Lecture 13

Life history variation

WILD3810 (Spring 2020)

Life history variation

Organisms have limited resources to investment between growth, reproduction, and survivorship

- **Trade offs**

Evolution selects for different combinations of *life history traits*

> Demographic traits that influence fitness (i.e., λ)

- size at birth
- growth pattern
- age at maturity
- fecundity schedule
- mortality schedule
- length of life

Selection favors life history combinations that maximize the per capita growth rate

Life history variation

Which species has higher fecundity?

Which species has a higher age at first reproduction?

Which species lives longer?

Life history variation

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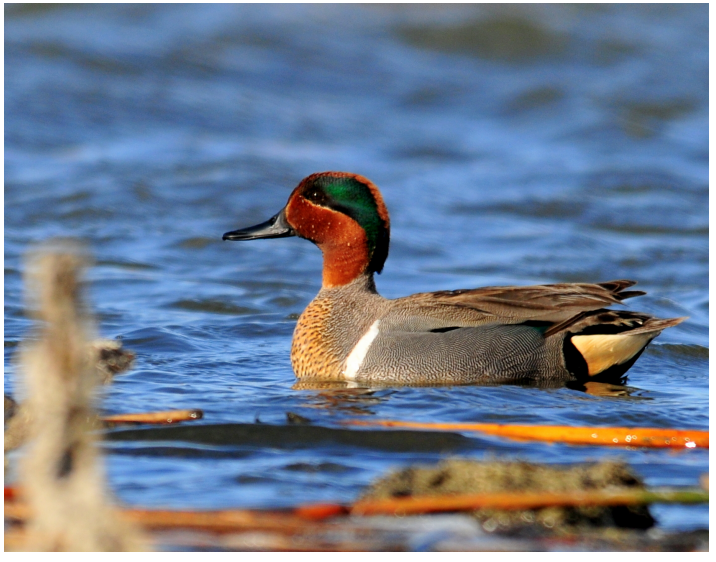


Life history variation

Which species has higher fecundity?

Which species has a higher age at first reproduction?

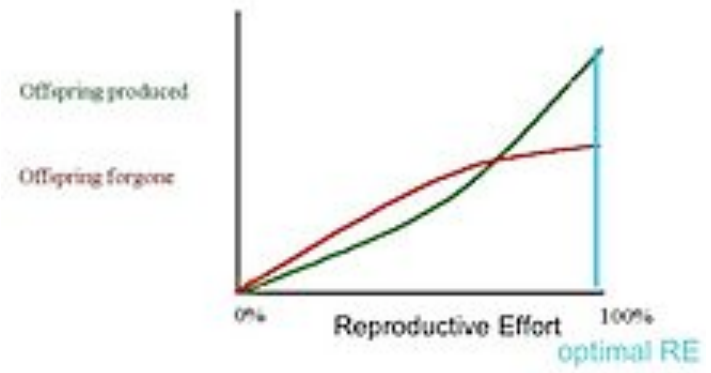
Which species lives longer?

Life history trade offs

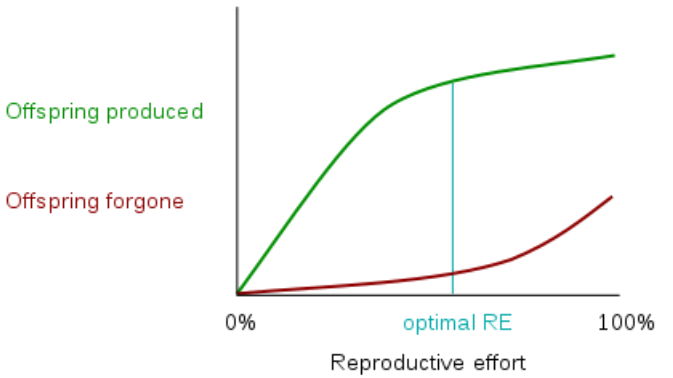
Life history trade offs

Current reproduction vs. future reproduction

Semelparity

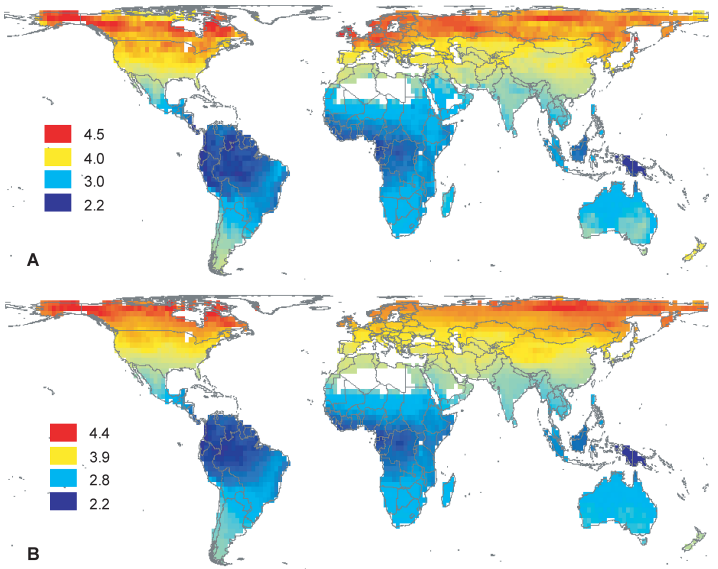


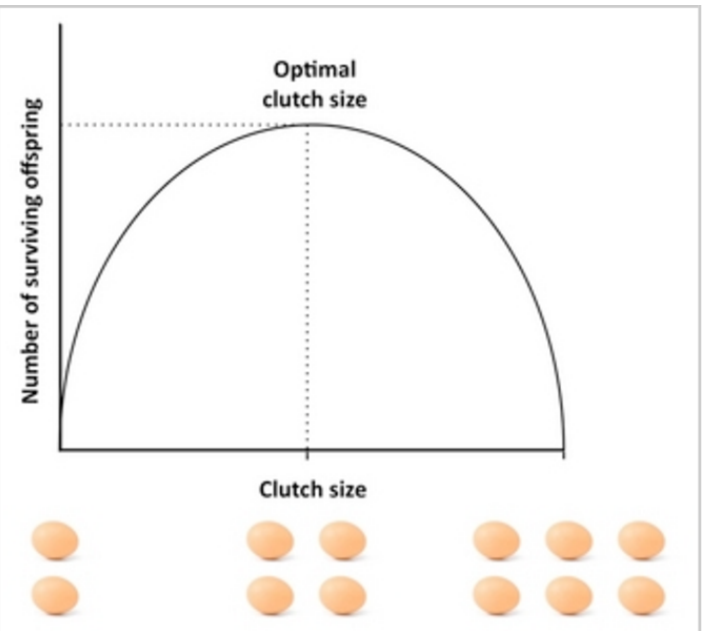
Iteroparity



Life history trade offs

Offspring quantity vs. quality (Lack 1954,1968)





r-K selection

Arises directly from logistic population growth model (MacArthur & Wilson 1967; Pianka 1970)

- r : density-independent rate of population growth
- K: carrying capacity

Evolution of life history strategies leads to:

r-selected species

- selection for ability to colonize and reproduce rapidly
- good colonizers, poor competitors

K-selected species

- selection for ability to contribute to N when the population is near K
- good competitors, poor colonizers

Life history trade offs

Predictions (based on Pianka 1970)

	r-selection	K-selection
Mortality	Variable & unpredictable	Constant & predictable
Population size	Variable & below K	Constant & close to K
Competition	Variable & weak	Strong
Selection favors	Rapid development, early reproduction, small body size, semelparity	Slow development, delayed reproduction, large body size, iteroparity
Length of life	Short	Long
Leads to...	High productivity	High efficiency

r-K selection

The predictions of r-K selection stimulated vast amounts of research on life history evolution

But...

- Many species don't fall neatly into these categories (combinations of r-selected traits and K-selected traits)
- Predictions are vague enough that many different results are "consistent" with them
- Carrying-capacity is not a demographic parameter so traits that influence resource use do not directly translate to a specific K

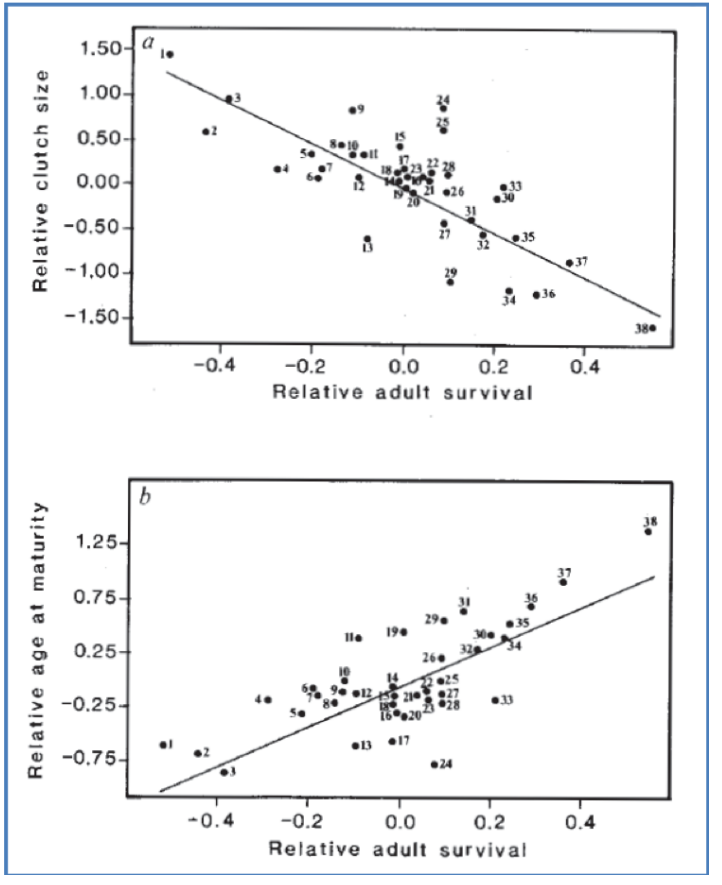
Fast-slow continuum

Fast-slow continuum

More recent studies view life history variation as existing on a continuum:

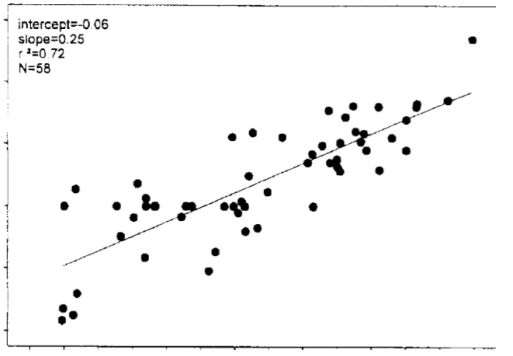
Slow species	Fast species
Low reproductive effort	High reproduction
Delayed maturity	Early maturity
High survival	Low survival
Long generation time	Short generation time

Fast-slow continuum in birds

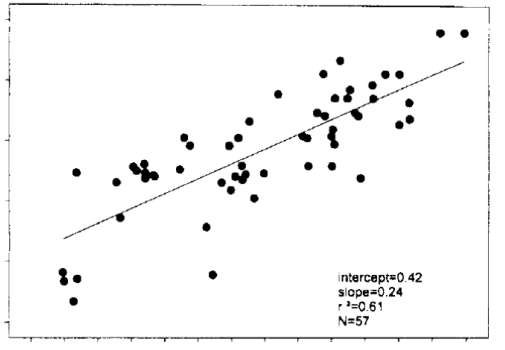


Fast-slow continuum in mammals

Age at 1st reproduction vs. adult body mass



Adult lifespan vs. adult body mass

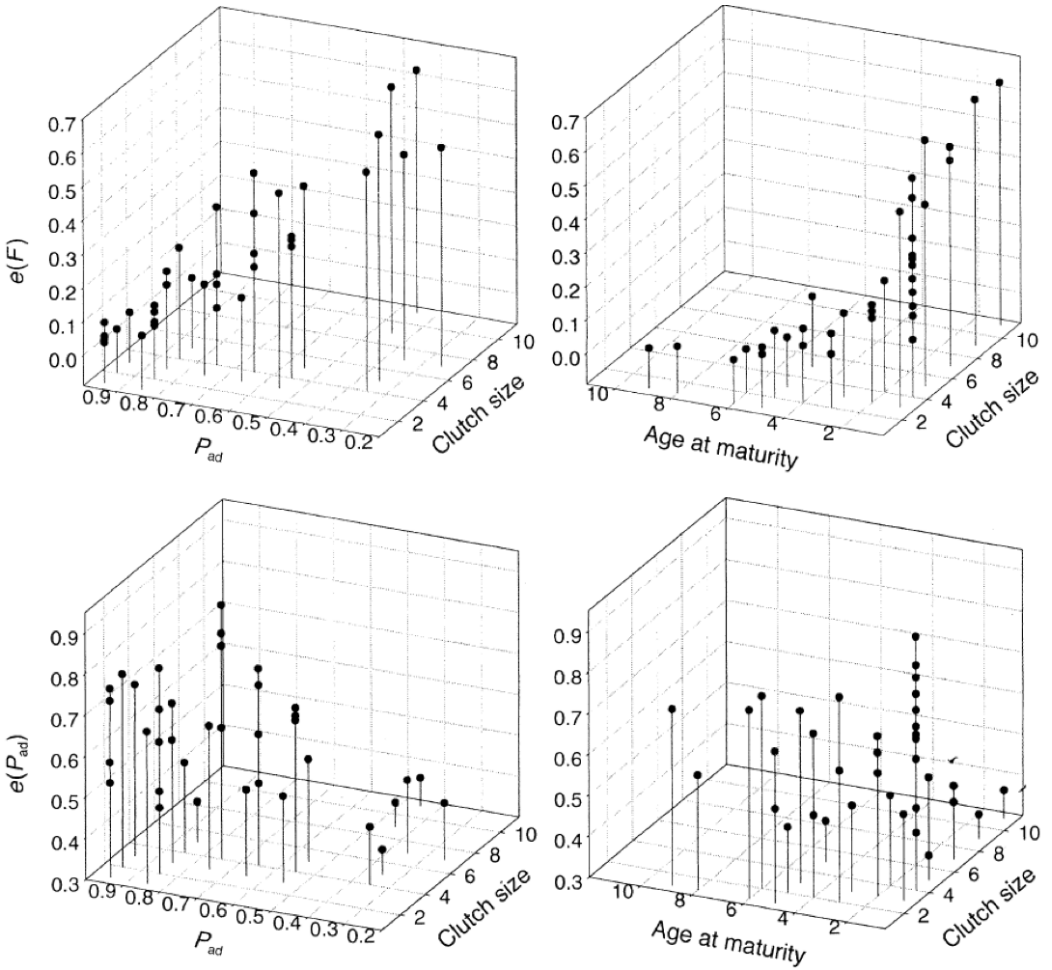


Fast-slow continuum and elasticities

Is the fast-slow continuum related to which vital rates influence λ?

- Explicit connection between evolved pattern of life history vital rates and impact on population dynamics
- Elasticities are useful to guide conservation & management

Fast-slow continuum and elasticities



Fast-slow continuum and elasticities

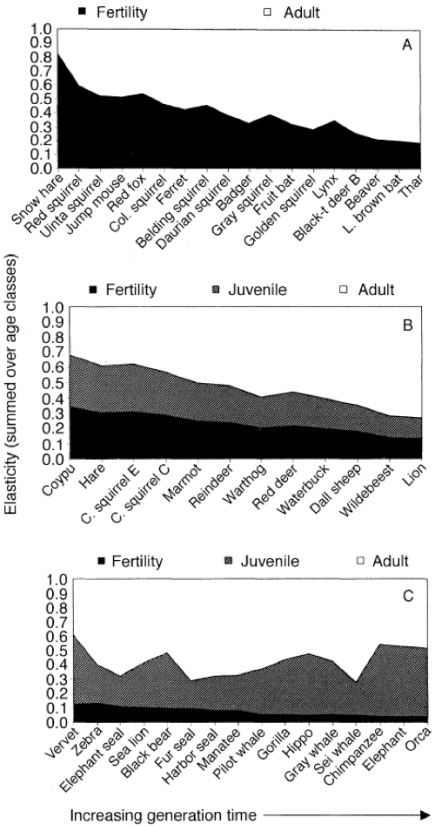


FIG. 2. Area plots showing the stage-specific elasticities for each mammal population, grouped by age at maturity and ordered by increasing generation time. (A) Age at first maturity = 1 yr; no juvenile stage. (B) Age at first maturity = 2 yr; fertility elasticity = juvenile survival elasticity (see *Methods*). (C) Age at first maturity >2 yr.

Fast-slow continuum and elasticities

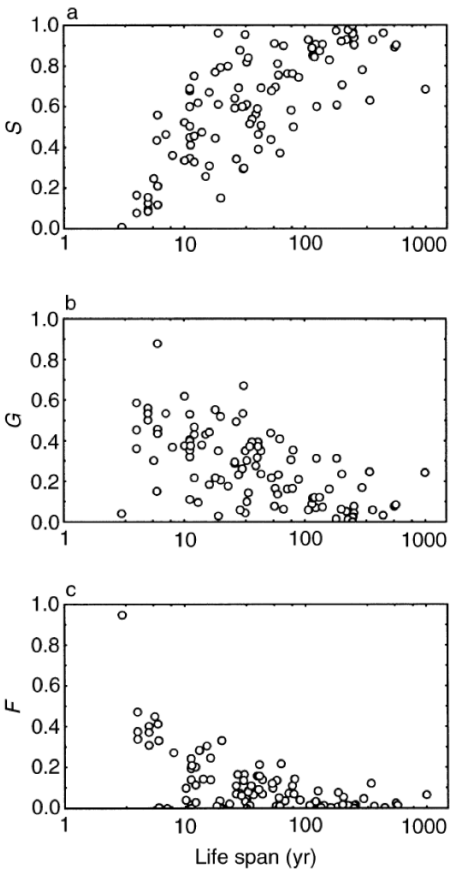


FIG. 4. The relationship between each of the elasticities of (a) survival, (b) growth, and (c) fecundity and life span for 102 species of perennial plants.

Fast-slow continuum and management

Distinctive demographic elasticity patterns across bird, mammal, and plant life histories

- Elasticities can be reasonably assessed from limited knowledge of an organisms life history (e.g., clutch size, age at maturity, etc.)
- Managers can assess whether to focus on managing survival (e.g., through harvest or wintering habitat) or reproduction (e.g., spring and summer habitat)
- Very important for the conservation of rare species
    - Detailed demographic studies not possible