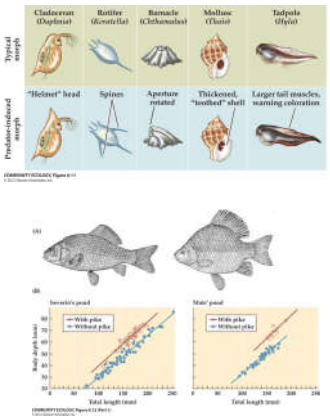
Morphological Shifts

- Plastic responses (e.g. Daphnia)
- Strong selection on specific phenotypes.
  - Morphologies to avoid predation through increased T_s or T_h



Evolutionary Trends in Life Histories

Evolution, 36(1), 1982, pp. 160–177

THE IMPACT OF PREDATION ON LIFE HISTORY EVOLUTION IN TRINIDADIAN GUPPIES (*POECILIA RETICULATA*)

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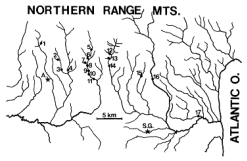


FIG. 1. Map of the study sites in northeastern Trinidad. Solid lines: rivers and streams. A: town of Arima. S.G.: town of Sangre Grande. Numbers refer to sampling sites and sites are named after the river systems in which they were taken: 1, Arima 6; 2, El Cedro 3; 3, El Cedro 1; 4, Guanapo 7; 5, Aripo 8; 6, Aripo 1; 7, Aripo I; 8, Aripo 11; 9 Aripo 6a and 9 (below and above a waterfall); 10, Aripo 6; 11, Aripo 10; 12, Quare 6; 13, Quare 3; 14, Quare 4; 15, La Selva 1; 16, Oropuche 2; 17, Arena 1. See also Fig. 9 in Endler (1978).

- Predation gradient:
  - C – large predators targeting adults
  - R – moderate sized predators targeting juveniles
  - A – low overall predation on all size classes
- RA = reproductive allotment
- Bd. Interval – time between broods

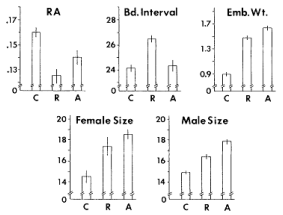
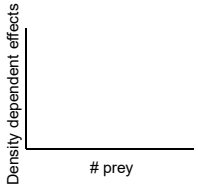
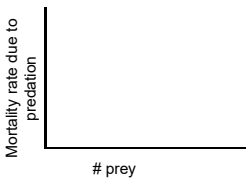


FIG. 3. Summary of results. RA, reproductive allotment. Bd. Interval, interbrood interval (days). Embryo Wt., mean embryo weight (mg.). Female Size, mean minimum size class of gravid females (mm) (see text). Male Size, mean size of mature males (mm). C, Crenicichla localities. R, Rivulus localities. A, Aequidens localities. Vertical line encompasses mean ± 1 standard error.

Predator Effects on Prey Populations

- Conceptually, the opposite of a resource shortage
  - Greater mortality due to predation should reduce density dependent effects (intraspecific comp)
  - Predator attacks often target weak individuals
  - Predators may target demographically unimportant stage (old or young)
- If predator population is stable, increase in prey population size decreases individual prey probability of death due to predation.
  - **Swamping and consumer satiation**



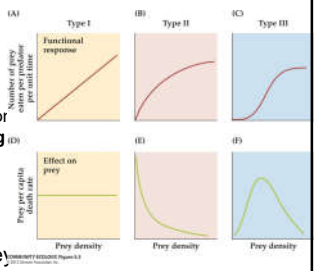


Predator Effects on Prey Populations – role of keystone Predator

- Reduce prey interspecific competition
  - Prevents competitive exclusion
  - Increase diversity
  - Potential explanation for greater diversity in tropical systems: More energy = more trophic levels = more predators = more diversity

Functional Response

- I – rate or consumption is linear with prey density until predator satiation. At high prey density, s and h negligible.
  - FR = aN
- II – consumption rises slowly and plateaus. Max consumption a function of h (constant representing **handling time**).
  - $\mathrm{FR} = \frac{aN}{1+ahN}$
- III – s-curve, due to switching behavior, or an increase in prey abundance leading to an increase in predator searching efficiency (**search image**).
  - $\mathrm{FR} = \frac{cN^2}{d^2+N^2}$



Where:
$c=h^{-1}$
$d=(ah)^{-1}$

Lotka-Volterra model

- Prey population:
  - a = attack rate
  - P = number of predators

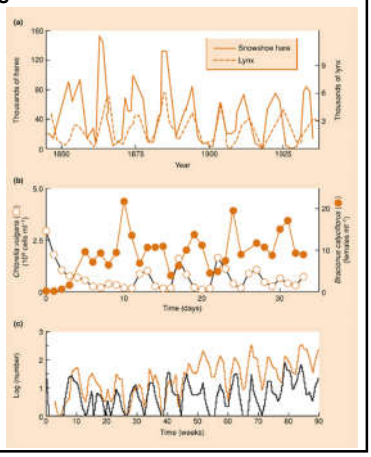
$$\frac{dN}{dt} = rN - aPN$$

- Predator population
  - f = predator efficiency at turning one prey into one new predator
  - a = attack rate
  - q = predator mortality rate
  - Predator birth rate = faPN

$$\frac{dP}{dt} = faPN - qP$$

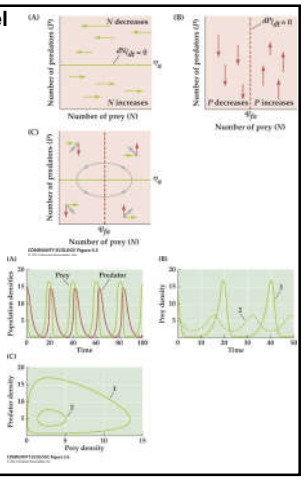
- Delayed density dependence…

Predator-Prey Interactions



Isoclines of Lotka-Volterra Model

- Isoclines defined by:
  - r/a – predator abundance
  - q/fa – prey abundance
- Model predicts stable predator-prey oscillations
- Eg. Prey increase in abundance if predator density below r/a
- Models predict stable oscillations. However, models are fairly simple, make a number of assumptions…
- **See spreadsheet**



Destabilizing Factors

- Models assume no competition among predators, type I functional response.
- Assume no competition among prey
- Predator/prey population may be stabilized or destabilized by:
  - Predator competition or interference (reduce predator effectiveness)
  - Different predator functional response (e.g. switching behavior)
  - Density dependence or other specific predator/prey population dynamics

Lotka Voltera Model + K

- Adding K to our model:
  - $\frac{dN}{dt} = rN\left(1 - \frac{N}{K}\right) - aNP$
  - $\frac{dP}{dt} = faPN - qP$
  - Where prey are now limited (K)