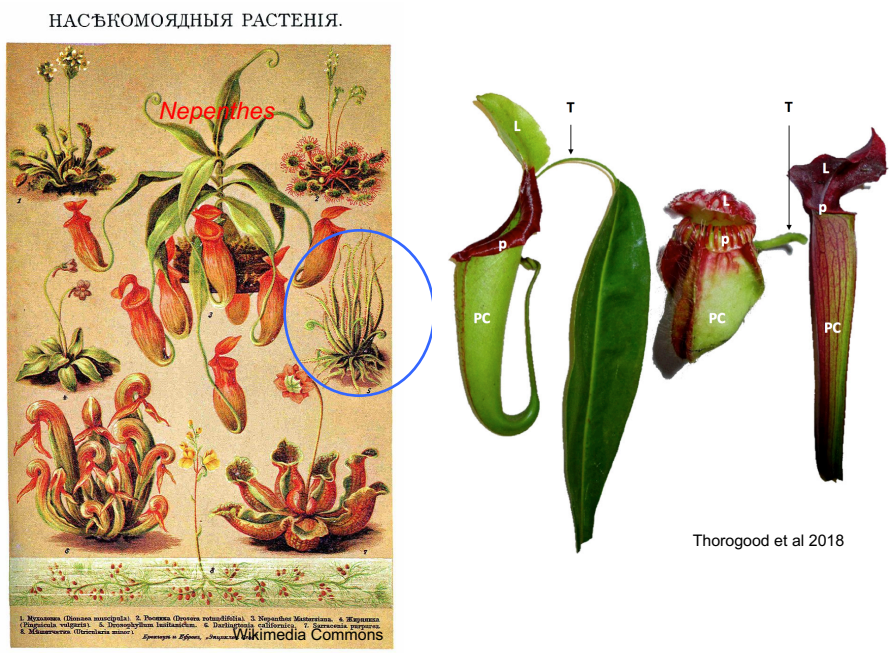

Sonoran Desert, near Maricopa, Arizona
Wikimedia Commons


Rainforest in Costa Rica
2

Pitcher plants, *Nepenthes* sp.



Lecture 1

Introduction to evolutionary biology

1. **Introduction to evolution section**
2. **How evolution is studied**
3. **Biodiversity & adaptation**

Relevant reading in Coyne – Chapter 1

Readings & background

1) Chapters in Coyne "*Why Evolution is True*"

2) I will assume a background knowledge from high school of the following topics:

   Mendelian genetics, inheritance, structure of DNA, mitosis and meiosis, chromosomes

Lectures on Evolution

1. Introduction to evolutionary biology
2. Darwin's big idea and how it changed biology
3. What Darwin saw
4. Natural selection and adaptation
5. Sexual selection
6. Neo-Darwinism and why genetic variation matters
7. The measurement and maintenance of genetic variation
8. Sex, reproductive systems and evolution
9. Populations structure, gene flow and genetic drift
10. Species, speciation and hybridization
11. Phylogenetics and macroevolution
12. Biodiversity, extinction and conservation

Questions in evolutionary biology

Type of question – how vs. why questions

- **how** questions (= proximate questions) involve determining the physiological or genetic mechanisms responsible for aspects of a trait
- **why** questions (= ultimate questions) involve determining the ecological function and adaptive significance of a trait

Approaches used in evolutionary biology

A variety of approaches are used to address questions; the best studies use more than one source of evidence:

- **Observational** – describe and quantify
- **Theoretical** – develop models – verbal, graphical, mathematical
- **Comparative** – obtain same data from many species
- **Experimental** – manipulate a system to address a specific hypothesis; requires an experimental design and statistical analysis

Important assumptions about evolution verified by scientific study

- Organisms on earth have changed through time
- The changes are gradual not instantaneous
- Lineages split or branch by speciation resulting in the generation of biodiversity
- All species have common ancestors
- Most evolutionary change results from natural selection - the only process responsible for the evolution of biodiversity and adaptation

Biodiversity and adaptation are therefore products of evolution

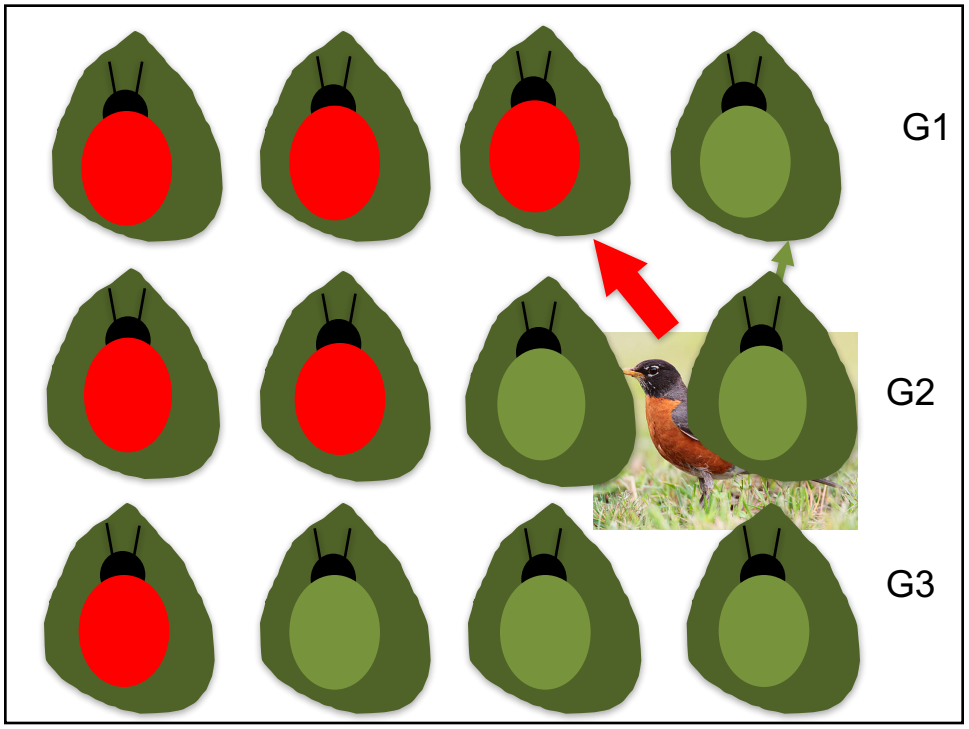
Biodiversity & Adaptation

Some simple definitions

Biodiversity – the variety of life on earth; the number and kinds of living organisms in a given area

Adaptation – has two meanings; state or process

- Any trait that contributes to fitness by making an organism better able to survive or reproduce in a given environment [as a noun]
- The evolutionary process that leads to the origin and maintenance of such traits [as a verb]

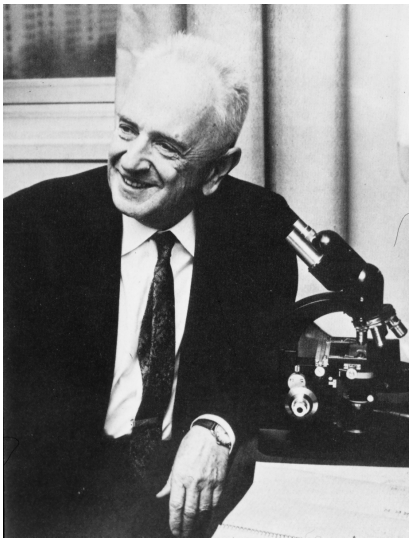


Conditions for evolution by natural selection

1. There is **variation** for the trait
2. Variation in this trait affects survival and/or reproduction (**selection**)
3. The trait has a genetic basis (=**heritable**)

Theory of Evolution

- The central unifying concept of biology
- Affects many other areas of knowledge
- One of the most influential concepts of Western thought



"*Nothing in biology makes sense except in the light of evolution*"

Theodosius Dobzhansky
(1900-1975)

Fruit fly geneticist and founder of the modern evolutionary synthesis

Evolutionary biology today

Major sub-fields:

- Evolutionary mechanisms (microevolution)
- Evolutionary history (macroevolution)

The best studies integrate information from both

Microevolution - mechanisms

- Determining the ecological and genetic mechanisms responsible for evolutionary change
- Involve population-level studies of natural selection, adaptation and speciation using diverse organisms
- Testing of theoretical models by experiments in the laboratory and field

Largely process orientated and experimental

*Macro*evolution - history

- Determining evolutionary relationships of organisms in terms of common ancestry - phylogenetics
- Affinities of organisms provide a basis for classification – taxonomy & systematics
- Comparative data from many sources e.g. biogeography, paleontology, morphology, development and genomics

Largely pattern-based and non-experimental

ANIMAL BEHAVIOUR, 2000, **59**, 411–421
doi: 10.1006/anbe.1999.1310, available online at http://www.idealibrary.com on IDEAL®

Courtship role reversal and deceptive signals in the long-tailed dance fly, *Rhamphomyia longicauda*

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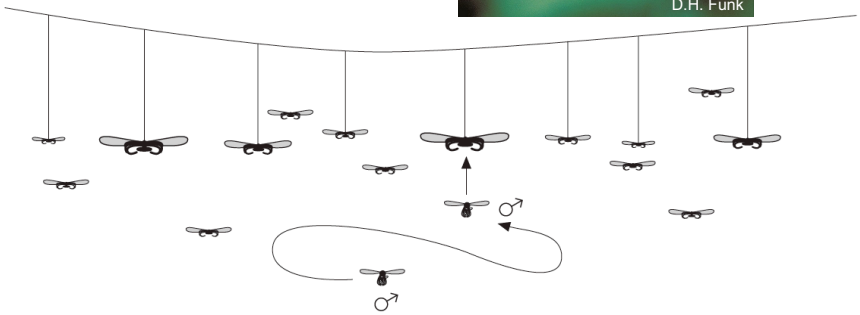
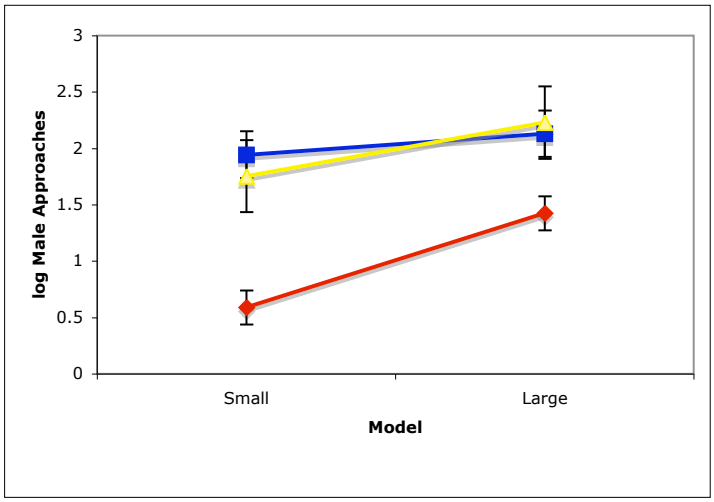
*Stroud Water Research Center
†Department of Entomology and Applied Ecology, College of Agricultural and Natural Resources, University of Delaware

Rhamphomyia longicauda

Funk & Tallamy 2000



Funk & Tallamy 2000


log Male Approaches
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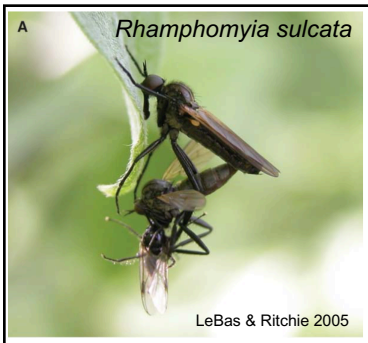
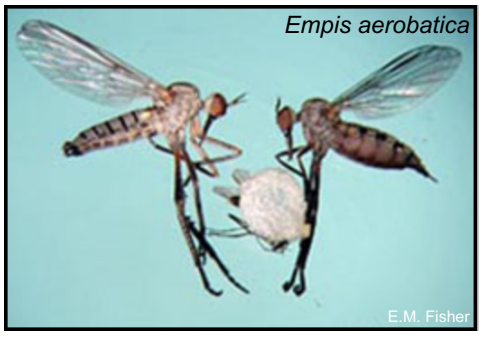
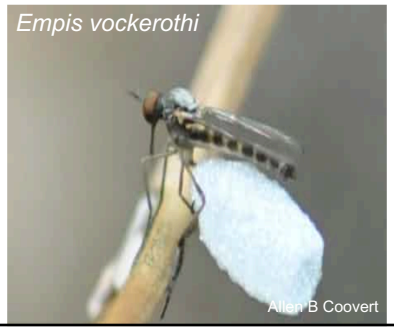
2.5
2
1.5
1
0.5
0
Small
Large
Model


A
Rhamphomyia sulcata
LeBas & Ritchie 2005


Empis aerobatica
E.M. Fisher


Empis vockerothi
Allen B Coovert