

## Predator-Prey Dynamics

Elton's lynx-hare cycles

Single species

Cycling related to time lags

Increase when at low density causes crowding and "over compensation" next year

Predator-prey cycles are also related to lagged density dependence

Prey increase

Preds increase

Preds begin to reduce prey density

Preds begin to decline

Prey begin to increase again...

Lotka-Volterra equations

Neutrally stable cycles with period approx  $2\pi\sqrt{rd}$

Exhibits "paradox of enrichment" or top down control

Increase in prey production only increases predator density

Mathematical concept of stability

Does small perturbation to a steady-state solution grow or die out?

For continuous differential equations, stability related to slope of growth function in the vicinity of the steady state (negative slope stable, positive slope is unstable)

Discrete time stability also determined by slope (derivative) of growth function at the steady-state (-slope  $> 1$  is unstable)

Factors that can lead to stability in predator-prey cycles

Change in predator functional response

Prey switching by generalist predator

Spatial variation in predator and prey density

Reduction in the lag duration