Adaptation

Outline

what is an adaptation?

not all traits are adaptations

approaches to studying adaptation
- experimental approaches
- comparative method

Adaptation

A trait or integrated series of traits, that increases the fitness of its possessor is an adaptation (such traits are said to be adaptive). Adaptations are the product of selection.

"derived character that evolved in response to a specific selective agent"

(Harvey & Pagel 1991 The comparative method in evolutionary biology)

complex phenotype, not caused by the physical environment

performs a specific function

exaptation: prexisting trait that serves a new function

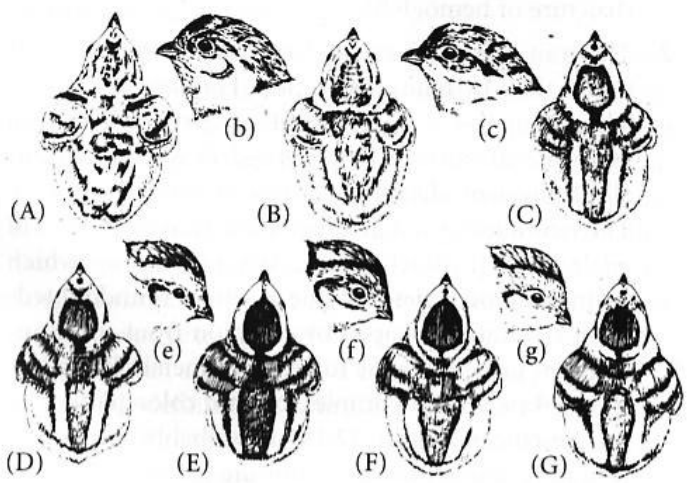
swimming guillemont

flying guillemont

swimming penguins

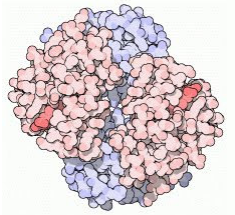
Not all traits are adaptations

differences are not always due to adaptation

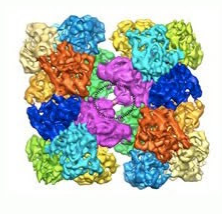


Not all traits are adaptations

not every trait of an organism is an adaptation



HEMOGLOBIN



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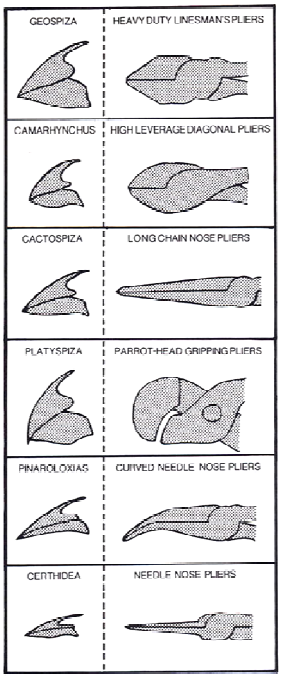
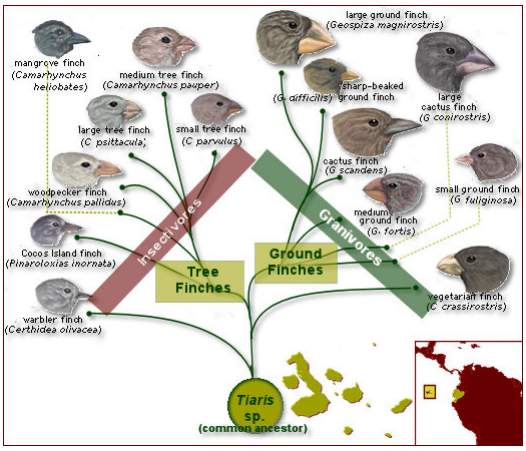


Not all traits are adaptations

adaptation is not perfection



studying adaptation

-observation of variation in a character

-formation of a hypothesis to explain the variation

-testing a prediction of the hypothesis

- experiments
- comparative method

Experimental Approach to Studying Adaptation

test the effect of variation in a single factor
-- randomize effect of other factors

test predictions made by several alternative hypotheses

key features of experimental design:

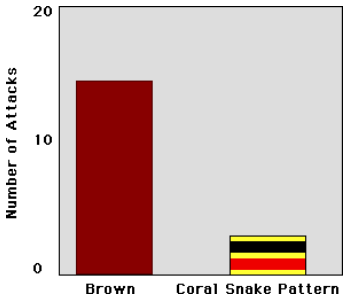
well-defined experimental and control groups

standardized conditions for handling of control and experimental organisms

randomization

sufficient replication (statistical analysis)

does coral snake coloration provide protection from predators?



Brodie 1993

Mimicry -- a common adaptation

Pollination by sexual deceit in an African daisy

Ellis and Johnson 2010 Am Nat 176:E143

Gorteria diffusa, a highly polymorphic plant

does floral deception lead to increases in pollen transfer?

two hypotheses:

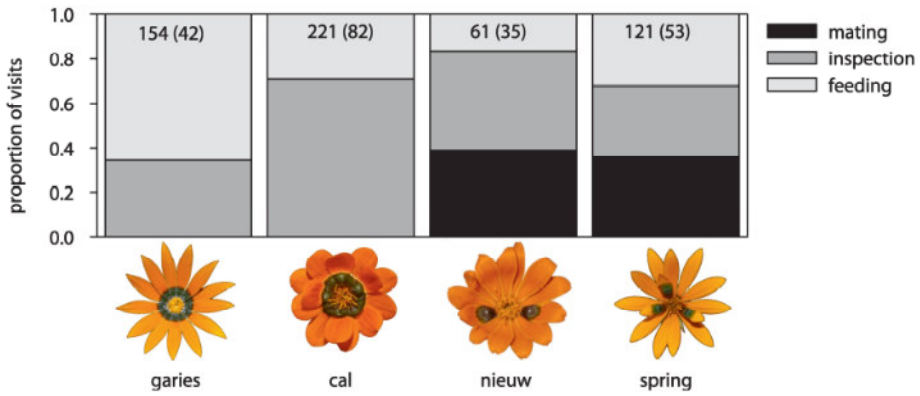
1) flowers with fly-mimic petals induce mating behavior in males

null hypothesis: all flower types are equally likely to elicit male mating behavior
-observations
-cage experiments

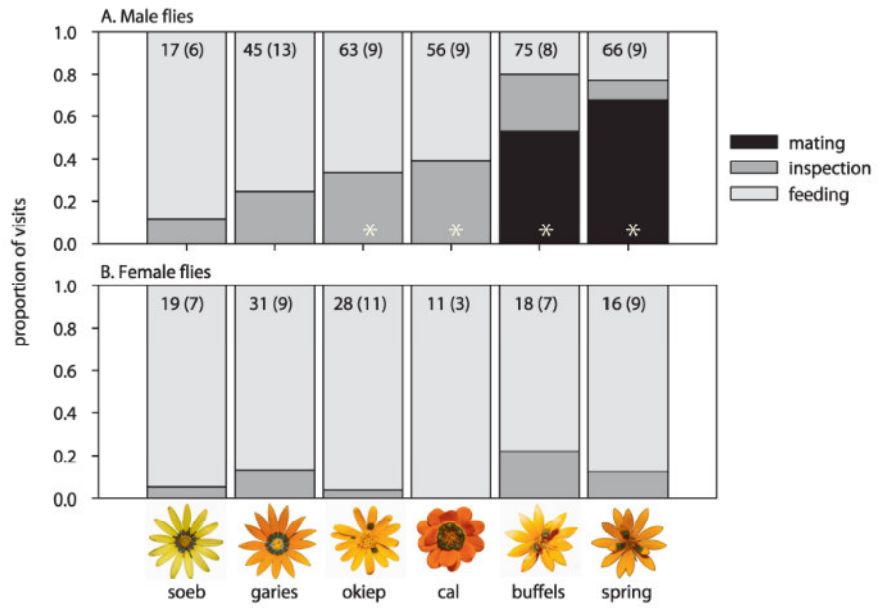
2) mating behavior by males leads to greater pollen transfer

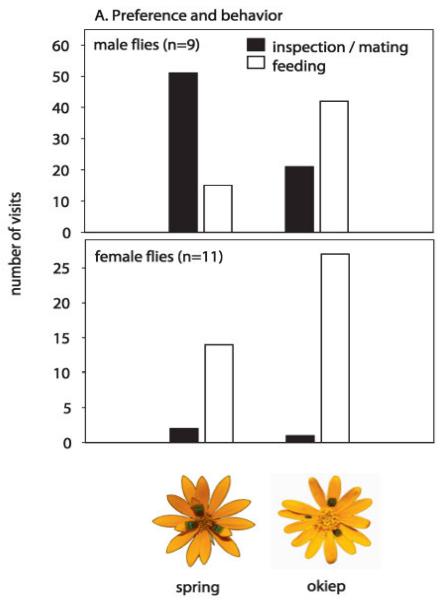
null hypothesis: male and female flies are equally good at pollen transfer

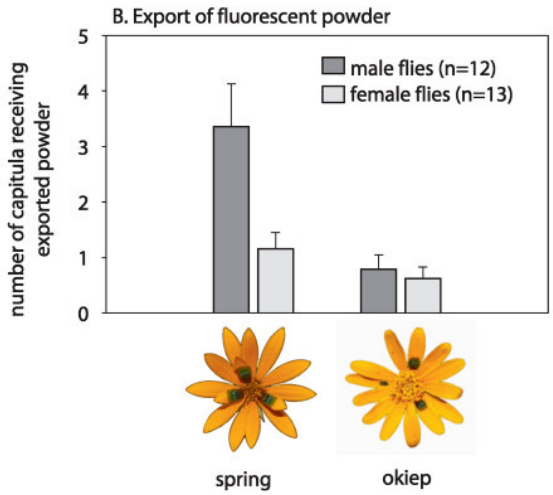
in the field, fly behavior differs among flower phenotypes



in experimental cages, male but not female behavior differs among phenotypes







Comparative Method (next time)

test hypothesis by comparing patterns of variation among species

- variation in two characters associated among species
  (e.g., scatter-hoarding and hippocampus size)

- variation in a character is associated with variation in an environmental character across species
  (e.g., columnar, spiny growth form in deserts)


Cactaceae


Apocynaceae


Fouquariaceae


Asclepiadaceae


Euphorbiaceae

adaptations are the product of natural selection

approaches to studying adaptation:
- correlation of trait and fitness (observational)
- experimental manipulation
- comparative method

experimental approach--importance of clear hypotheses,
- good experimental design, incl. appropriate controls

color variation in oldfield mice
- only mimetic, not simply aposematic, patterns provided protection
- mimetic patterns were protective only in sympatry

comparative method—account for effects of shared ancestry

aposematism and toxicity in poison dart frogs
- warning coloration has increased in parallel with increased toxicity