Announcements

- Hand in 1st in-class exercise
- 2nd In-class exercise Thursday

- Study questions posted on class website

- Help available from me this week:
  - Tues. 11:45-1:00p
  - Thurs. 12:30-1:30p

Where we left off Thursday...

Life histories

- Bubble diagrams summarize average life history events
  - usually with 1-year time steps (survival per year)

- Result of natural selection
  - Organisms exist to maximize **lifetime reproductive success**
  - Represent successful ways of allocating limited resources to carry out various functions of living organisms
    - Survival, growth, reproduction

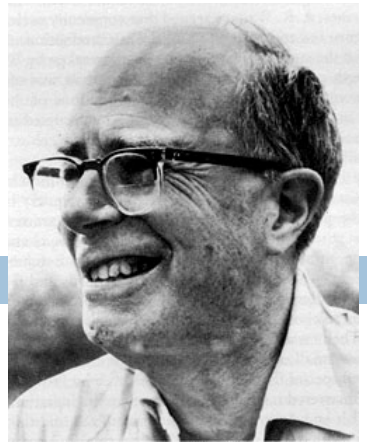
Trade-offs in life histories

- **Limited time & energy that must be allocated between demands**
  - How to maximize lifetime reproductive success? Is there always a conflict?
  - Exception: David Reznick—compared reproductive and non-reproductive Trinidad guppies--predict that non-reproductives would grow bigger—not true. Same size.

- **When to begin breeding? How often to breed? How many offspring per event?**
  - Depends on survival schedule of each organism (shaped simultaneously)
  - Priorities: Individual survival to reproduction, investment in reproduction, investment in maintenance (if reproducing multiple times)

- **Investing in offspring reduces survival of parents** (risky, energy consuming)

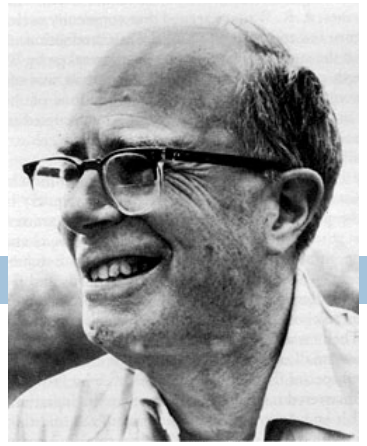
Lack clutch



- David Lack first suggested that birds limit the number of eggs they lay, because it is costly to raise offspring, and they would be less successful with larger broods.

- How would you test this experimentally?

Lack clutch



- David Lack first suggested that birds limit the number of eggs they lay, because it is costly to raise offspring, and they would be less successful with larger broods.

- How would you test this experimentally?
  - by adding and removing eggs from clutches!

Magpies usually lay 7 eggs.

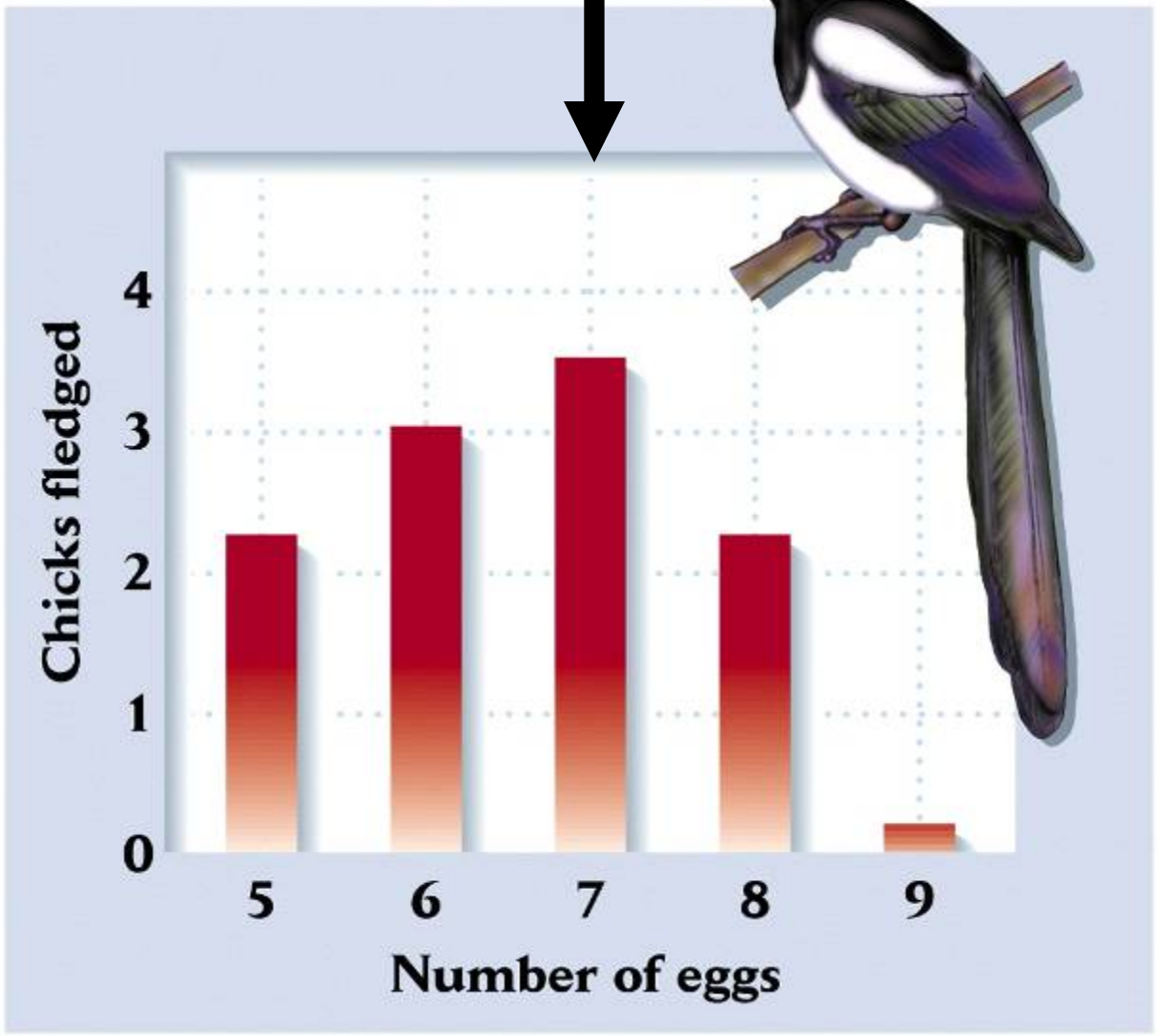
Maximizes number of fledglings

Why 7?

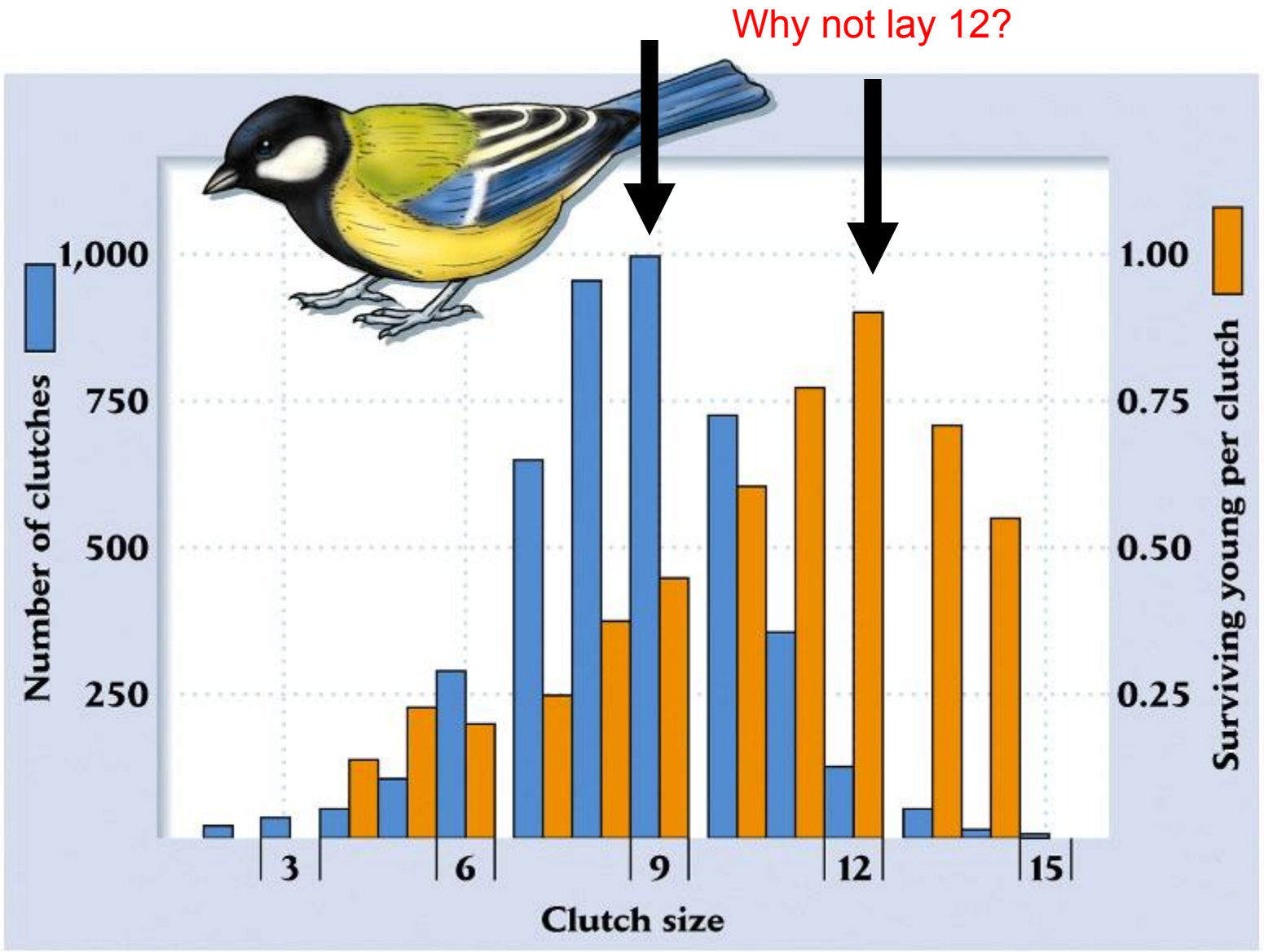
Treatments:

Add 1 or 2

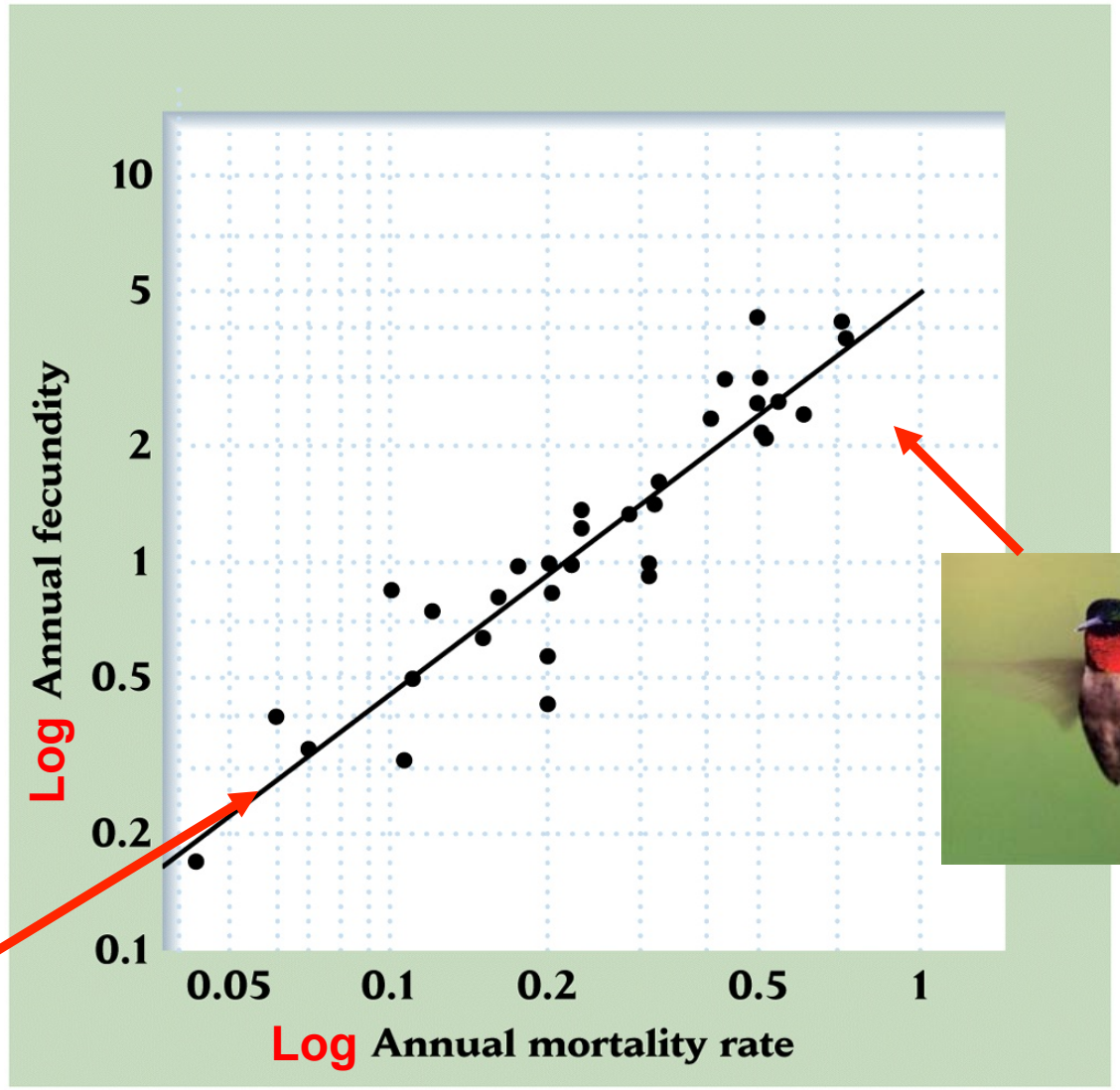
Subtract 1 or 2



Great tits usually lay 9 eggs. But the highest number of surviving young per clutch occurs at 12 eggs.



Birds

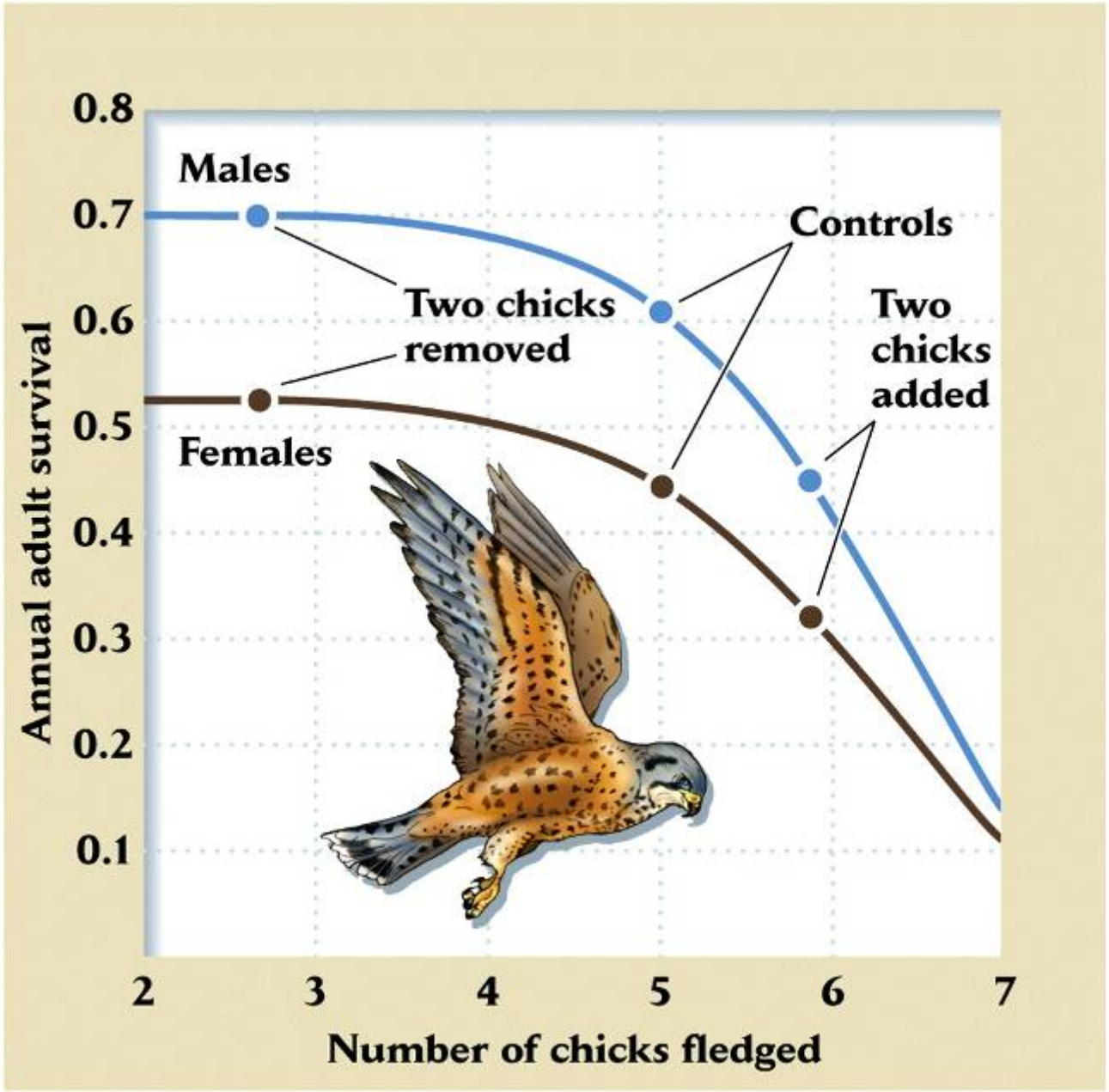


1 egg/ ~2yr
9 mo. parental care
Lifespan >60yr

2 eggs x 2 / yr
20d parental care
Lifespan 2-3yr

European Kestrels-invest energy in the form of gametes and parental care

at the expense of their own survival



Fecundity vs adult survival

- Current reproduction may be improved by larger clutch, but future fecundity (or survival) may suffer

- Again think about selection to maximize total *lifetime* reproductive success

Age at first reproduction

- Reproduce now vs. later?
- Delayed reproduction is common in organisms that become better parents, have higher fecundity, or attain larger size with age
- Again, reproducing is costly and risky for the parents

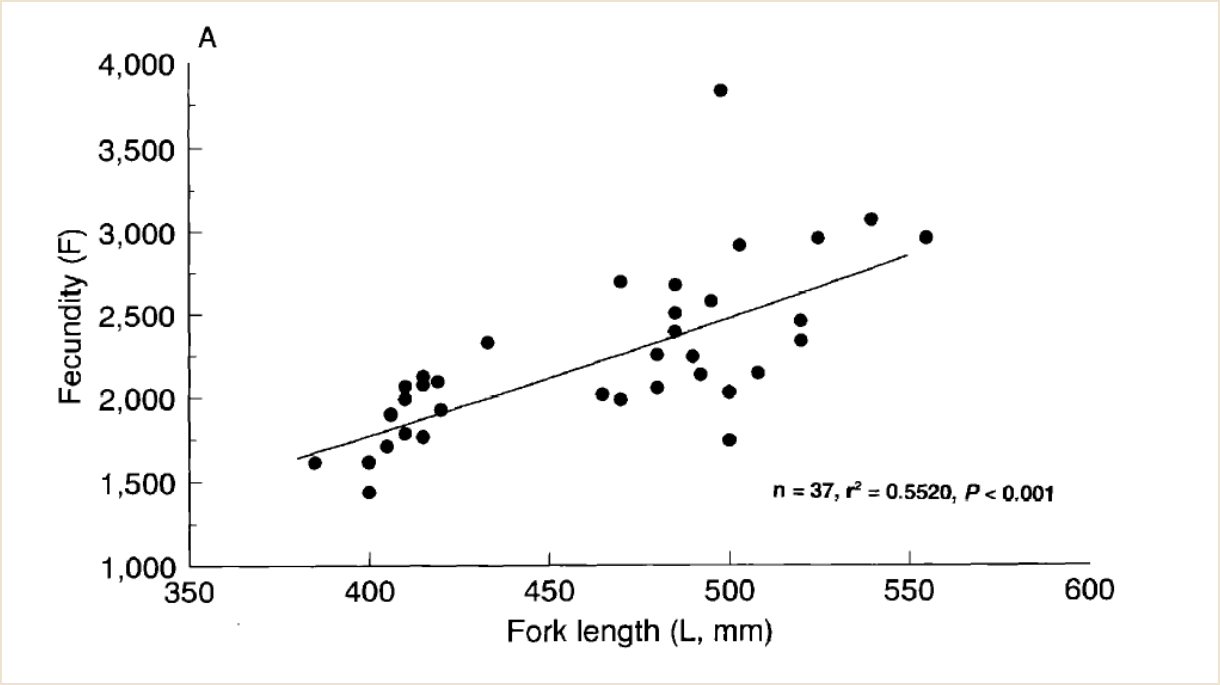
Hypothetical:Total eggs produced by organism that can increase reproductive output by 10 if it waits a year

Age at 1st repro	Life Span: 1	2 yrs	3 yrs	4 yrs	5 yrs
1	10	10 x 2	10 x 3		
2	--	20	20 x 2		
3	--	--	?		
4	--	--	--	?	
5	--	--	--	--	?

Total eggs produced

Age at 1st repro	Life Span: 1	2 yrs	3 yrs	4 yrs	5 yrs
1	10	20	30	40	50
2	--	20	40	60	80
3	--	--	30	60	90
4	--	--	--	40	80
5	--	--	--	--	50

Sockeye salmon fecundity increases with size



Semelparity, so put nearly all available energy into fecundity

Bigger body = more energy for offspring

Environmental condition affects life history

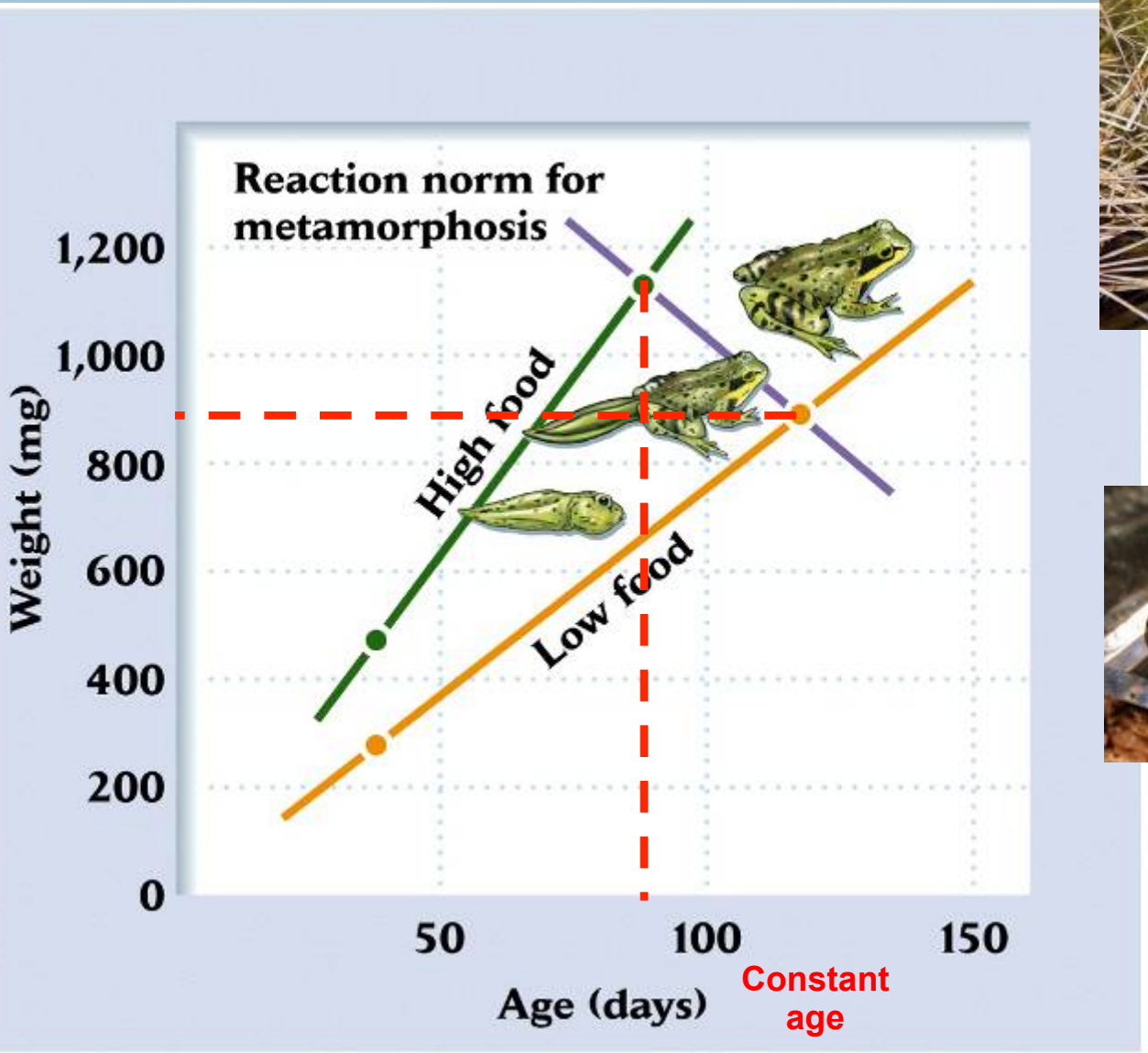
- Most life-history features under ~inflexible genetic control
  - Can you alter # offspring/reproductive episode in humans?
    - Not without fertility drugs.

- Sometimes flexibility in traits has been selected for

  - **Phenotypic plasticity**: life history traits affected by environment

Time to metamorphosis depends on food availability

In this case, both time and size at metamorphosis are affected



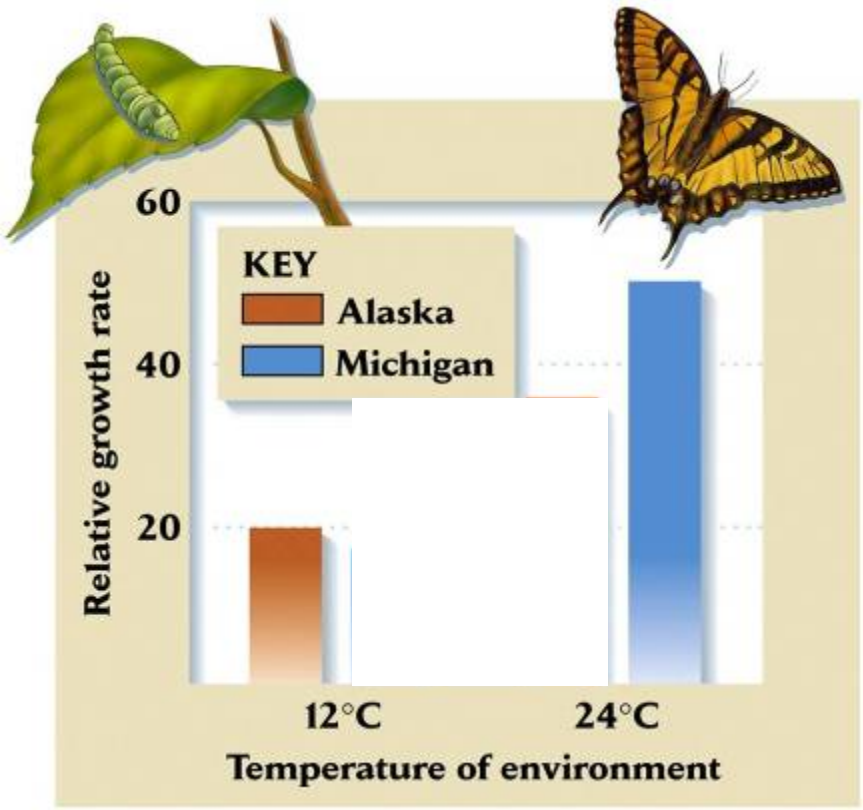
Environmental condition affects life history

- Most life-history features under ~inflexible genetic control
  - Can you alter # offspring/reproductive episode?
    - Not without fertility drugs.
- Occasionally flexibility in traits has been selected for
  - **Phenotypic plasticity**: life history traits affected by environment
- Can test for plasticity between pop's of the same species with **reciprocal transplant experiments**

Reciprocal Transplant experiment

-Swallowtail caterpillars

-compare "performance" in either environment



Alaska **Michigan**

4 treatments:AK in AK conditions

AK in MI conditions

MI in MI conditions

MI in AK conditions

Are their responses identical in same environment?

-suggests environment drives plasticity

Or does each population have a "fixed" growth rate regardless of environment?

-suggests genetic control

Which one here?

Environmental condition affects life history

- Most life-history features under ~inflexible genetic control
  - Can you alter # offspring/reproductive episode?
- Occasionally flexibility in traits has been selected for
  - **Phenotypic plasticity**: life history traits affected by environment
- Can test for plasticity between pop's of the same species with **reciprocal transplant experiments**
- Genotype x environment interaction: each genotype responds differently to environmental condition
  - Lizard example in readings
  - Are populations that respond differently diverging?


naturalvisions.co.uk

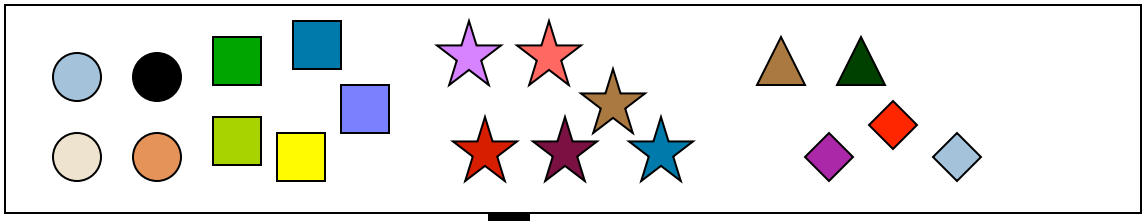
Populations

- What constitutes a population?
  - Interbreeding individ's of a species
  - Somewhat arbitrary distinctions between pop's
- Populations vary in *space*
  - Distribution
  - Dispersion
- Populations vary in *time* (Thursday)
  - Abundance and *dynamics*
- Characterizing population dynamics (Thursday)
  - Life Tables→ parallels Life History diagrams
  - Get out your calculators!

Populations in space & time

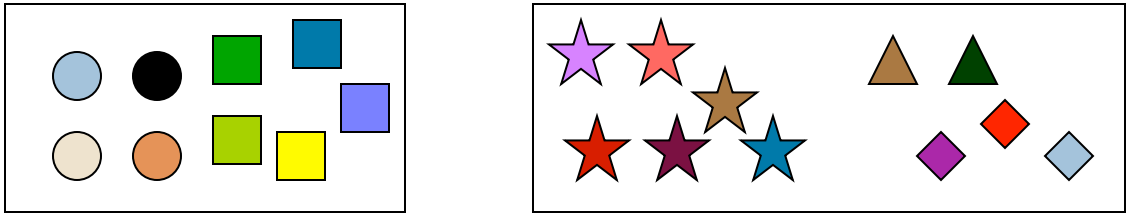
- Distribution: spatial extent of a species
  - What shapes species/population boundaries?
    - LOTS of things. History, Physical/Environmental limitations, Biological interactions

All species on earth



Historical filter:

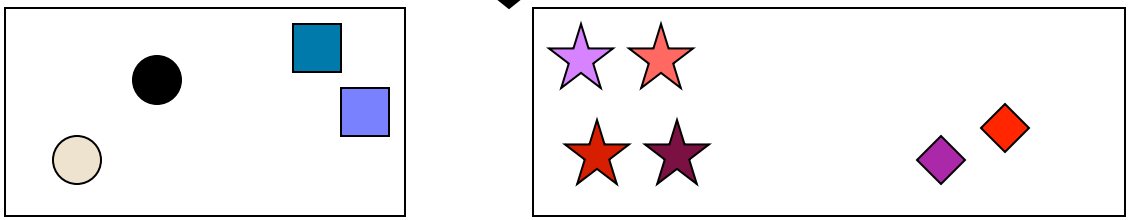
Where taxa evolve



Physical filter:

Habitat requirements

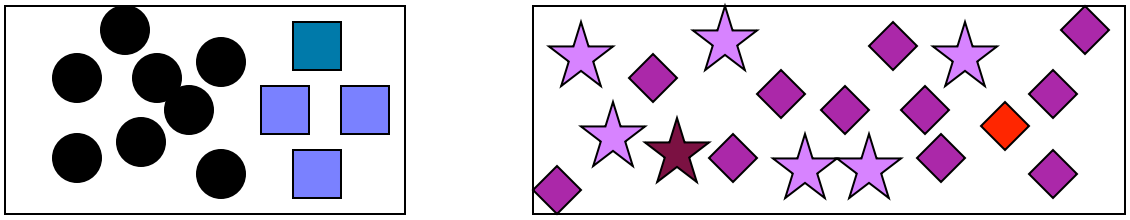
Environmental limits



Biological filter:

Other species

Predators, prey, parasites, etc.



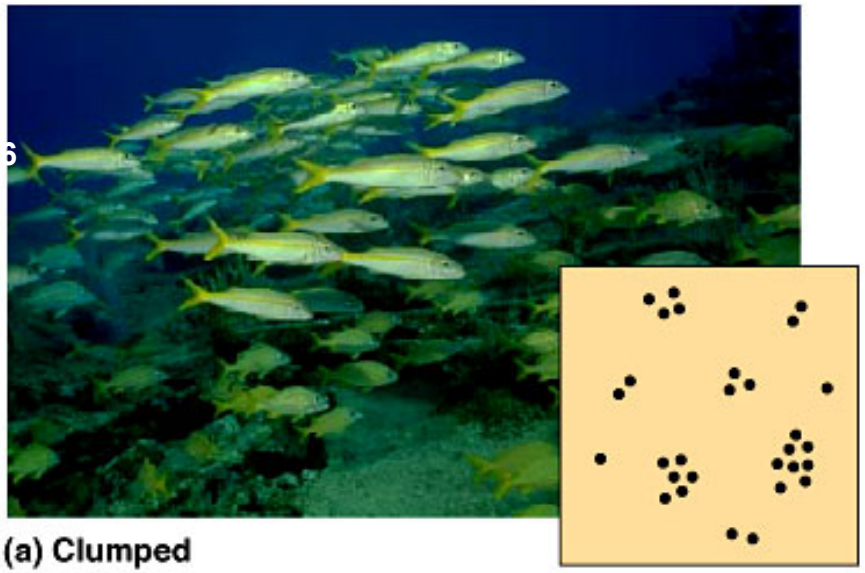
Populations in space & time

- Distribution: spatial extent of a species
  - What shapes species/population boundaries?
    - LOTS of things. History, Physical/Environmental limitations, Biological interactions
  - Within a distribution, how do we classify the spatial arrangement—**Dispersion** of organisms?
    - CLUMPED→RANDOM→UNIFORM

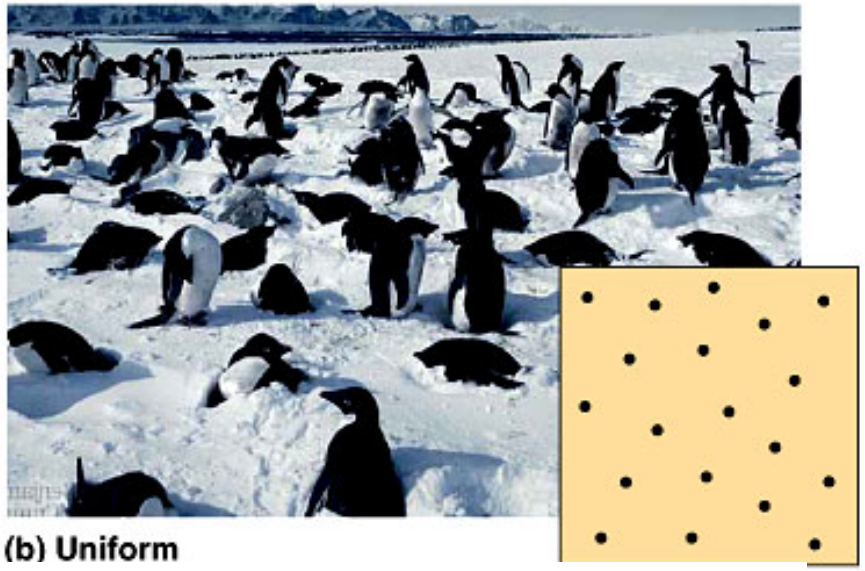
    Can you think of an ecological driver for each?

Dispersion patterns

Predator avoidance, patchy resources

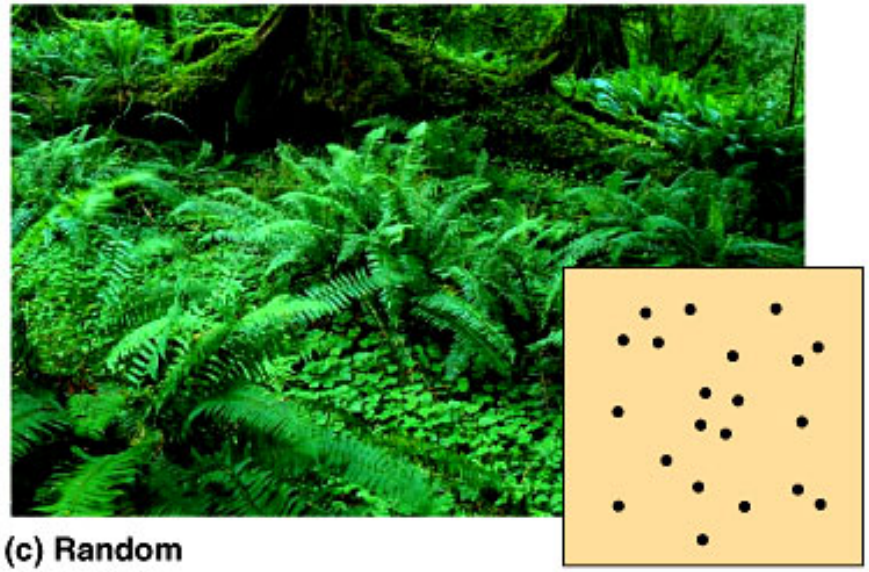


(a) Clumped



(b) Uniform

Territoriality, strict competition for resources



(c) Random

Most common form. Stochasticity, disturbance, predators/herbivores, patchy resources