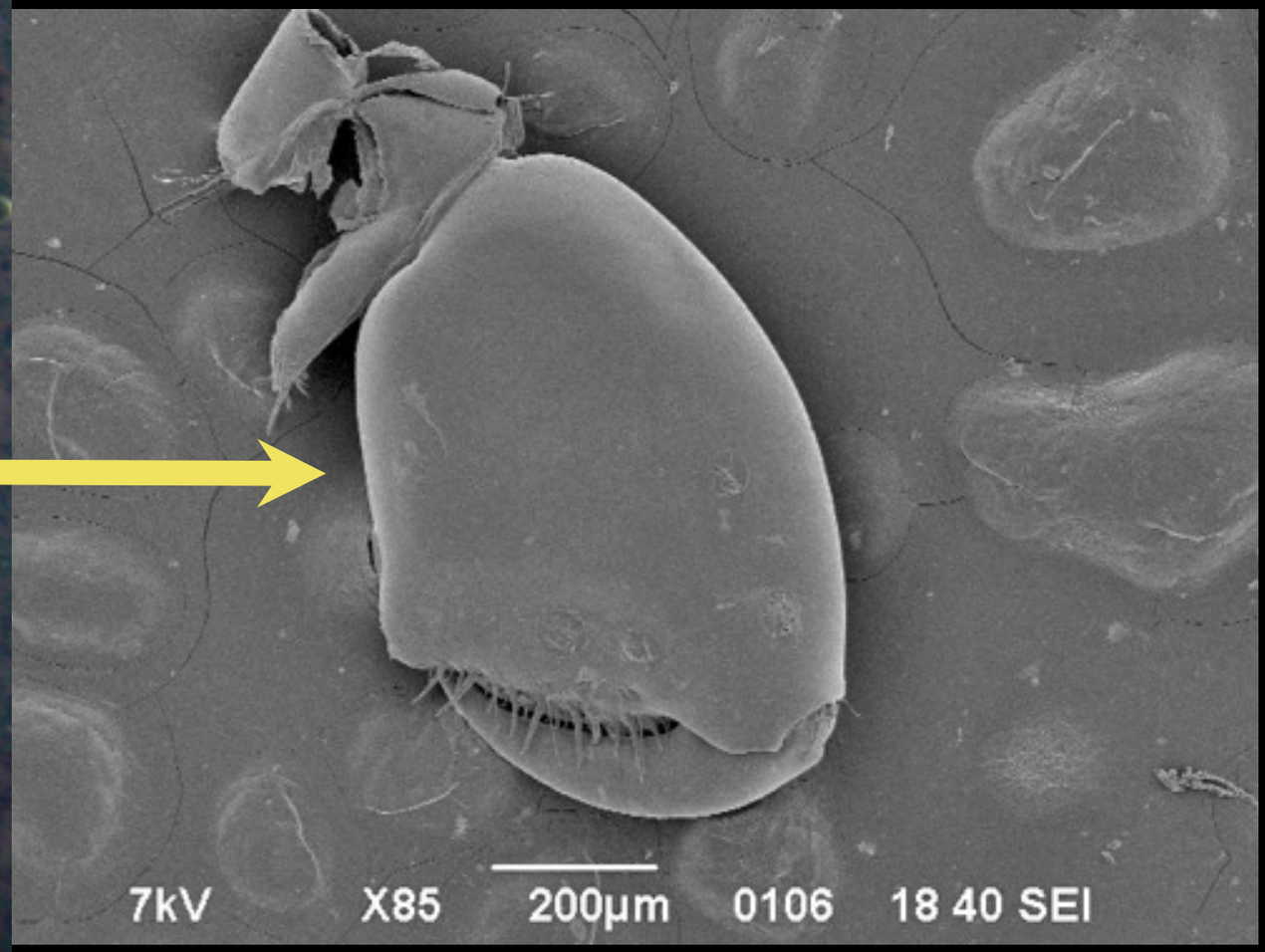
Precopulatory mate guarding

Patterns of selection in the field



Patterns of selection in the
eld

Pairing Success

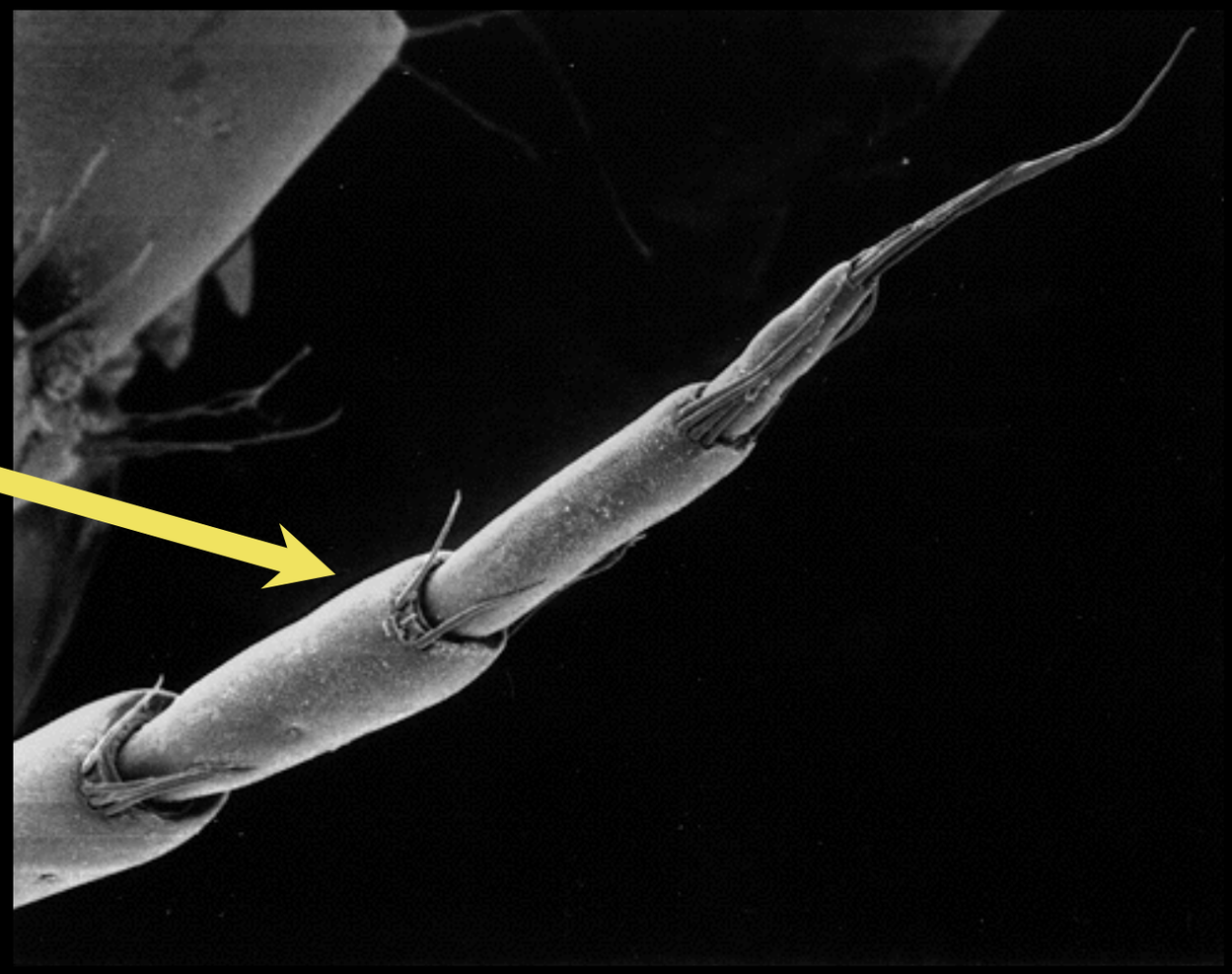


0.55 0.68 0.81

Gnathopod width (mm)

Patterns of selection in the
eld

Pairing S



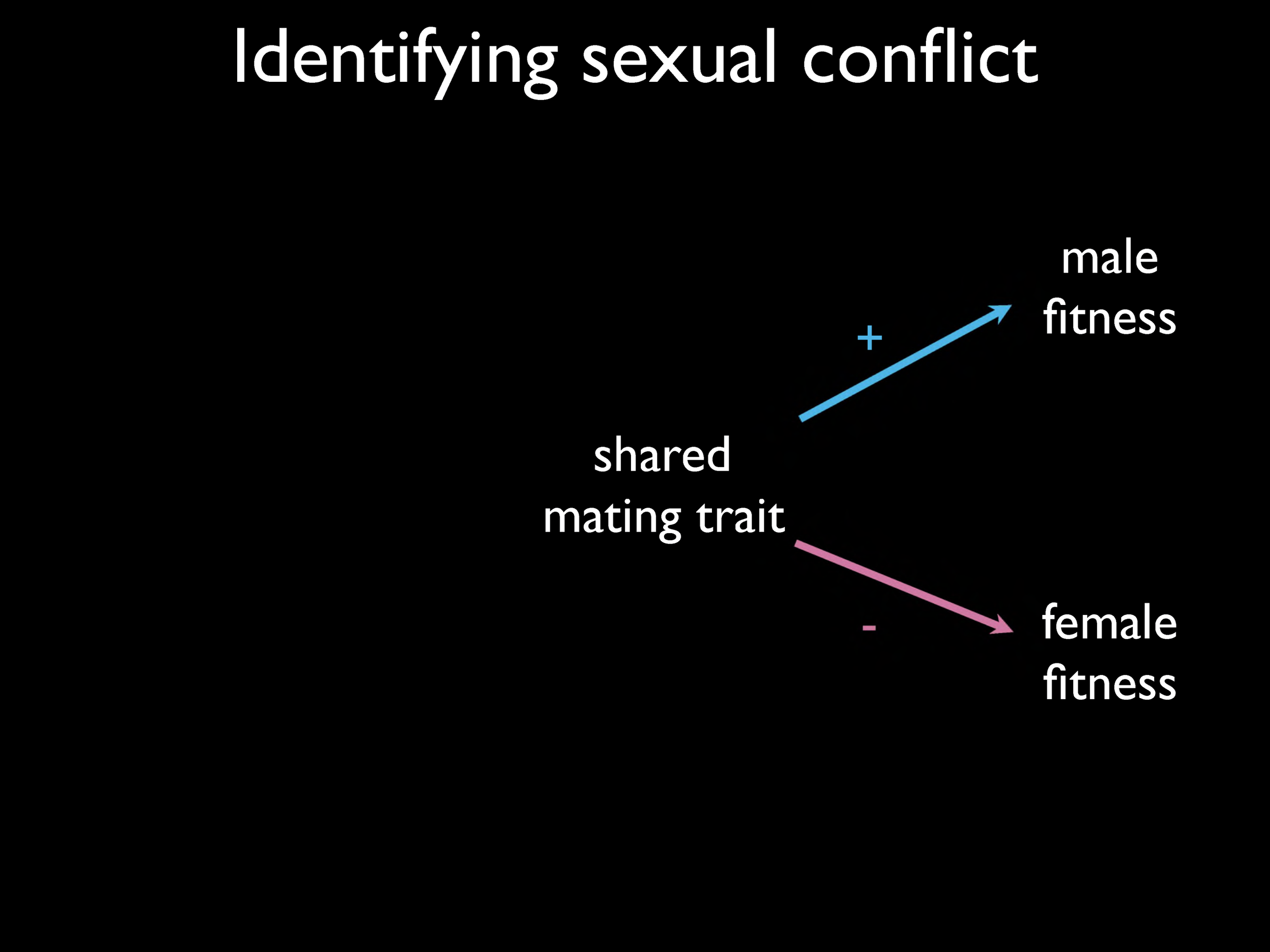
0.37 0.48 0.59

Antenna length (mm)

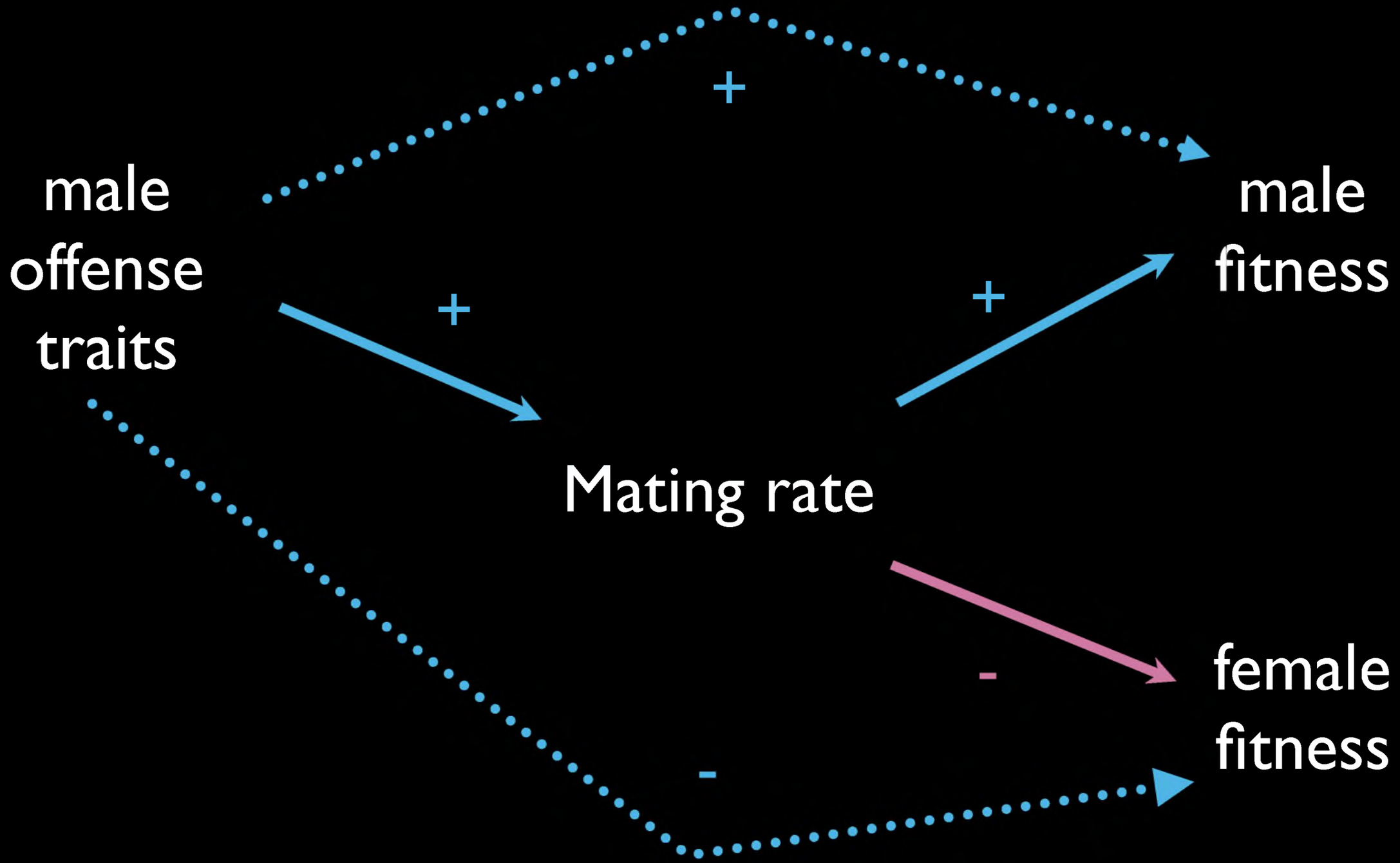
Which mechanism(s) of sexual selection are important?

Is there sexual conflict in *Hyalella* populations?

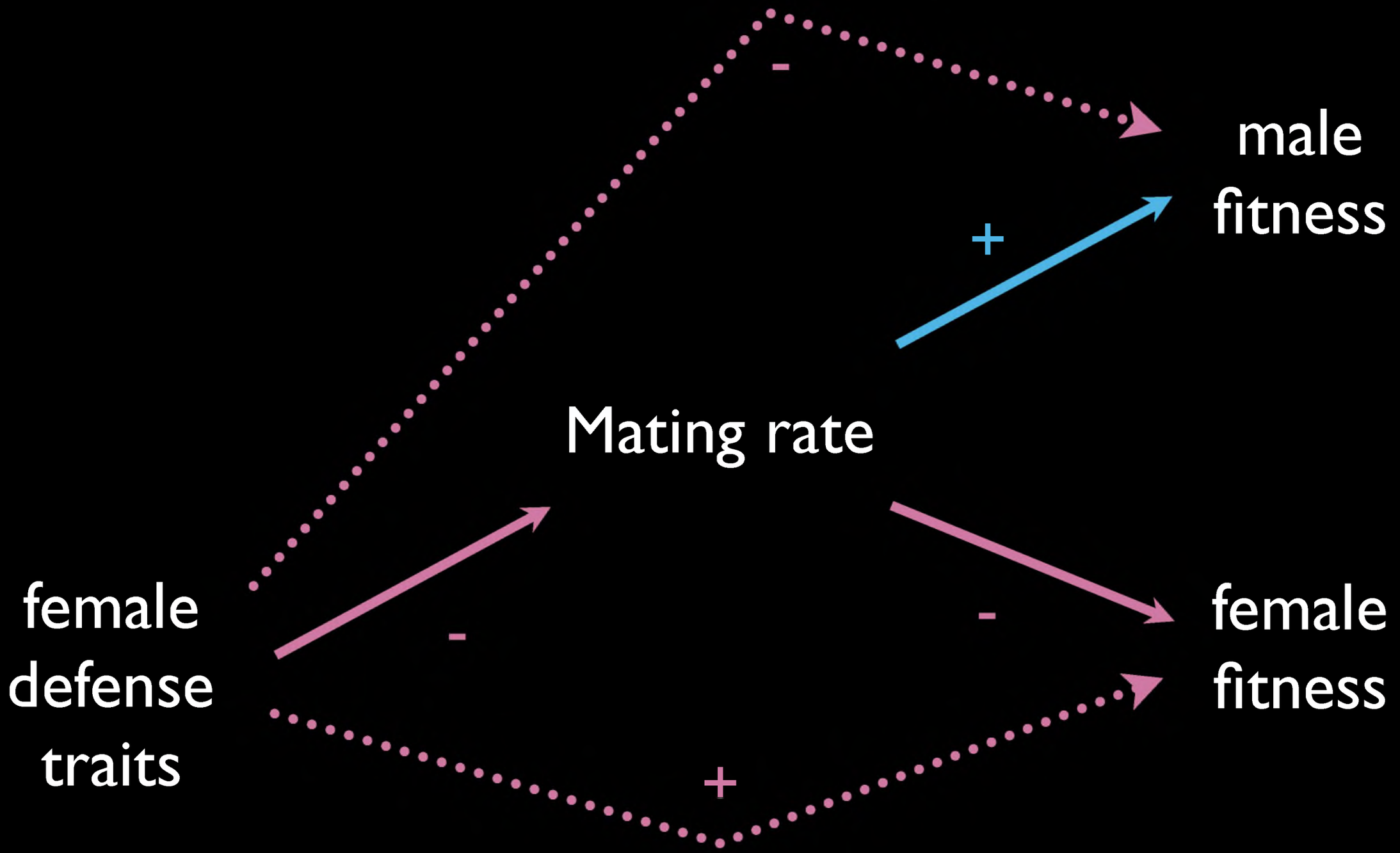
Identifying sexual conflict



Identifying sexual conflict



Identifying sexual conflict



Do the sexes disagree about?

male offense traits

+

female defense traits

-

+

male fitness

-

female fitness

Hypothesis: Disabling a defense/ offense trait should shift the shared mating trait in favor of the opposite sex.

Experiment 1: Does reducing female resistance increase pairing duration?

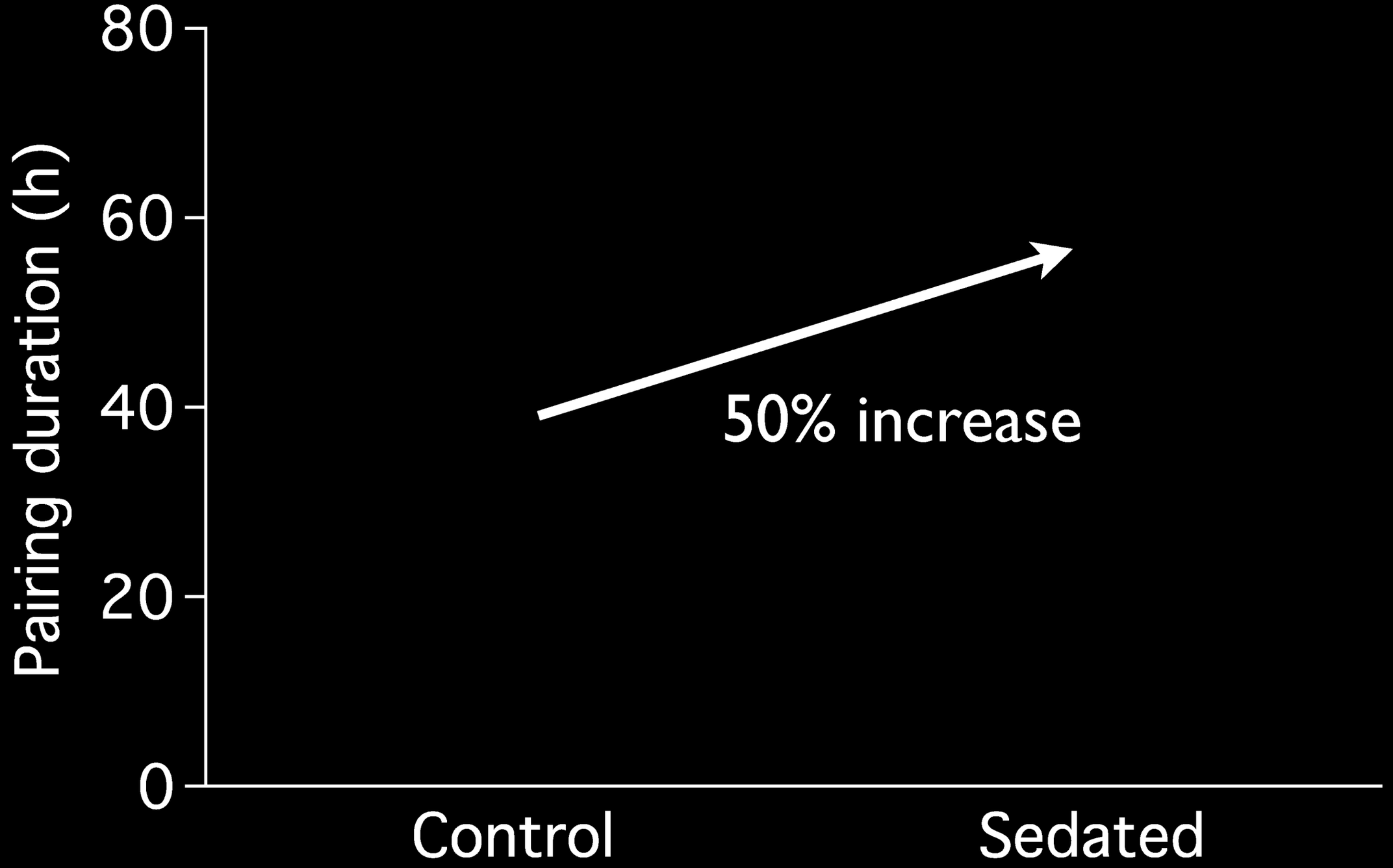
male offense traits

+

female resistance behavior

-

Experiment 1: Does reducing female resistance increase pairing duration?



Experiment 2: Does removing male claws decrease pairing duration?

male claws

+

female resistance behavior

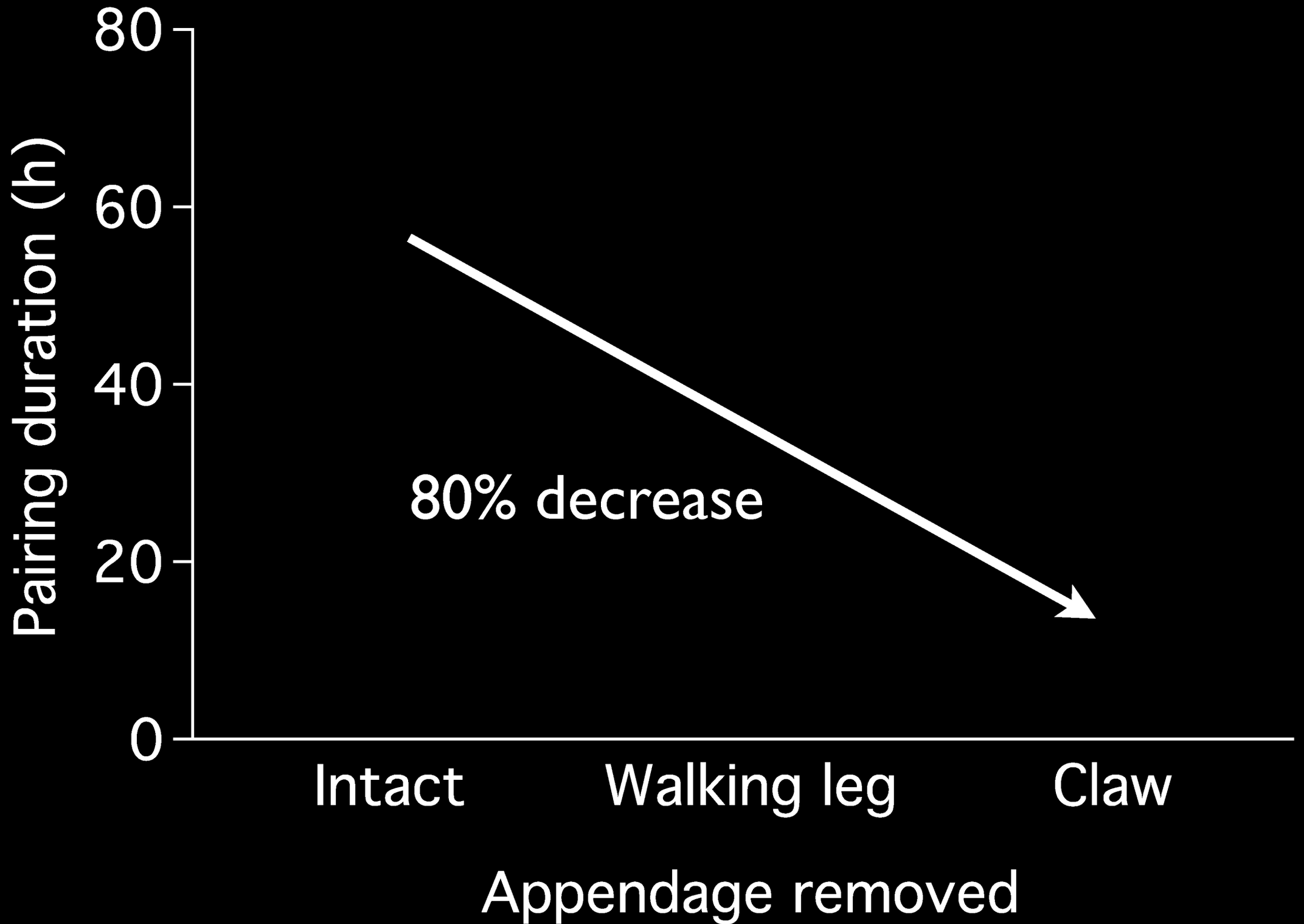
-


MARKET
PLACE

gnathopod
(aka claw)

pereopod
(aka walking leg)

Experiment 2: Does removing male claws decrease pairing duration?



The sexes disagree, but do females pay a cost for losing the conflict?

male fitness

+

-

female fitness

Hypothesis: Spending more time paired will decrease female fitness.

Does pairing increase predation risk?

→ + size selective → pairs > males > females

→ - size selective → males > females > pairs

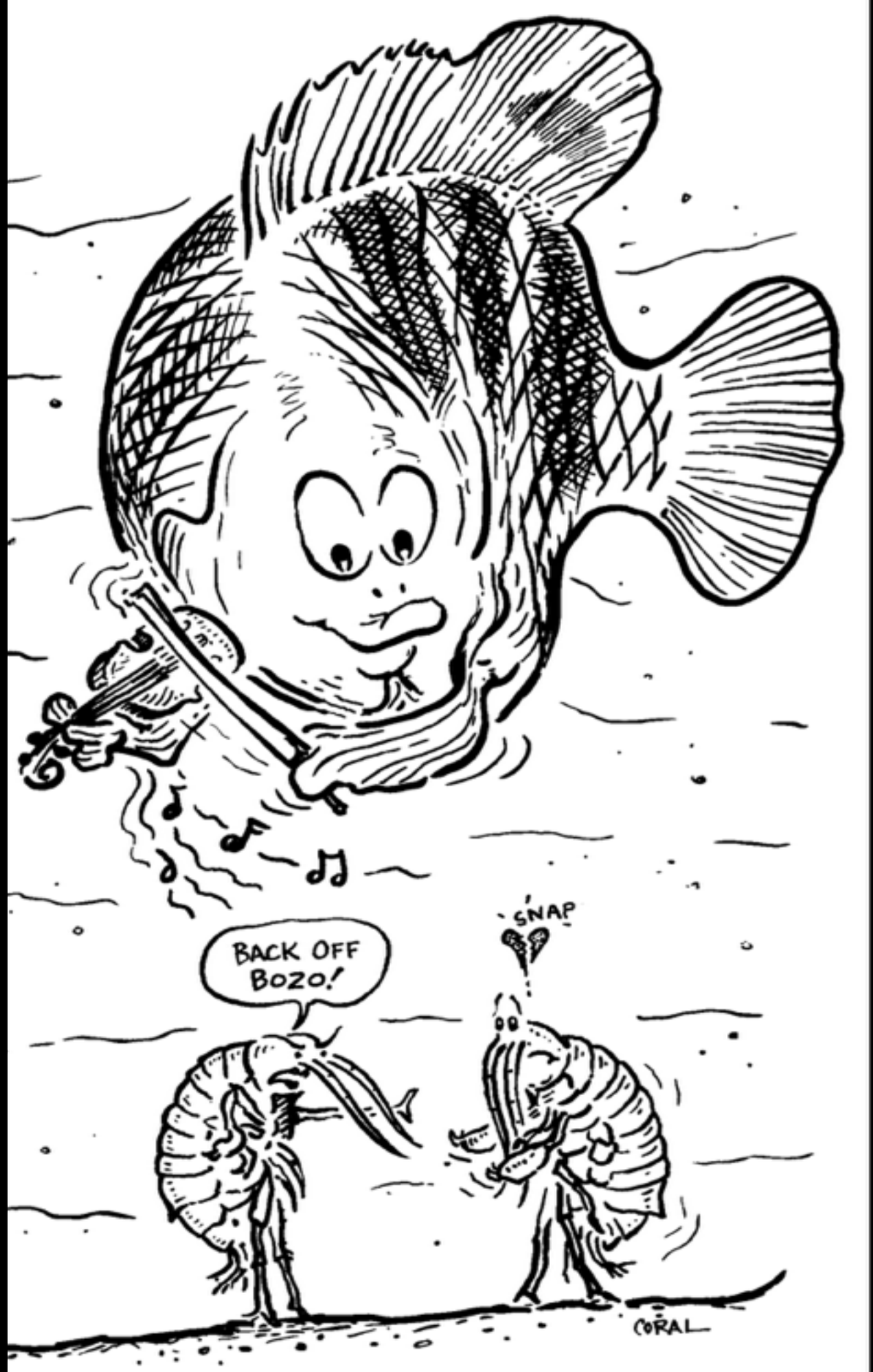
Experiment 1: Do bluegill sunfish prefer to eat pairs?

Experiment 2: Do larval dragonflies prefer to eat single individuals?

sexual conflict

female fitness

male traits



female fitness

?

male traits

In habitats without fish, do females benefit from mating with successful males?

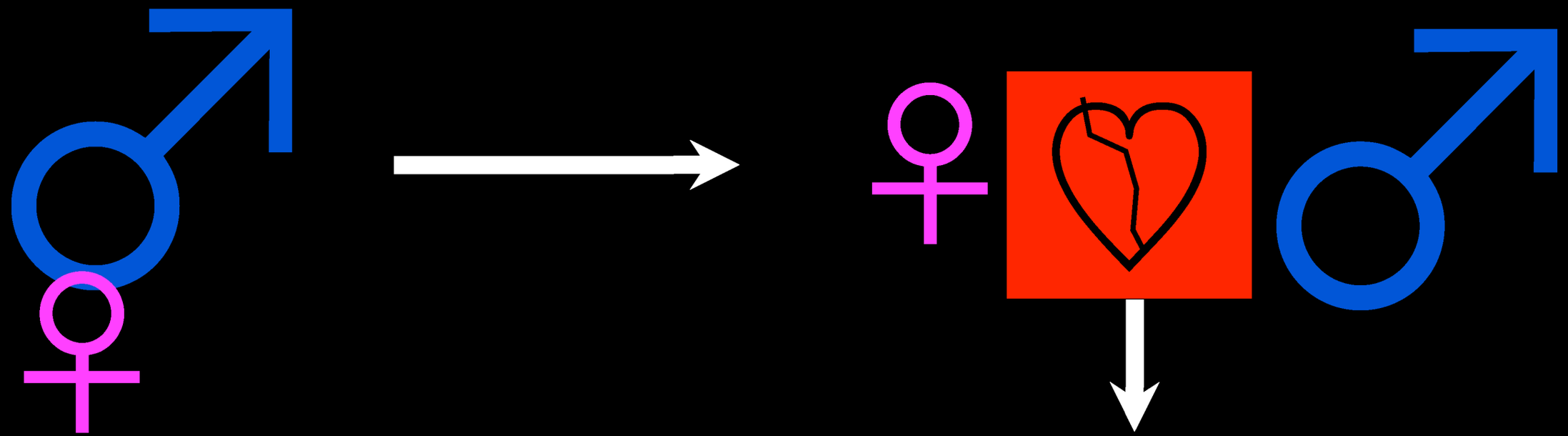
Do choosy females get **direct benefits** while paired?

Does pairing with a larger male decrease a female's predation risk?

Mate guarding is a common strategy in nature!

Do choosy females get **indirect benefits**?

Testing for indirect benefits

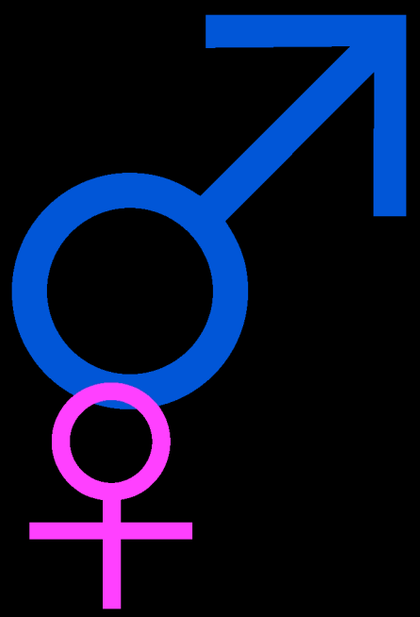


Response variables

Survival
Juvenile growth rate
Daughters' fecundity
Sons' mating success

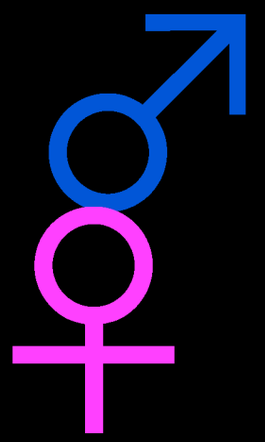
Choice treatments

original

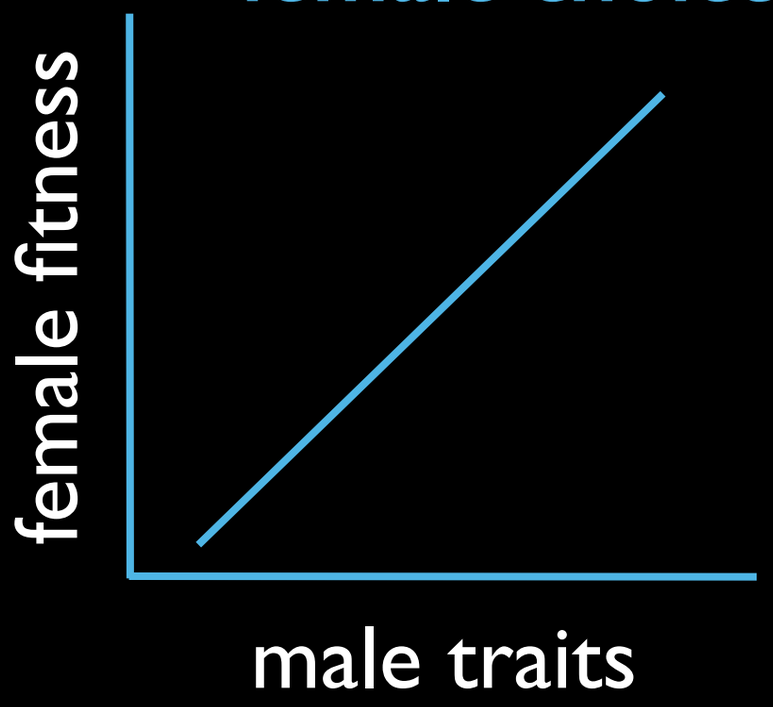


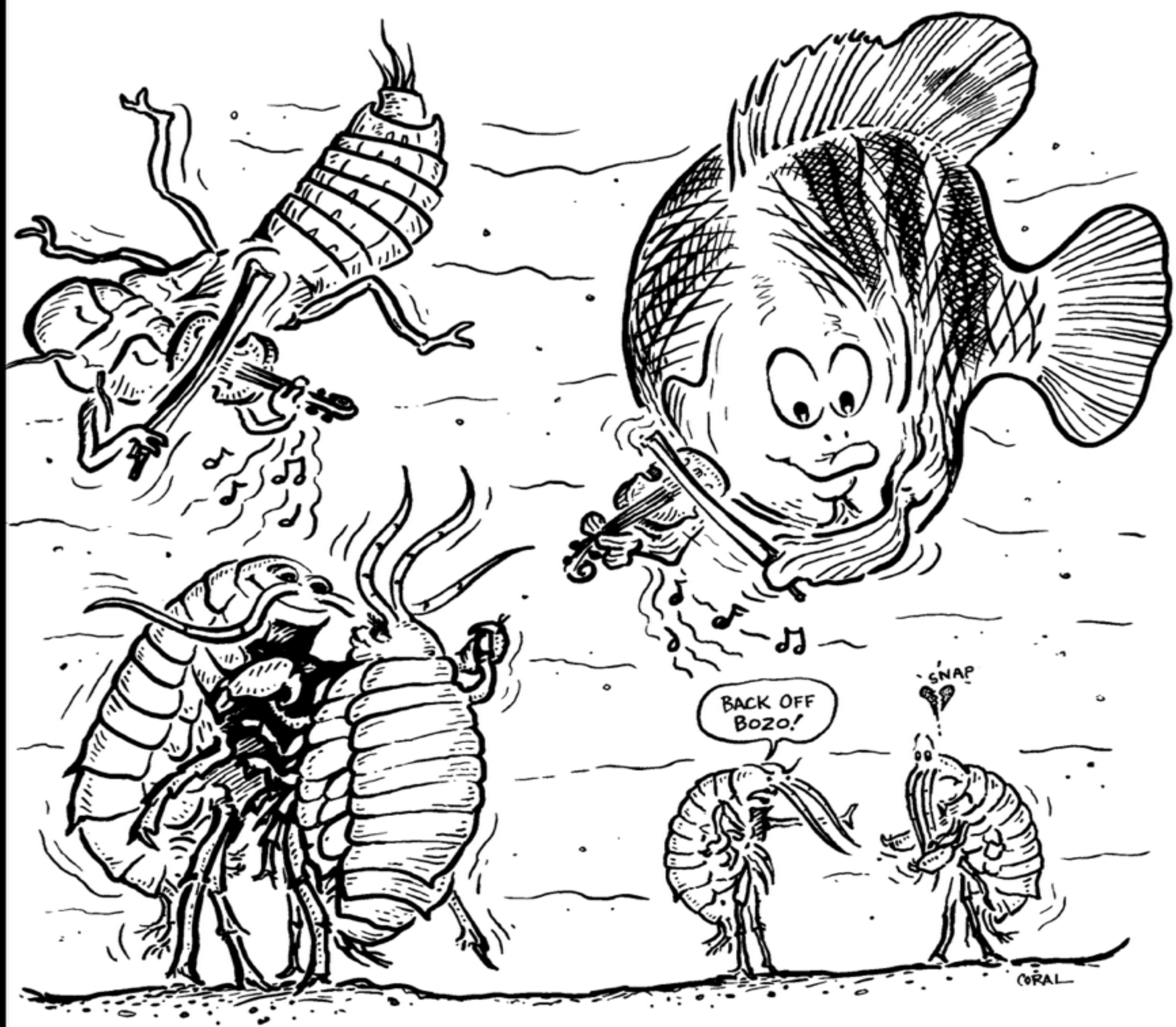
vs.

random



Do choosy females produce sexier sons?

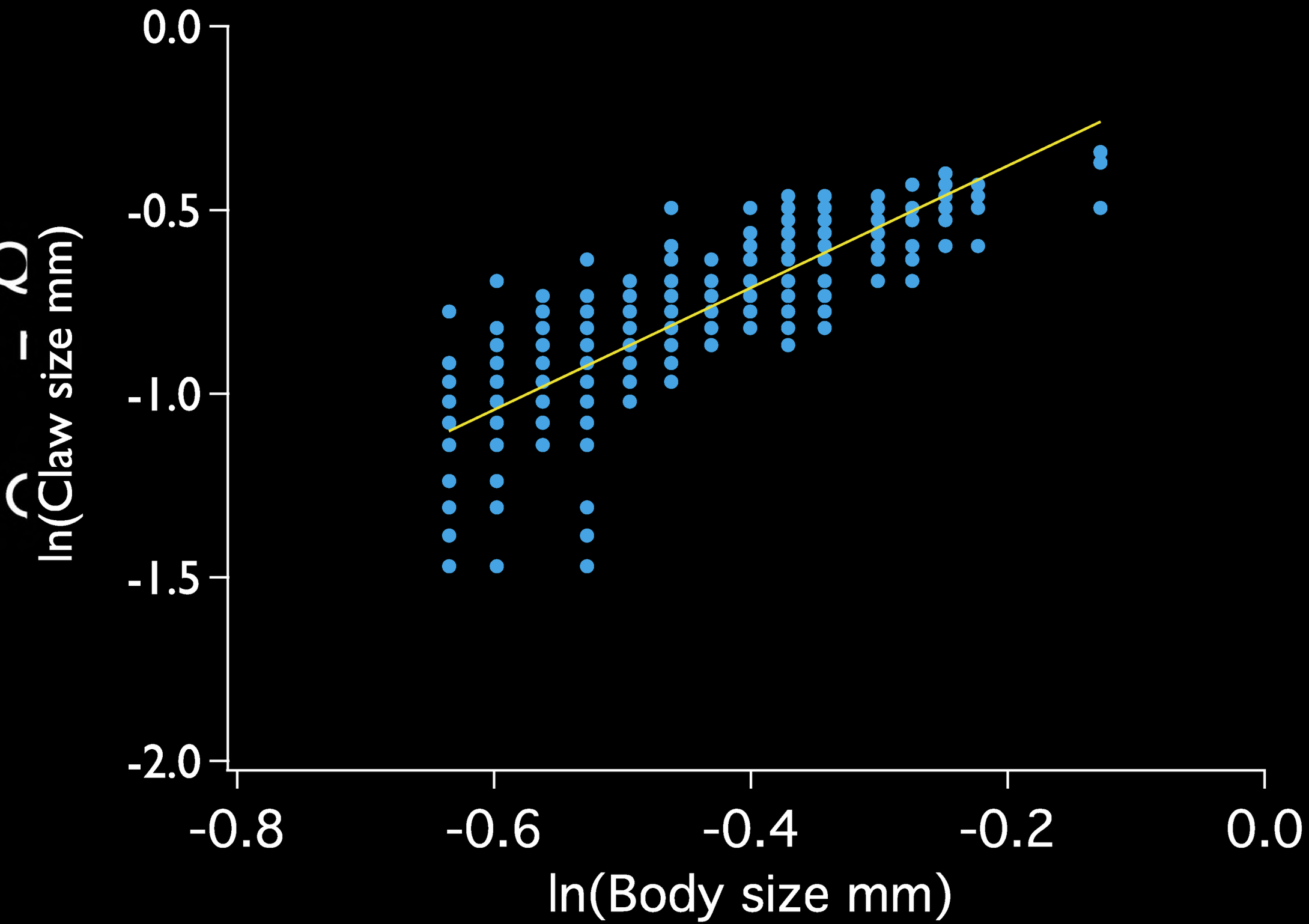

female choice
female fitness
male traits


BACK OFF BOZO!
SNAP
CORAL

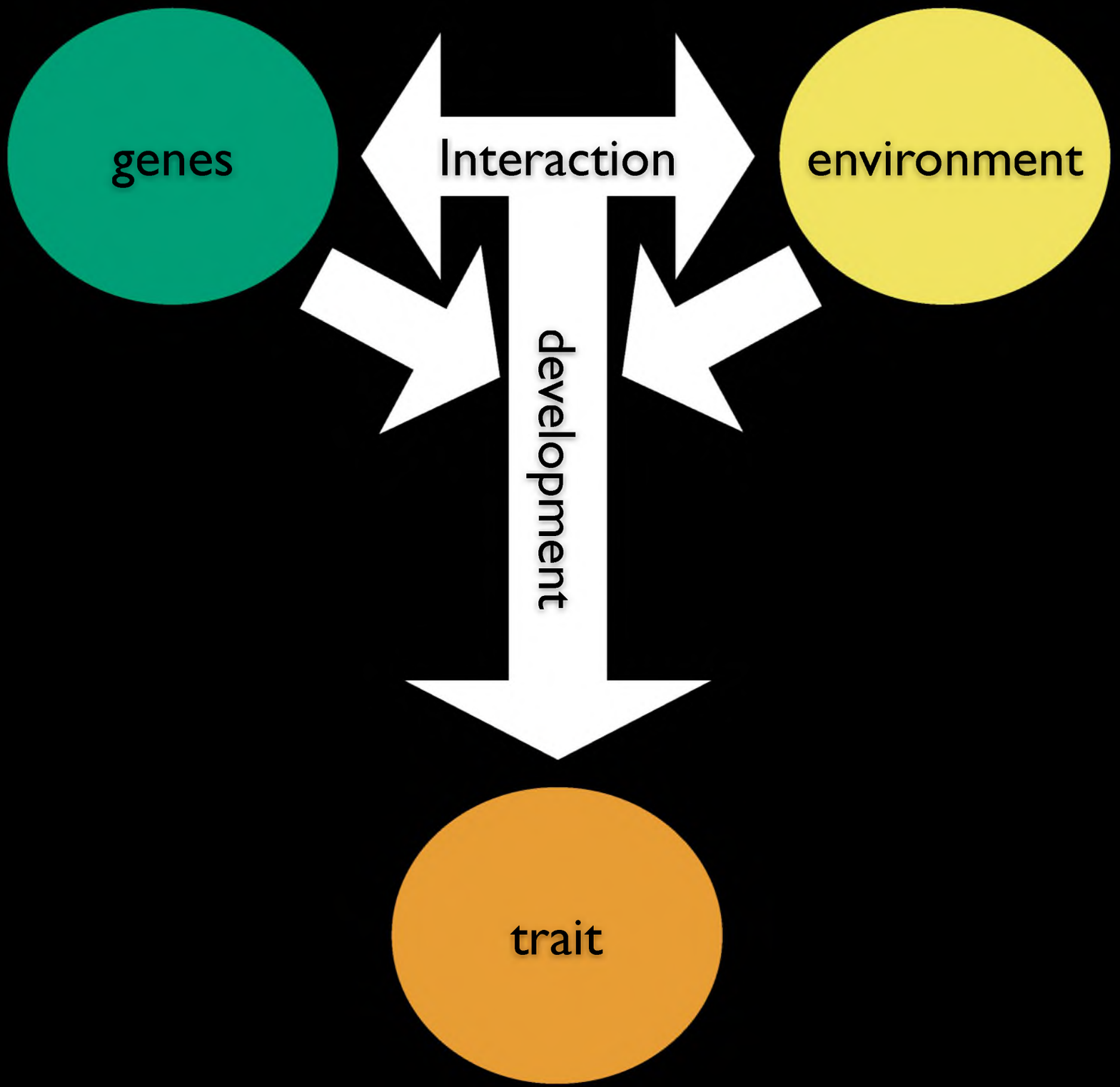
What we are working on now…..

Ques ween
mal ure?

What we are working on now…..

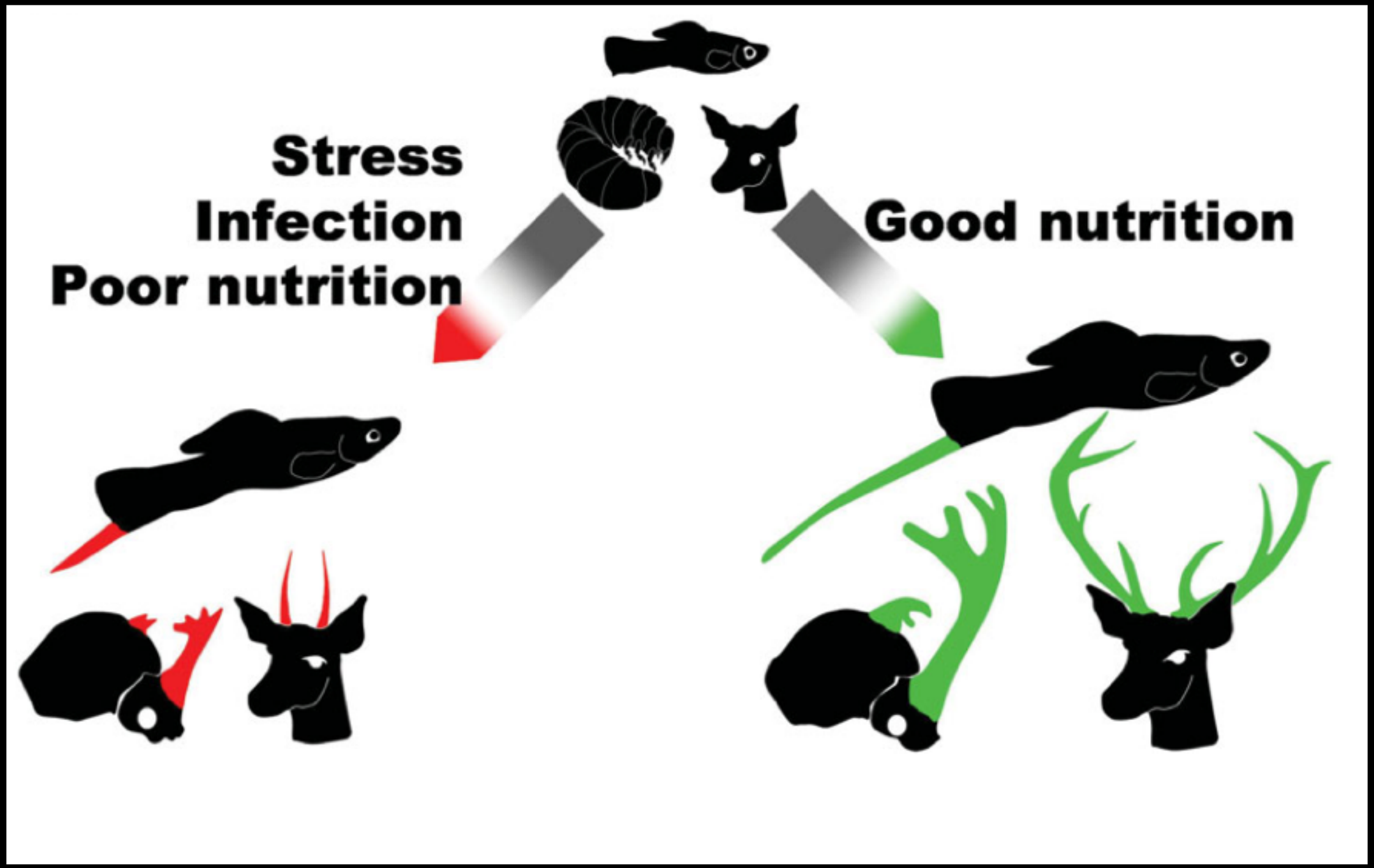


Can the environment affect development of mating traits?



Is the development of sexually selected traits particularly sensitive to stress (i.e. highly condition dependent)?

The paradigm



Warren et al. 2013, Bioessays

The problems

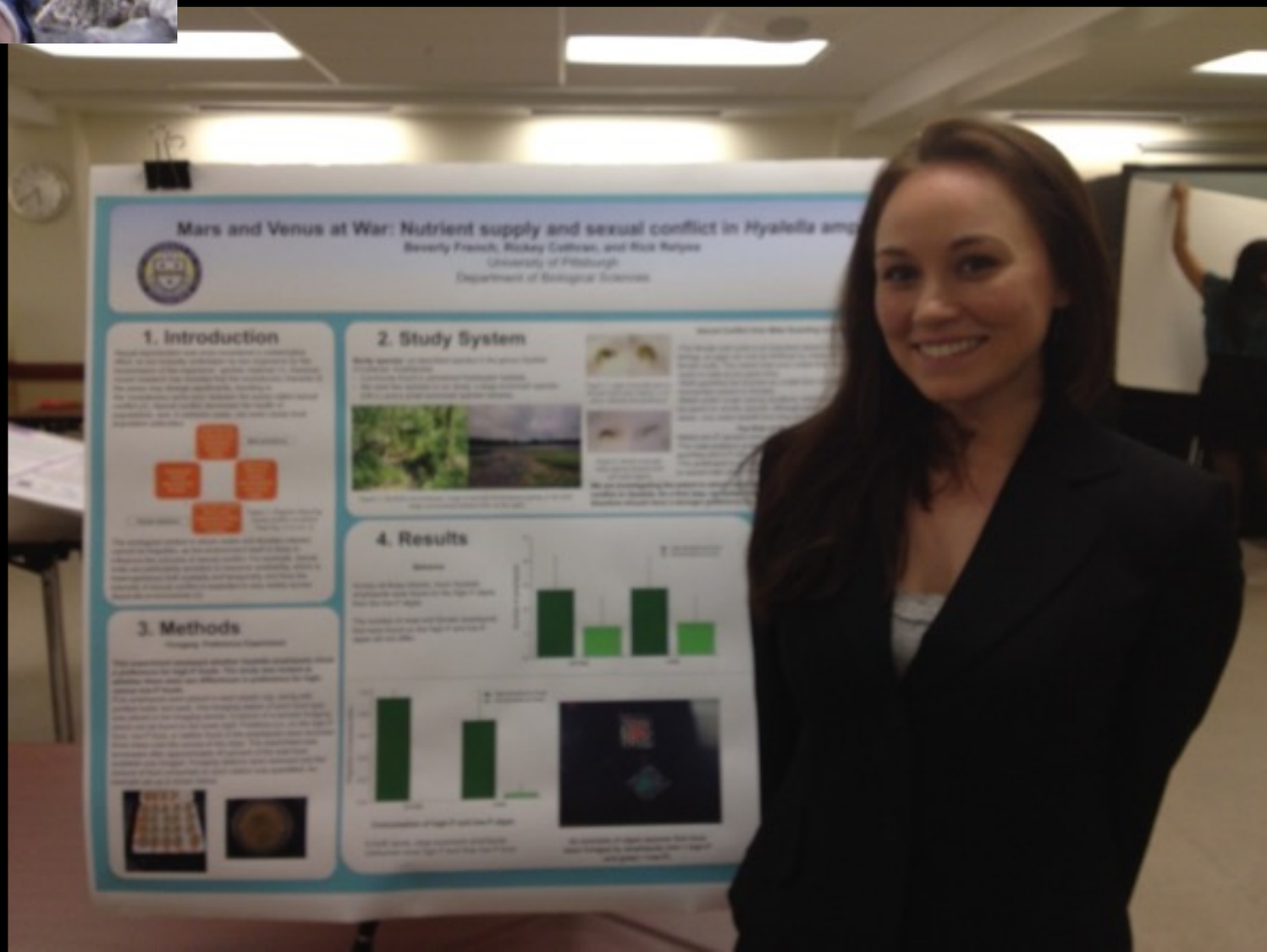
1) No control traits

2) Not accounting for changes in body size across resource environments

3) Extreme or unnatural resource environments

Cotton et al. 2004, Proc. Roy. Soc. B

Hypothesis: Sexually selected traits will be more sensitive to changes in resource availability than non-sexual traits.

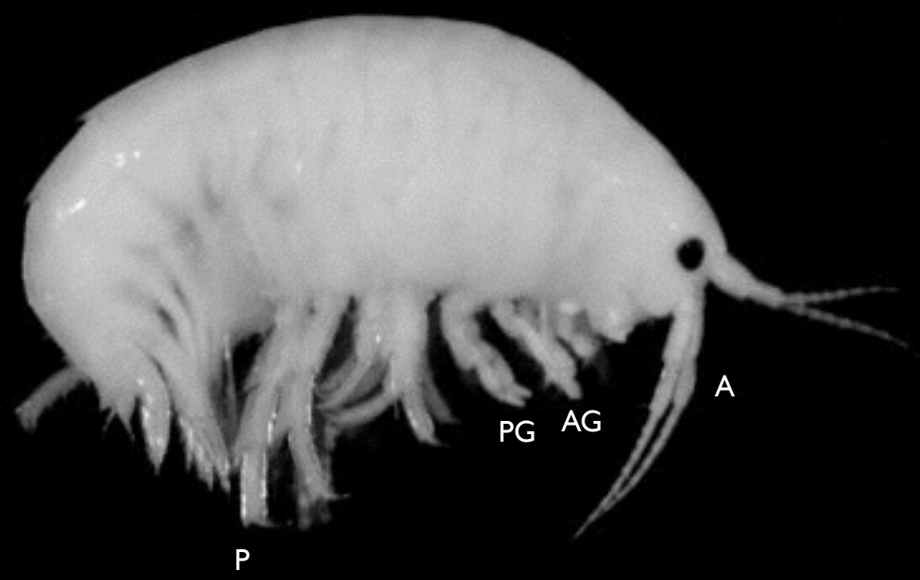

Mars and Venus at War: Nutrient supply and sexual conflict in Hyalella amp
Beverly French, Rickey Cothran, and Rice Rehjon
University of Pittsburgh
Department of Biological Sciences
1. Introduction
2. Study System
3. Methods
4. Results

No control traits

1 mm

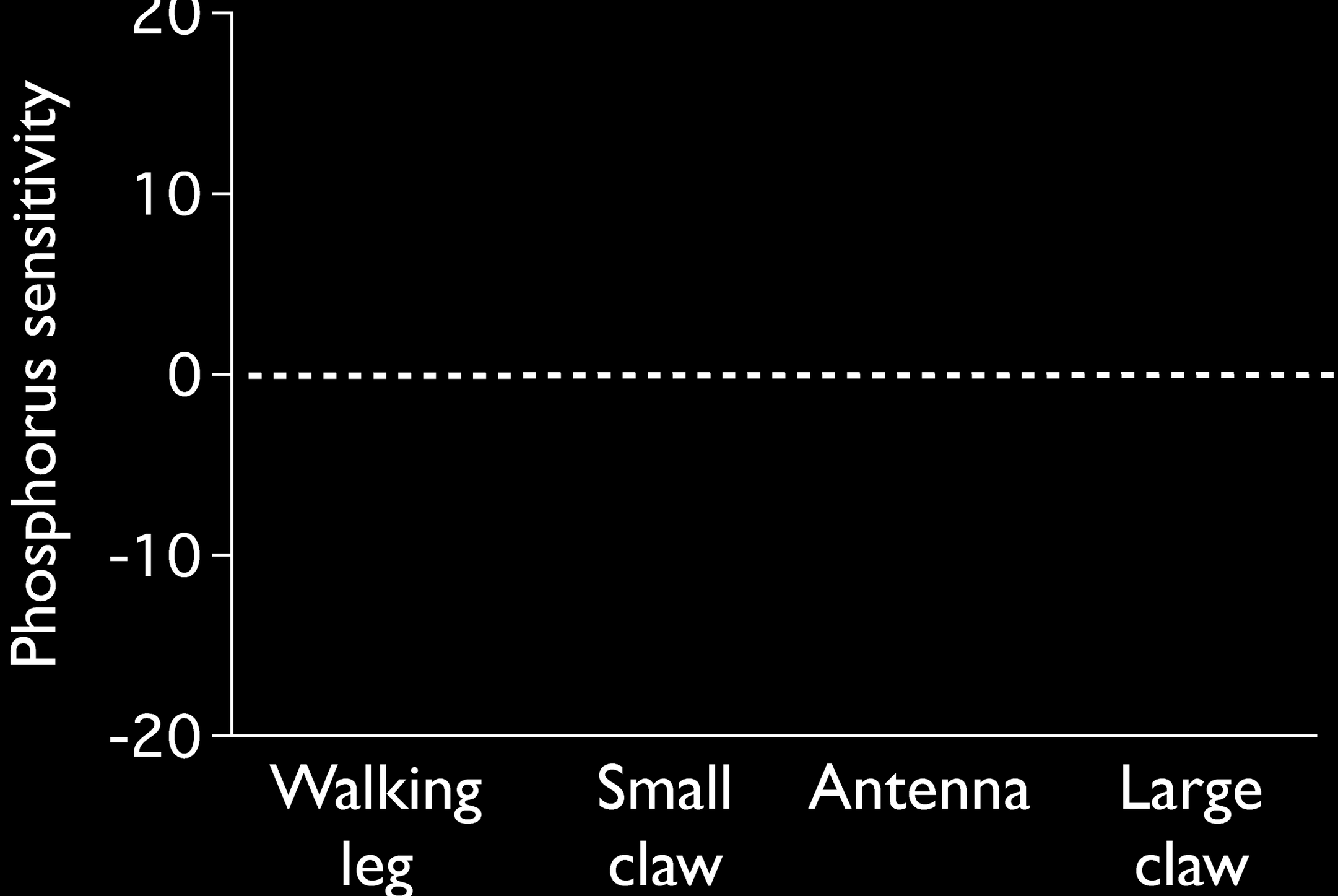
Male

Female

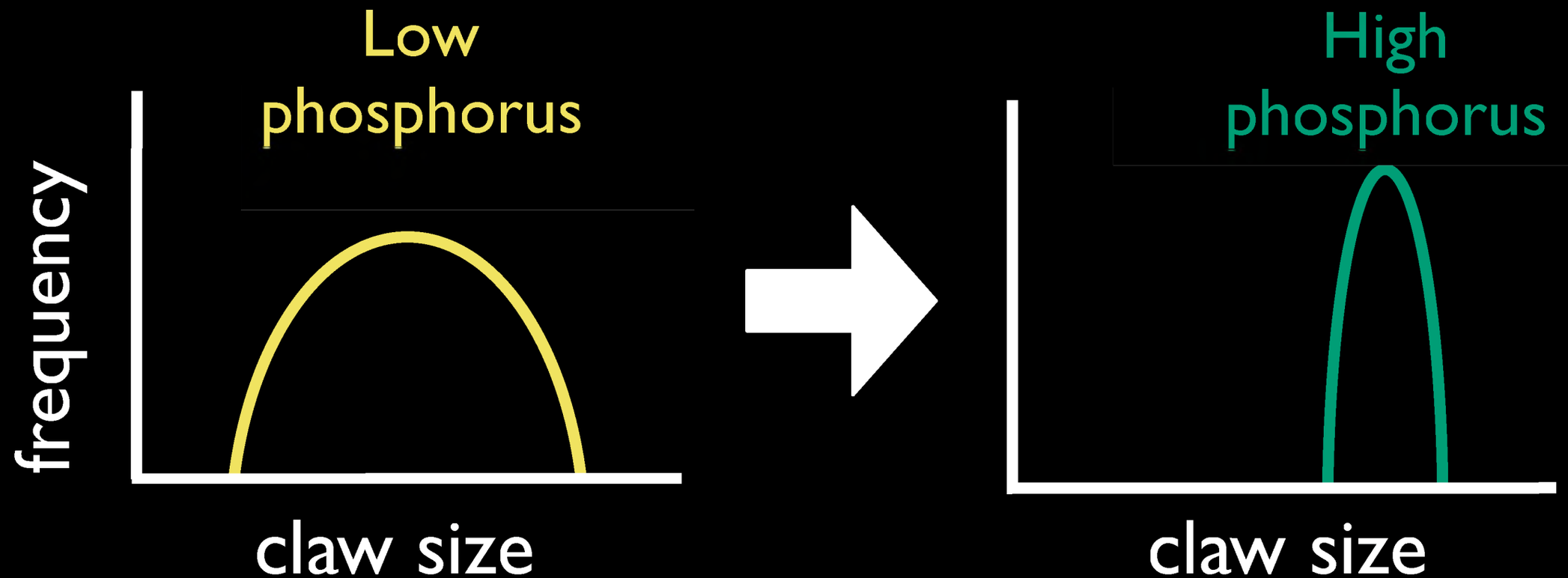


Using unrealistic resource environments

Are sexual traits more sensitive to phosphorus availability?



Implications for sexual selection



Sexual conflict - females have more well-armed males to deal with

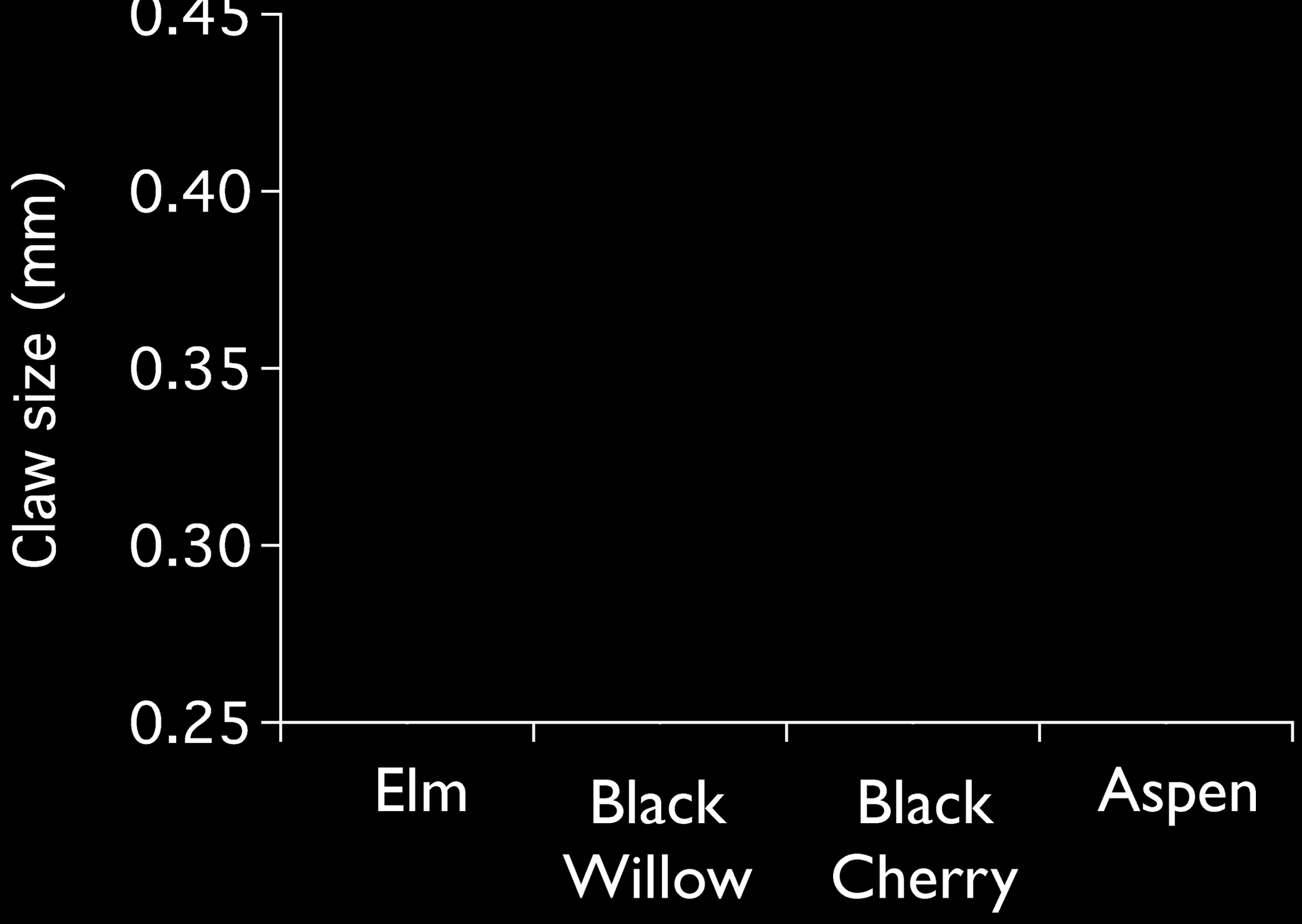
Female choice - females have less variation to choose from

What we are working on now…..

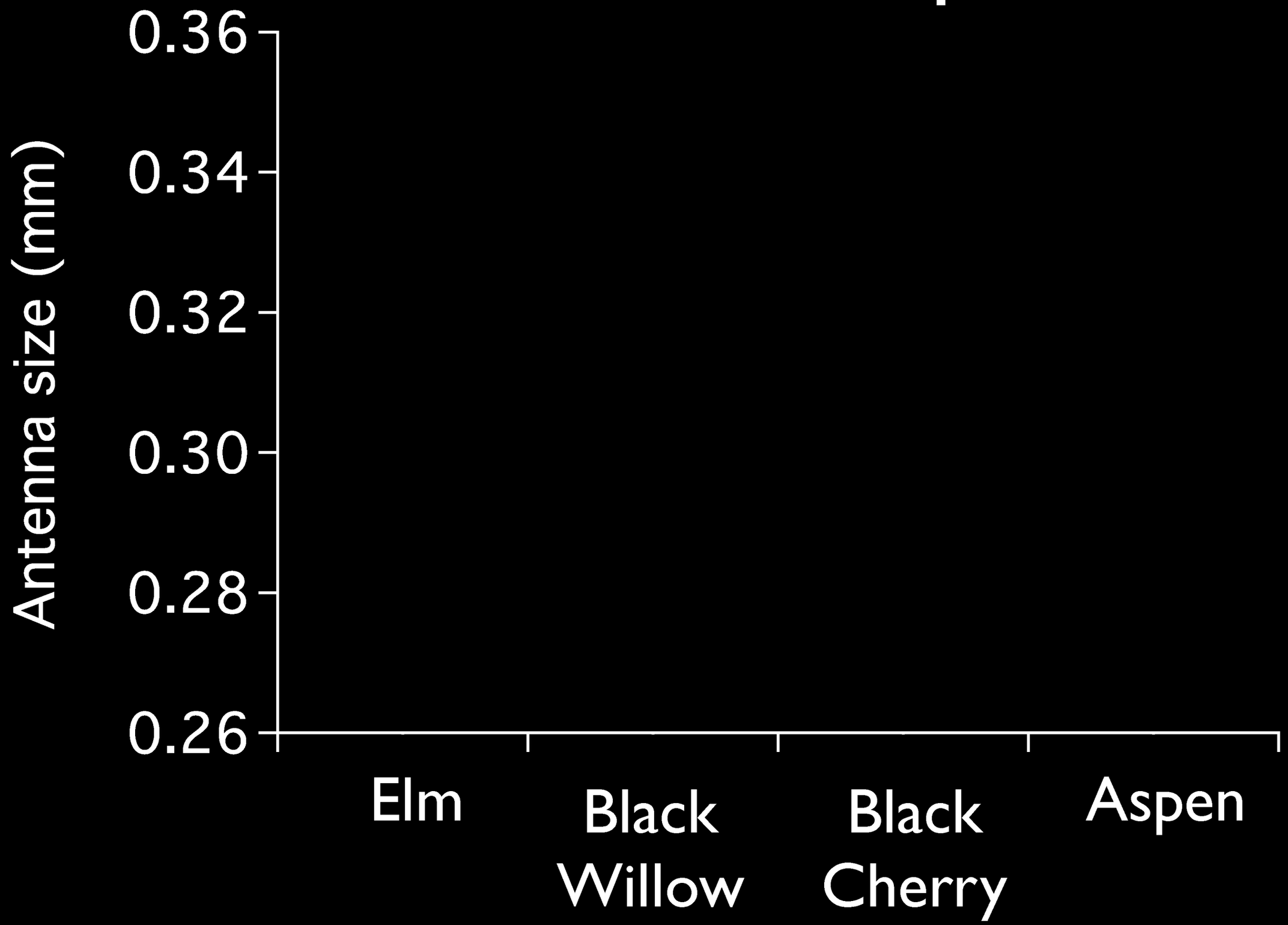
Does natural and human-caused variation in P availability affect sexual selection in nature?

What we are working on now…..

Does the type of leaf litter affect sexual trait development?



Does the type of leaf litter affect sexual trait development?



What about human-caused variation in P-availability?

Take home message

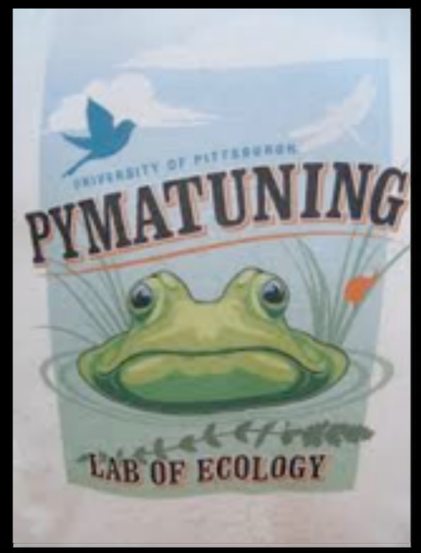
- The ecological context clearly affects how sexual selection operates in populations.
- To understand the consequences of rapid human-induced environmental change we need to explore how evolutionarily labile traits (e.g., sexually selected traits) respond to environmental change and the consequences of these responses.

Thanks!

Gary Wellborn
Univ. of Oklahoma
Rick Relyea
RPI
Puni Jeyasingh
Oklahoma State Univ.
Aaron Stoler
RPI
Jessica Hua
Univ. of Binghamton

<u>High School Teachers</u>
Ray Greco
Knoch High School
Kris Chapman
Greenville High School
Cindy Murray
Northwestern High School

SWOSU
DEPARTMENT OF BIOLOGICAL SCIENCES



UOBS

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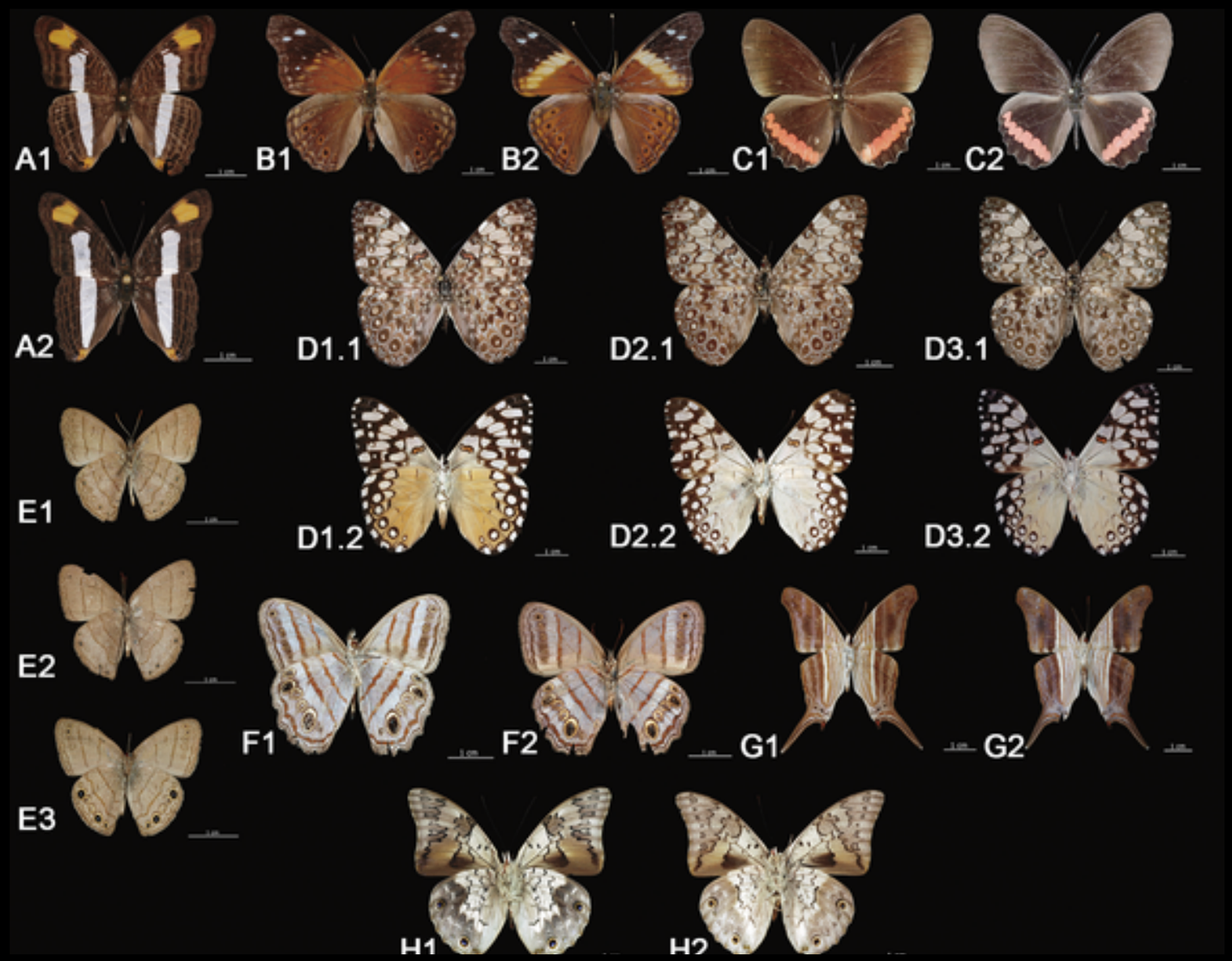
Beverly French
Grad Student UCSB
Pat Monahan
ESA
Ashna Dhoonmoon, Sinthia Youmbi, Lindsey Hendricks, Shanna Simmons, and Lau Nguyen
(students at SWOSU)

NSF

Mechanisms that maintain species diversity in communities



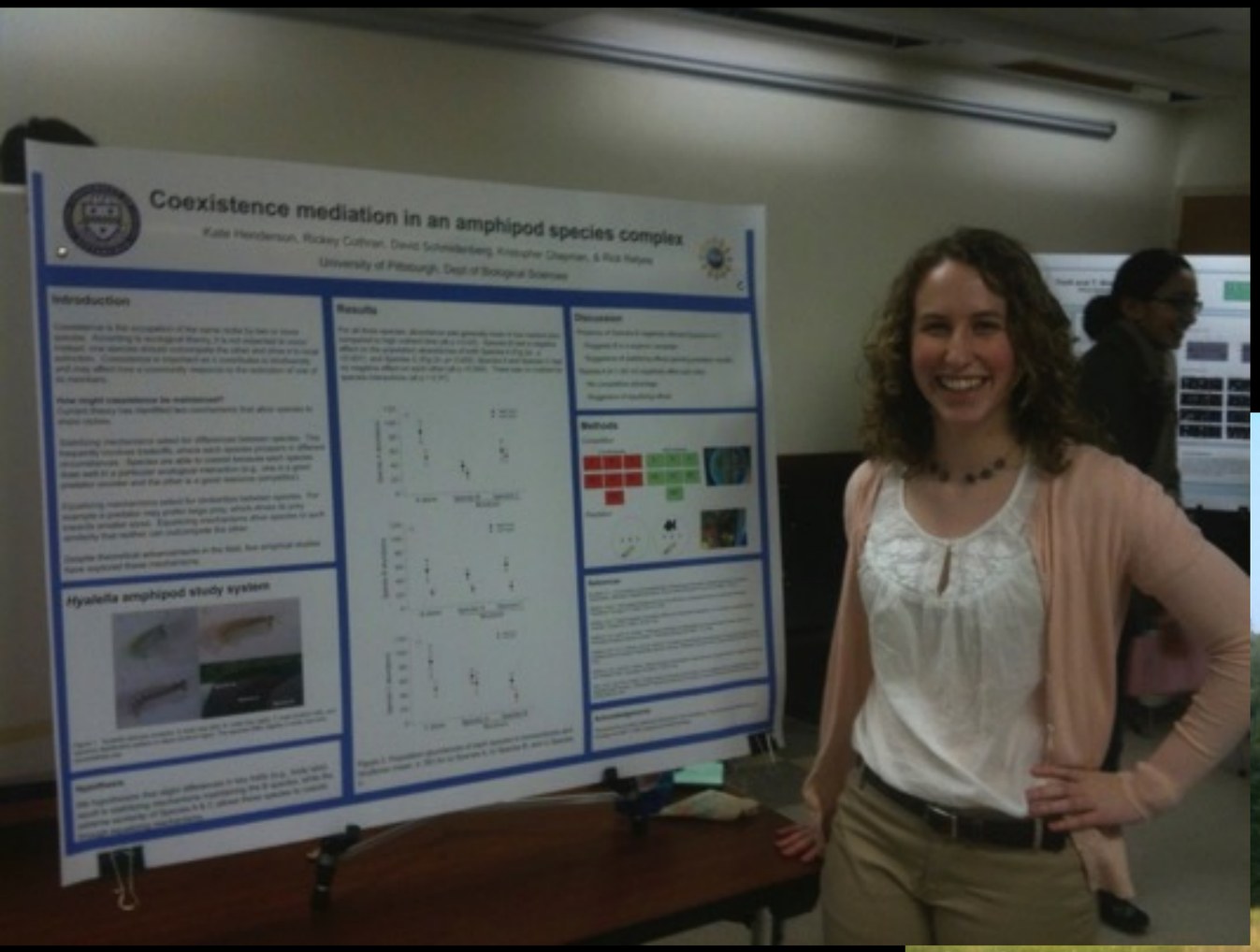
Prado et al. 2011, PLOS

Fortunately, they are not as cryptic when alive

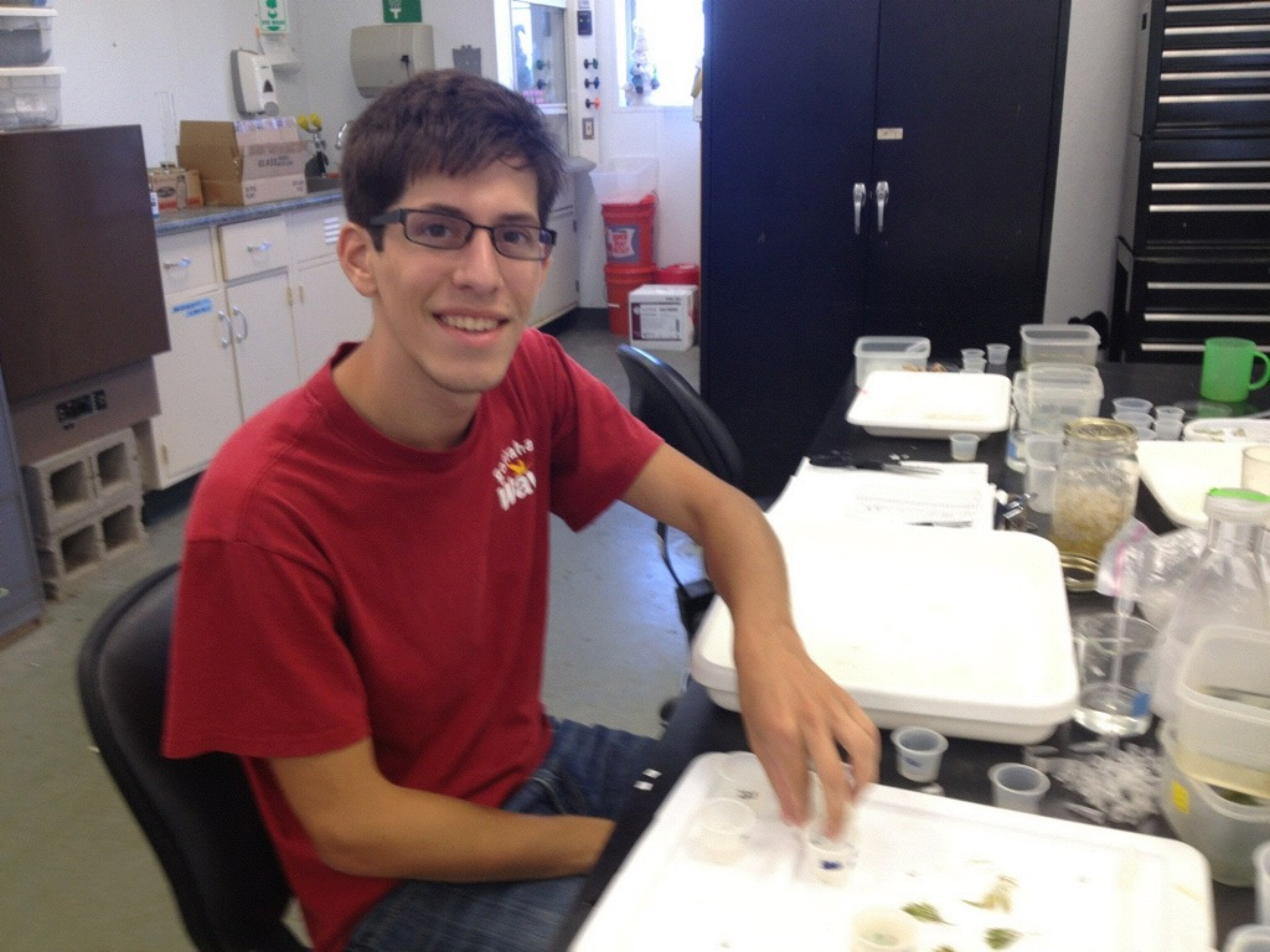
Species A

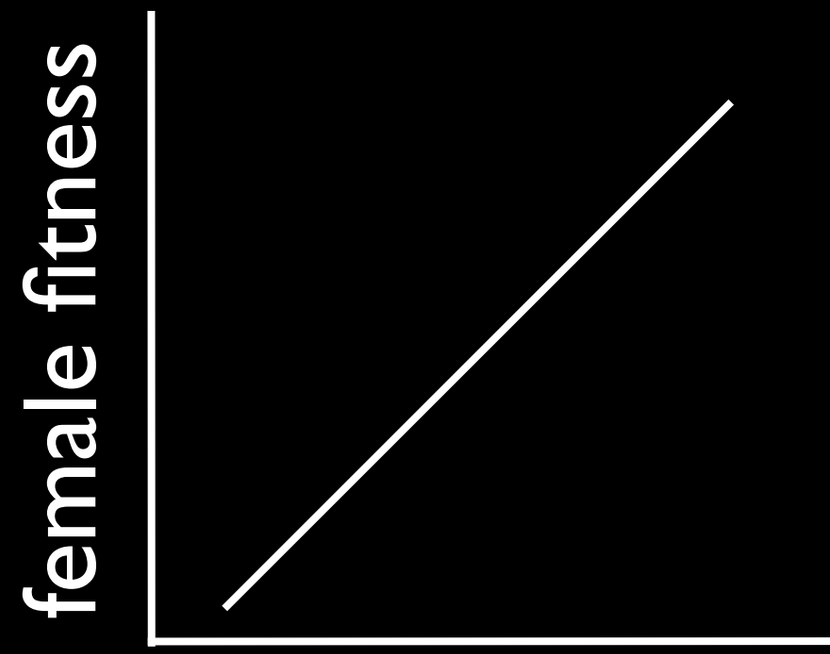
Species B

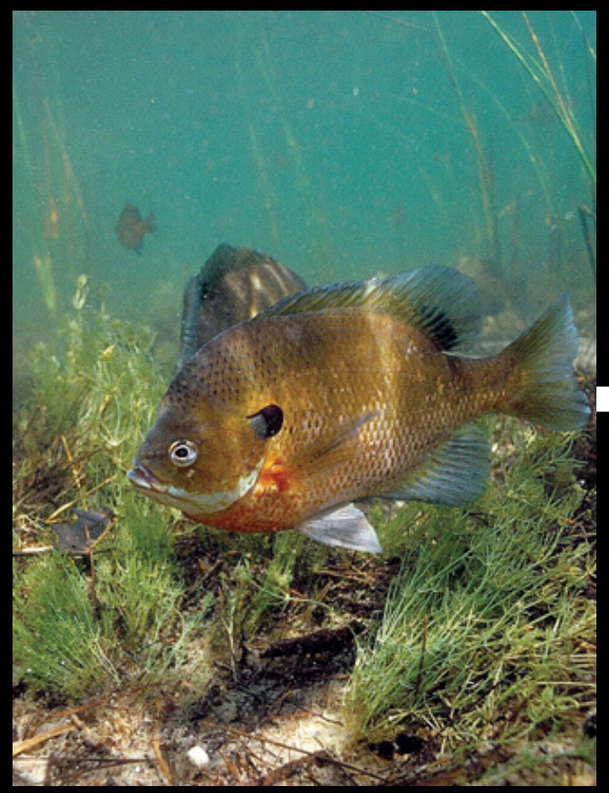
Species C

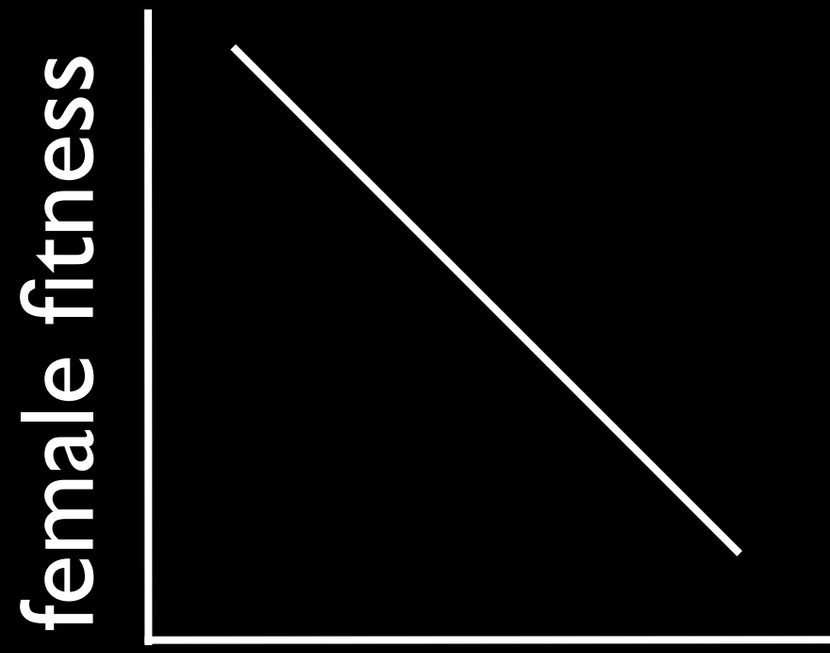

Coexistence mediation in an amphipod species complex
Katie Henderson, Rickey Cothran, David Schneidenberg, Kristopher Chapman, & Rick Relyea
University of Pittsburgh, Dept of Biological Sciences
Introduction
Results
Discussion
Methods
Hyalella amphipod study system
Hypothesis

Evo-ecotoxicology




female fitness
male traits

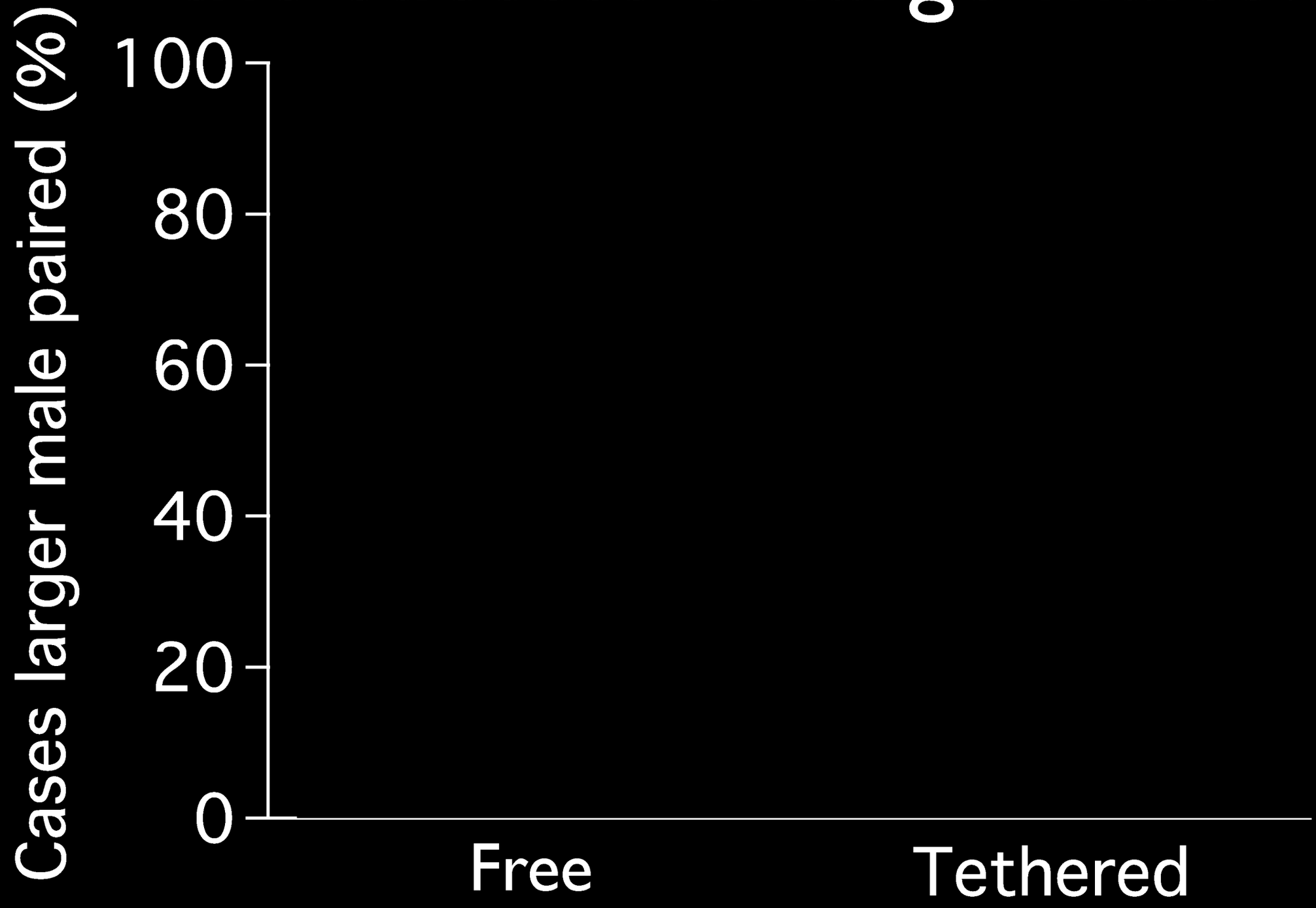



female fitness
male traits

Hypothesis: Males with large sexual traits will still be successful when we remove the opportunity for male-male competition.

Experiment 1: Does tethering affect the success of large males?

Experiment 1: Does tethering affect the success of large males?



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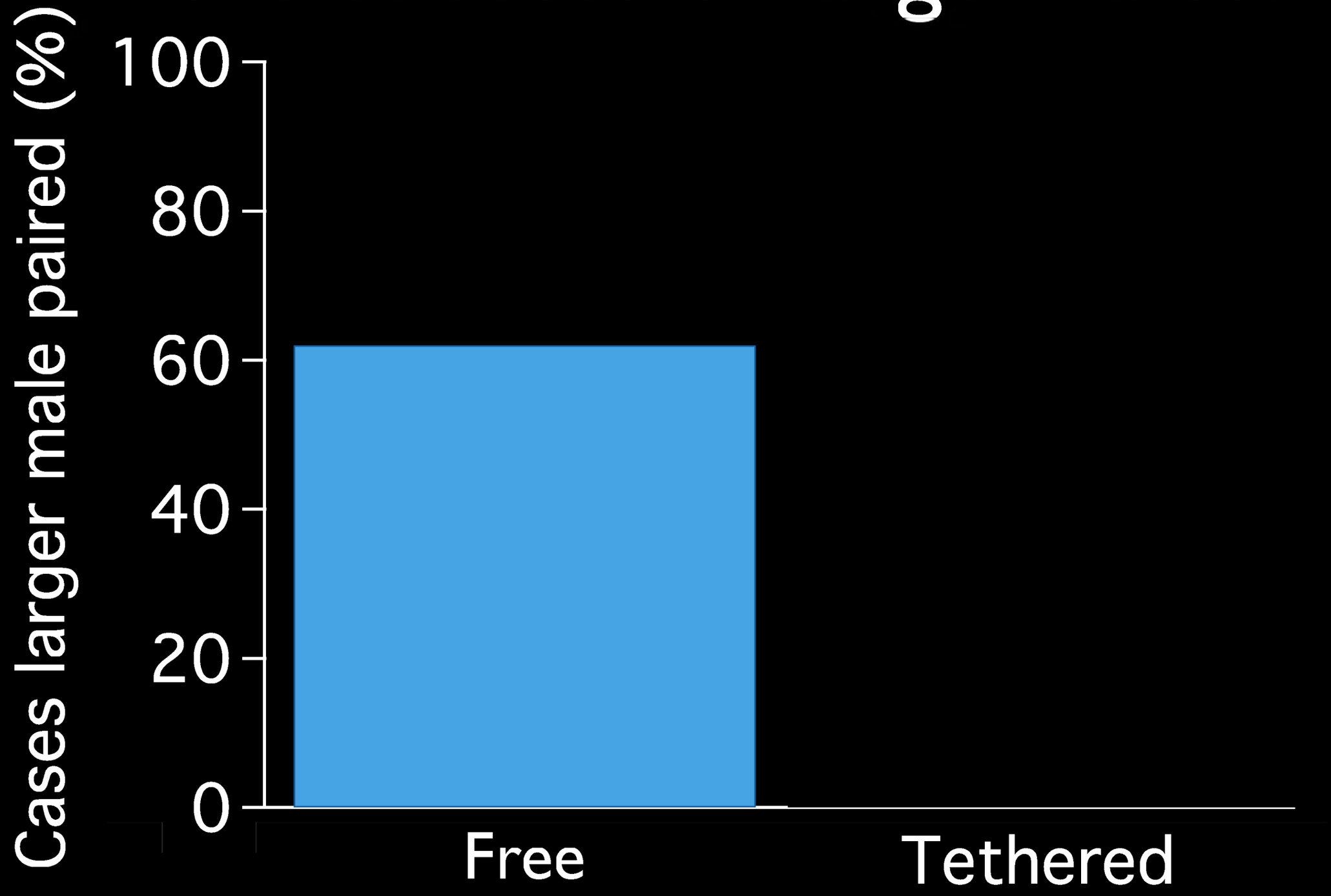
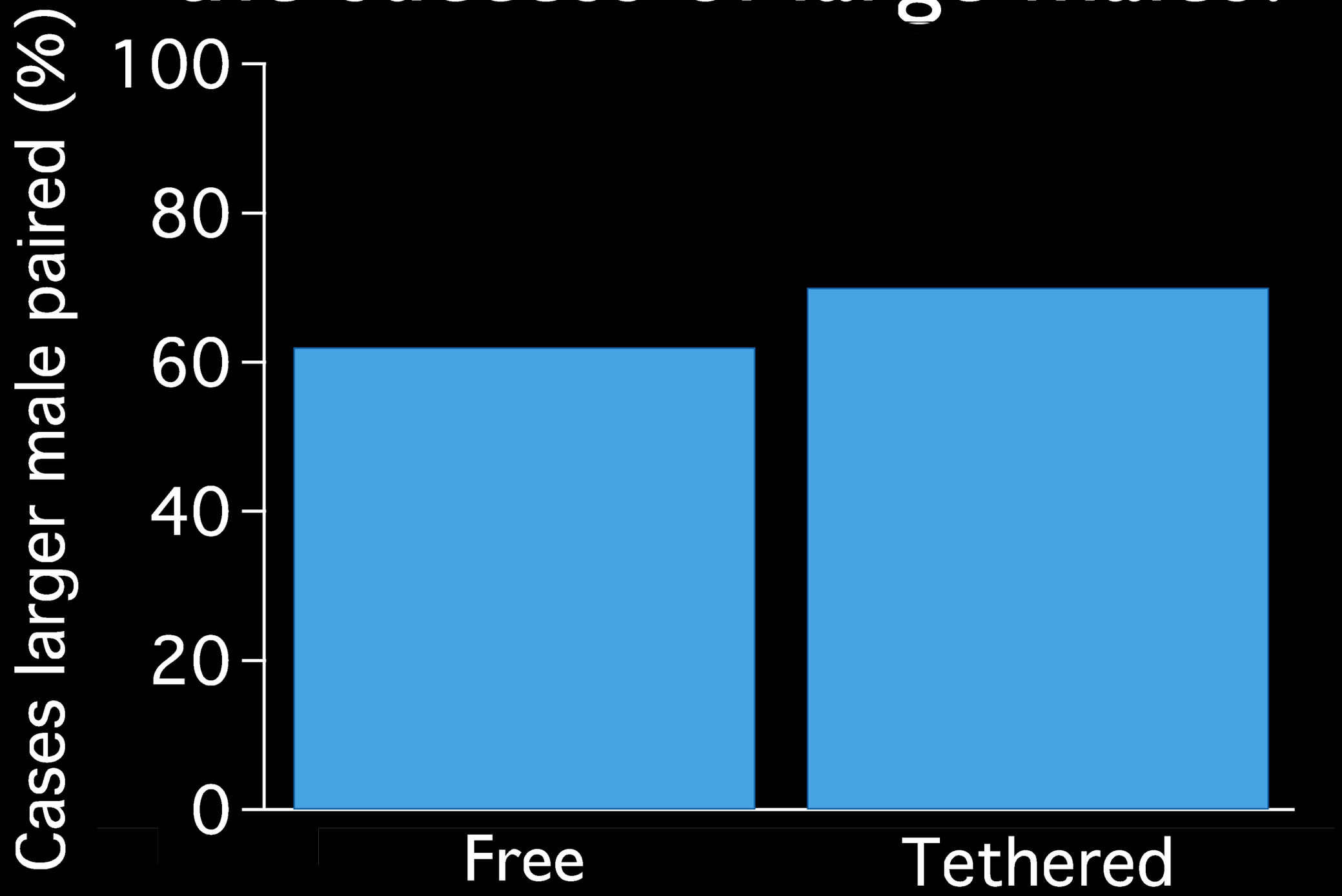
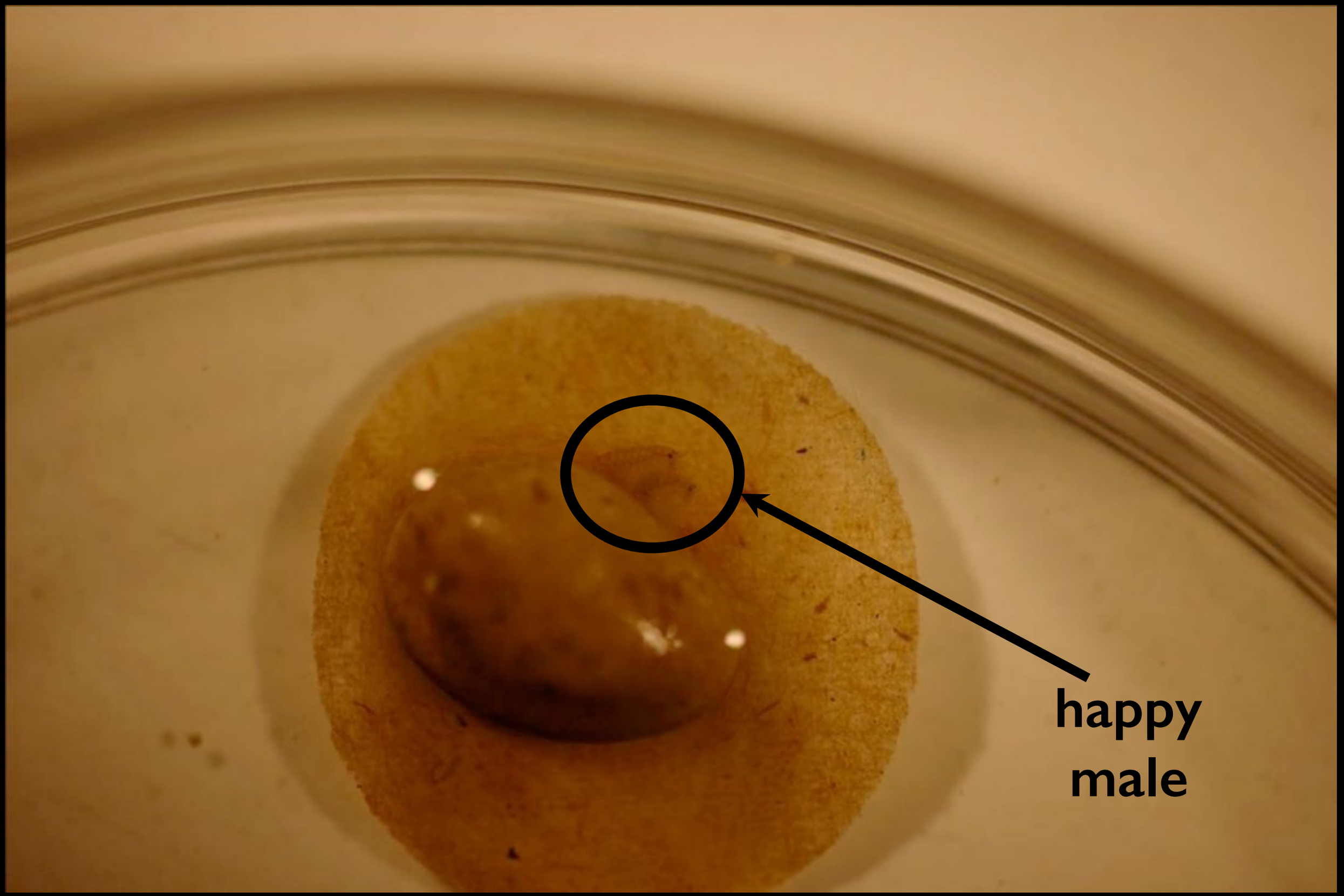
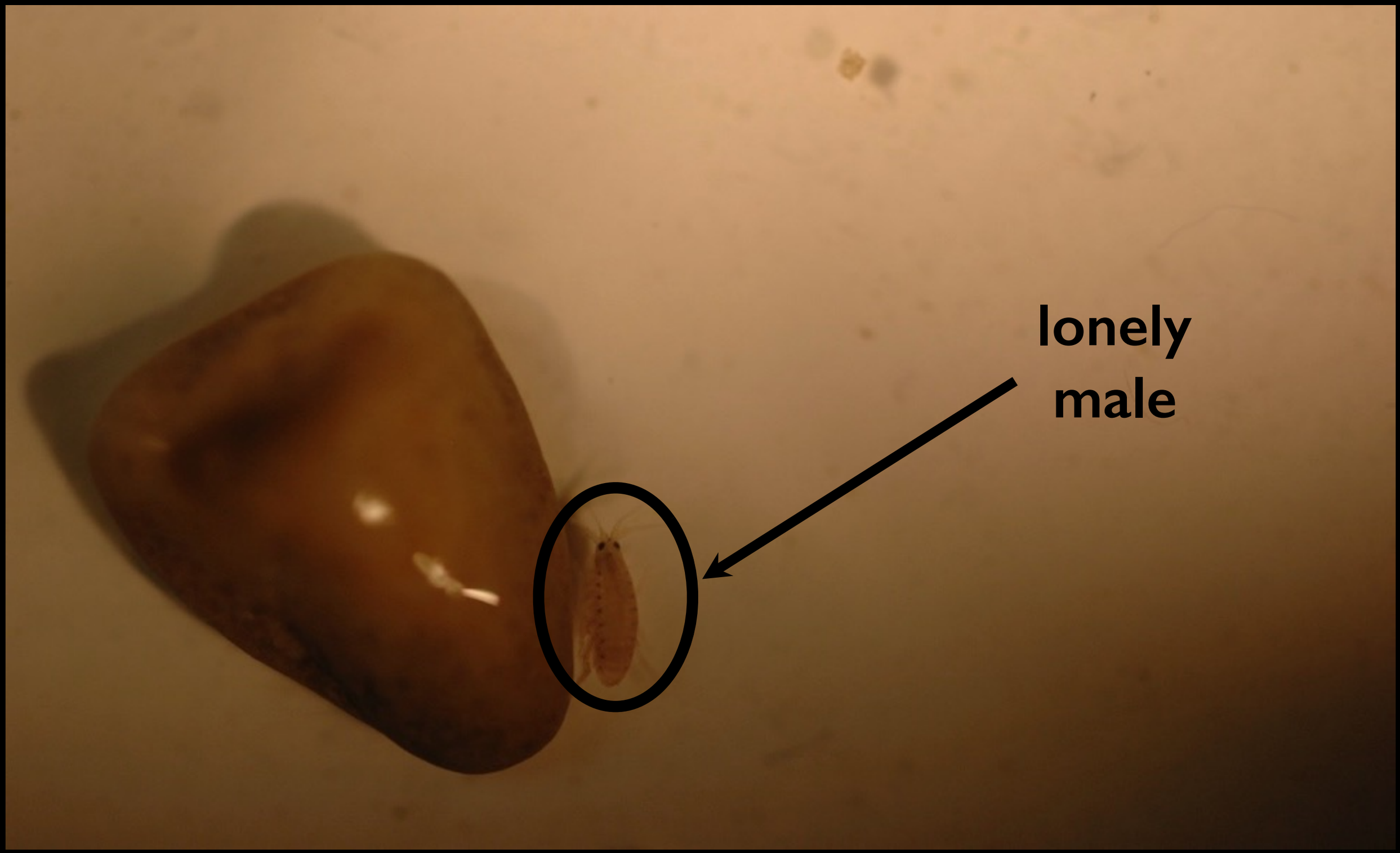


Experiment 1: Does tethering affect the success of large males?



The arena


happy
male

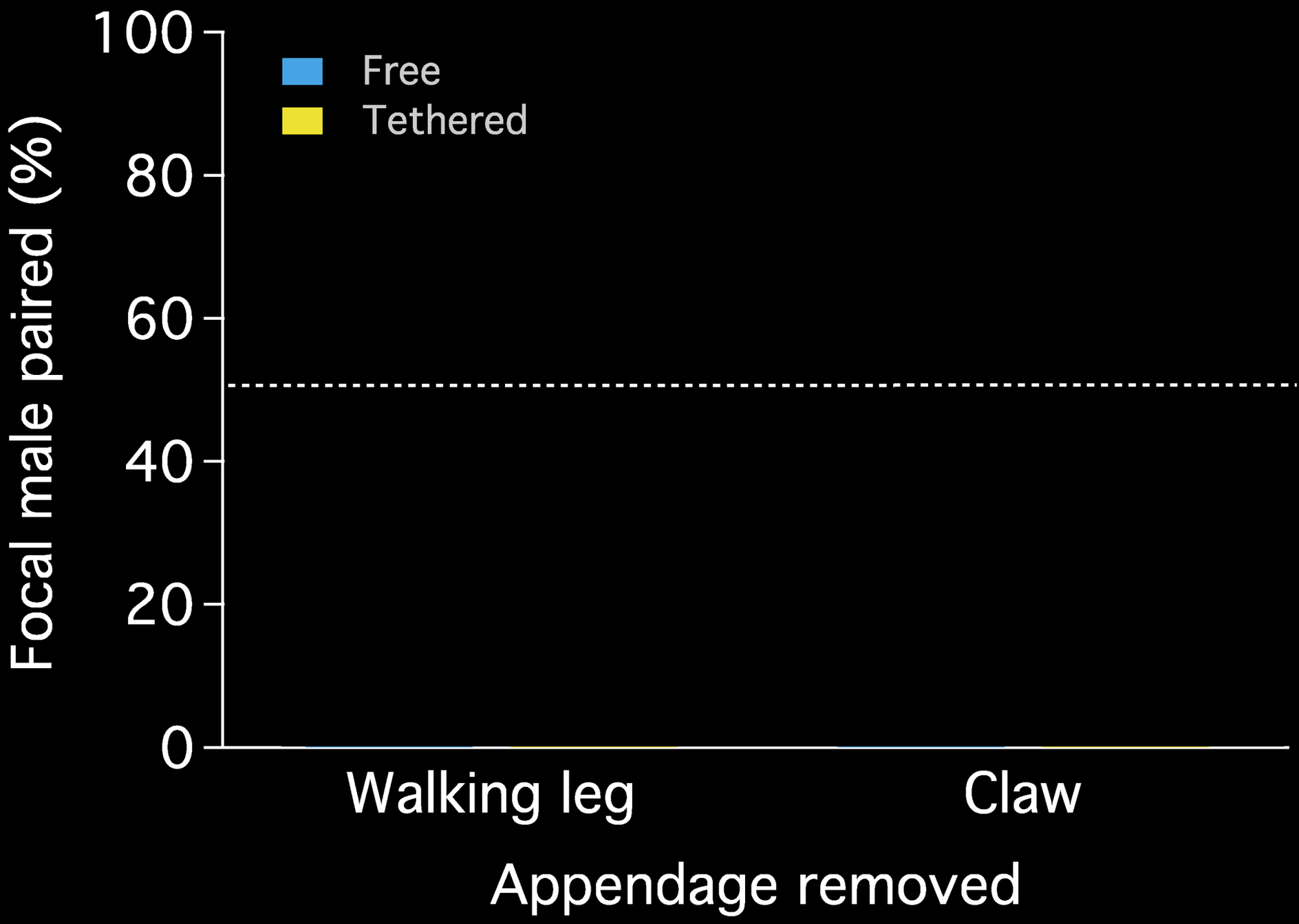

lonely
male

Does tethering affect the success of males with large claws?

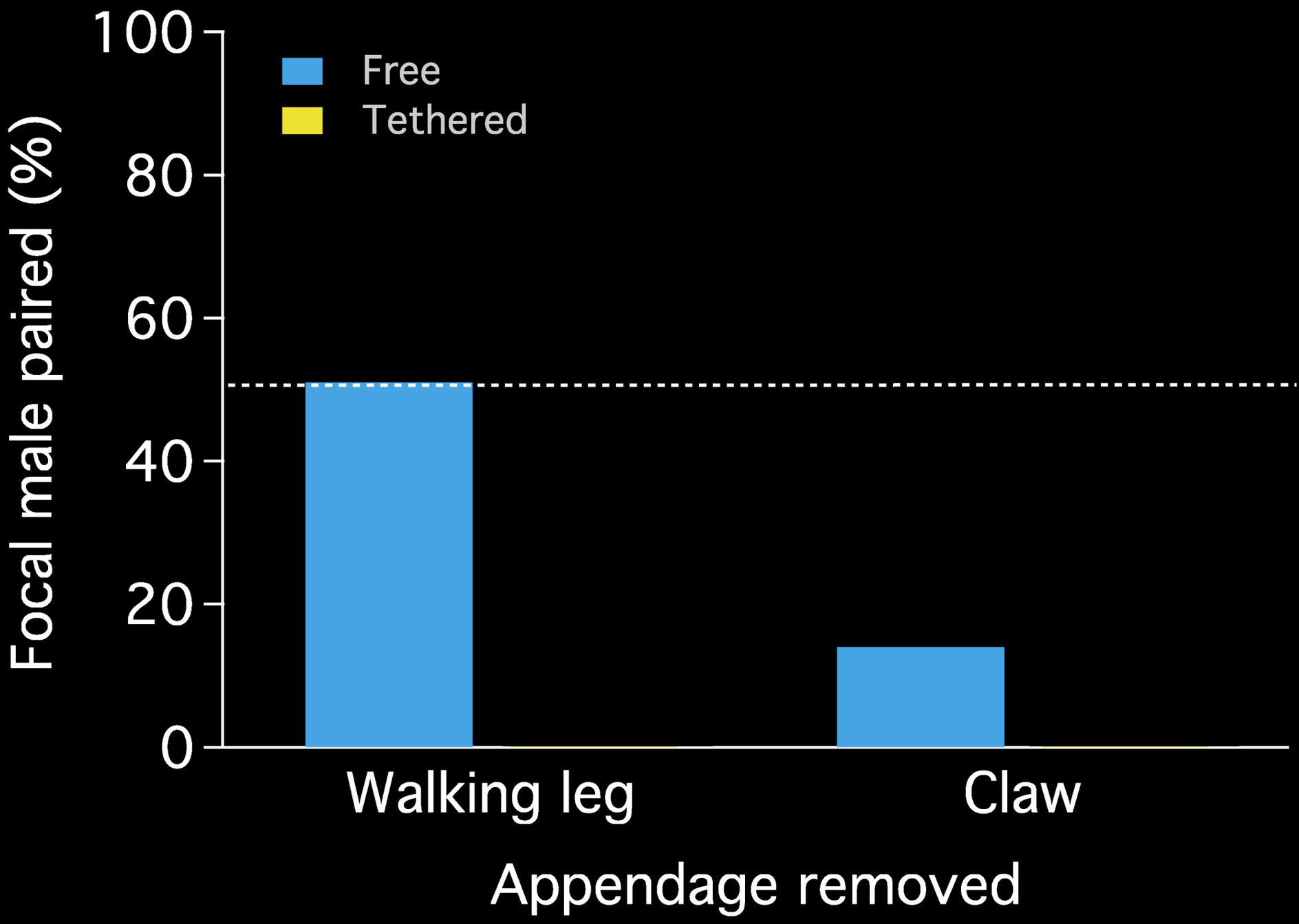
gnathopod
(aka claw)

pereopod
(aka walking leg)

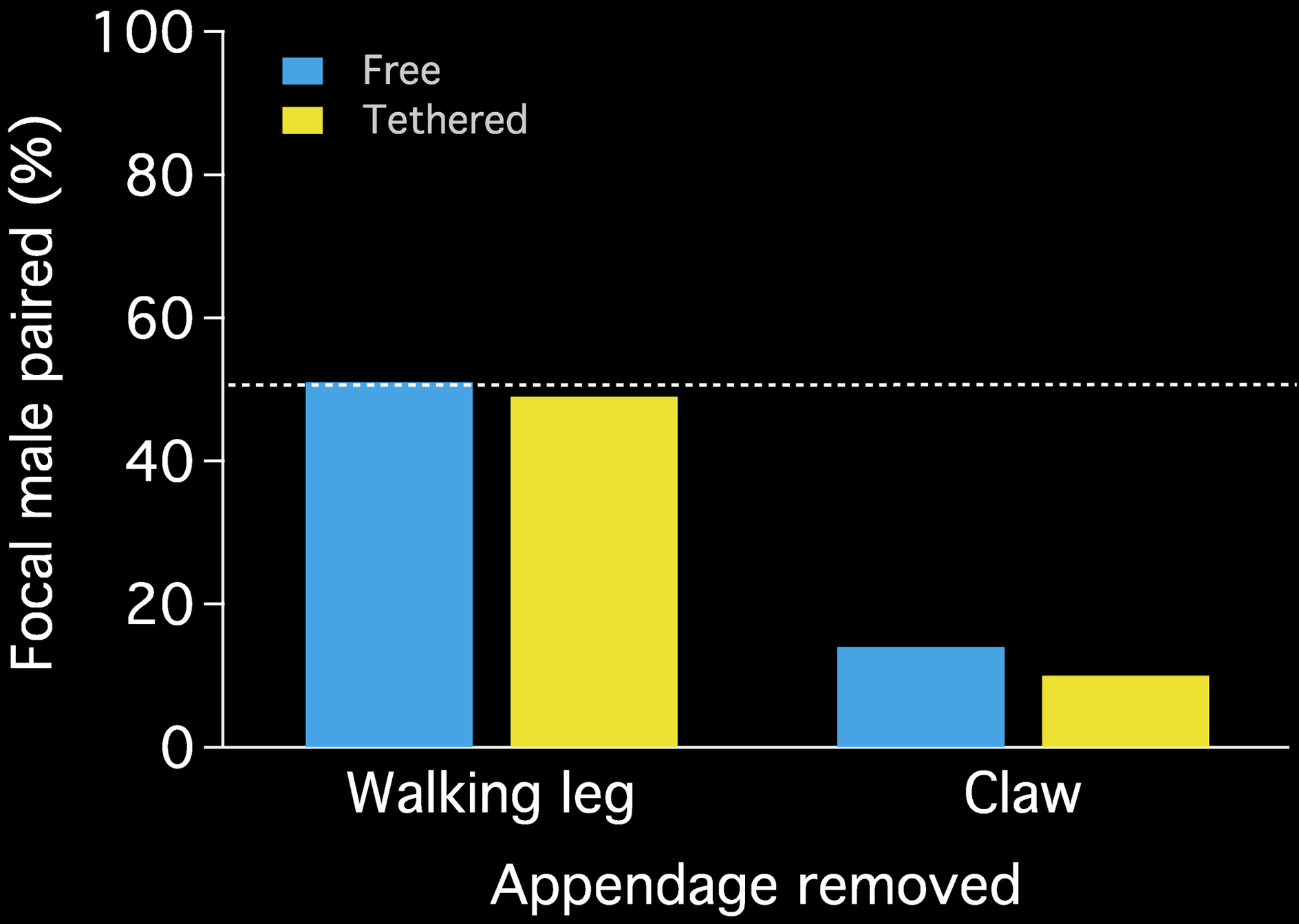
Does tethering affect the success of males with large claws?



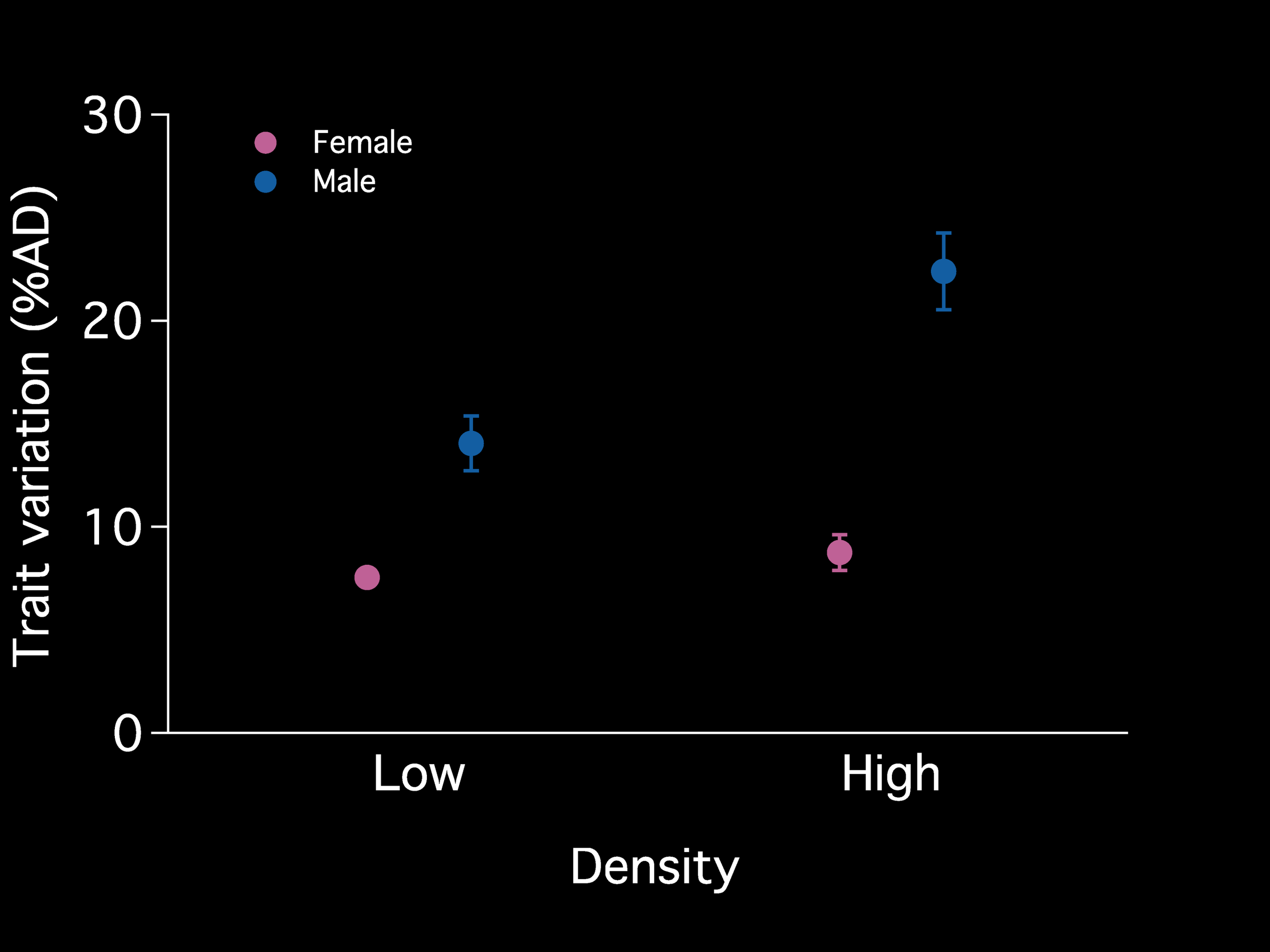
Does tethering affect the success of males with large claws?

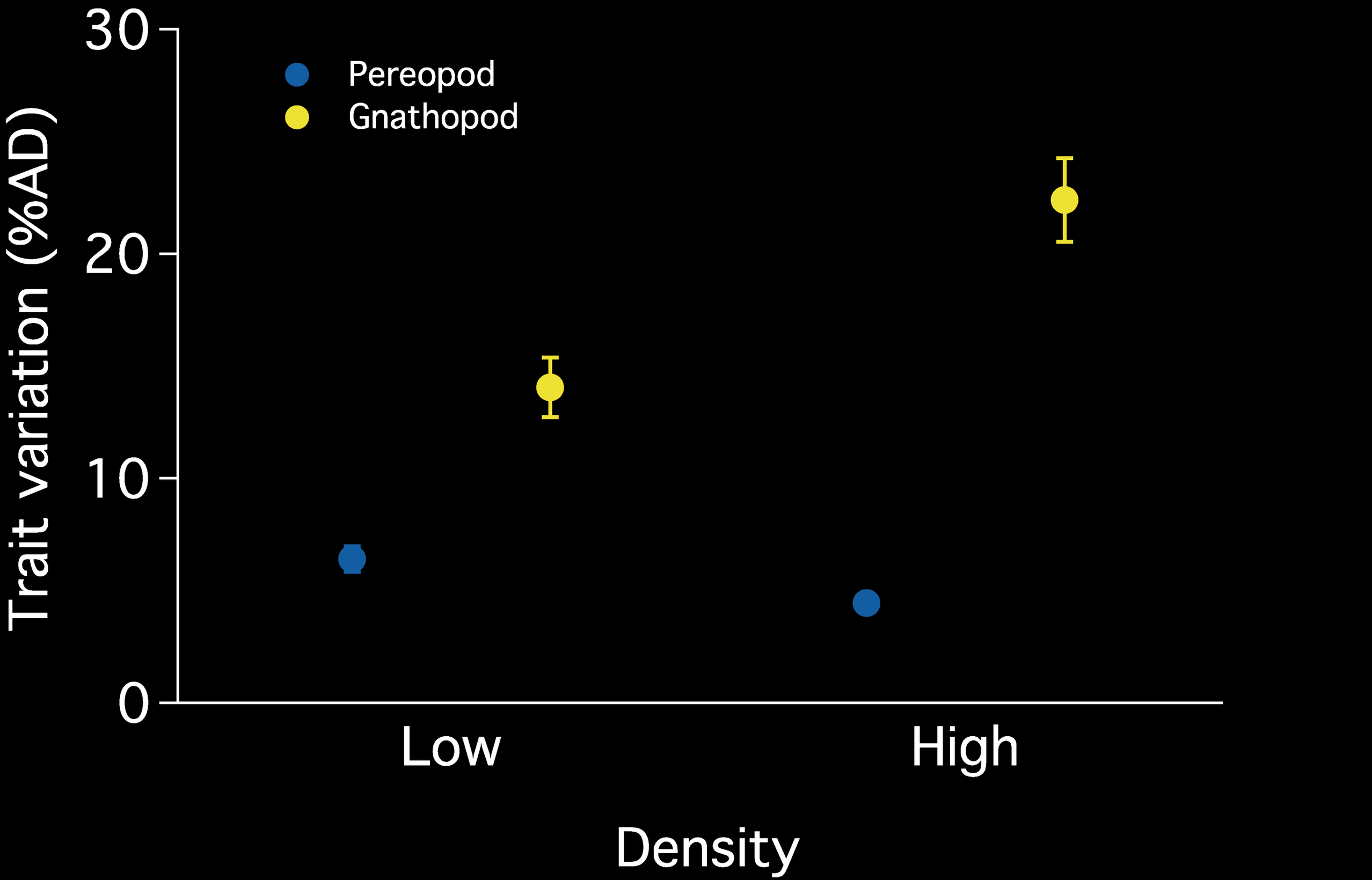


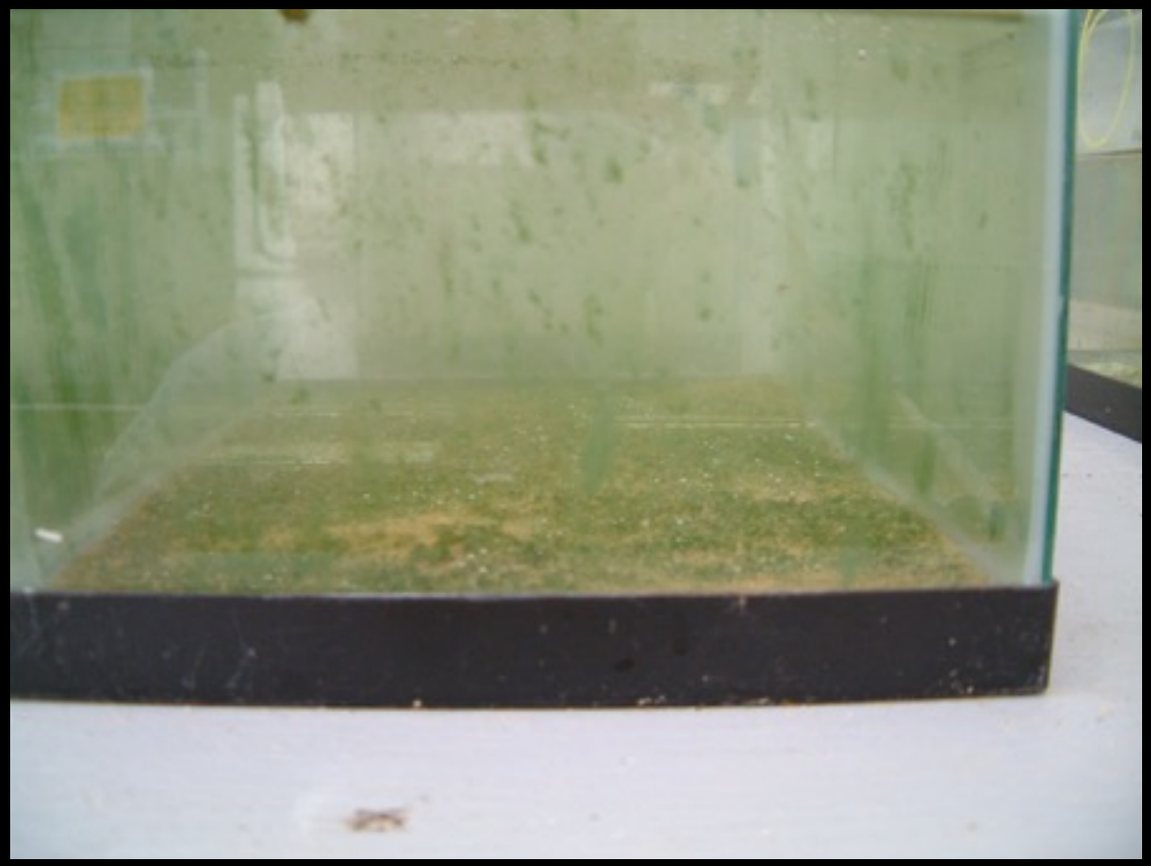
Does tethering affect the success of males with large claws?



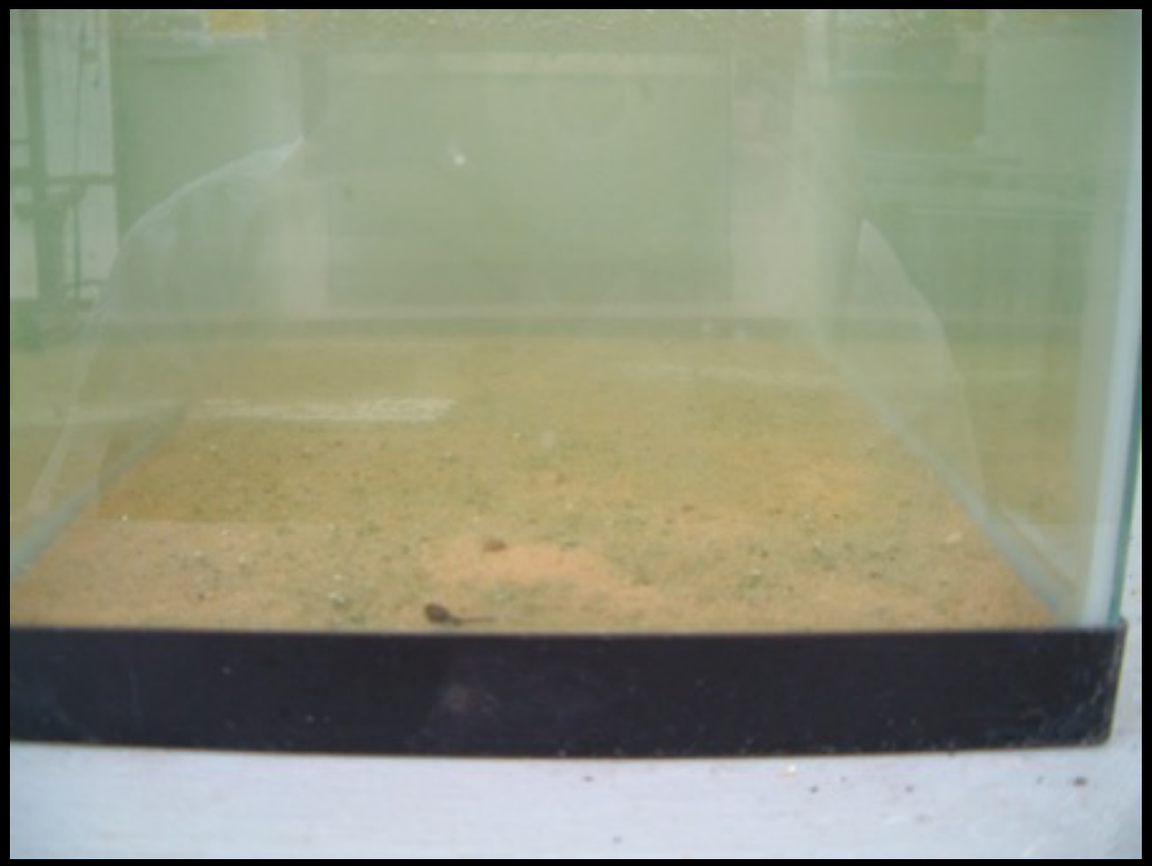
Fly fisherman's amphipod


Female
Male
30
20
10
0
Trait variation (%AD)
Low
High
Density


30
20
10
0
Trait variation (%AD)
Pereopod
Gnathopod
Low
High
Density



low density



high density

1 mm

Male

PG

A

P

Female

P

PG

AG

A

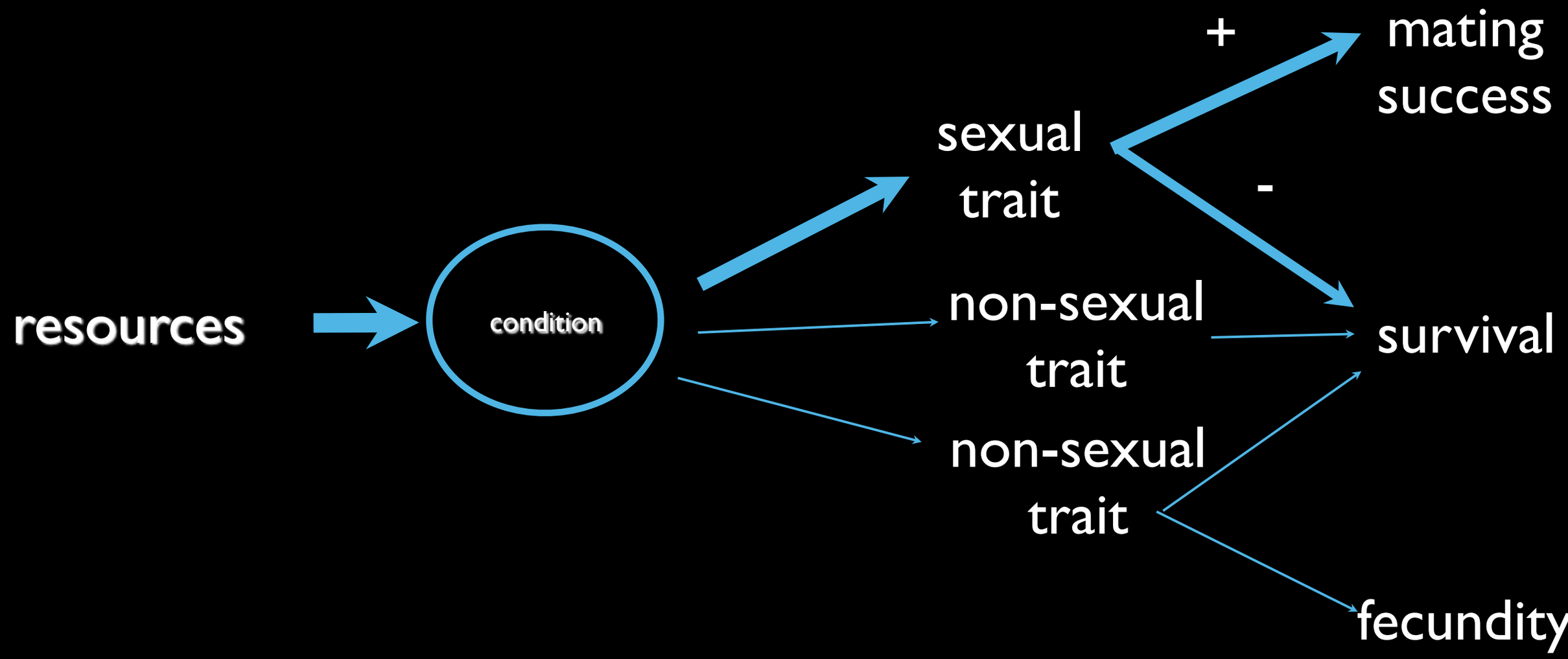
P

AG

A

PG

500 µm


resources
condition
sexual trait
+
mating success
-
survival
non-sexual trait
non-sexual trait
fecundity