Predation

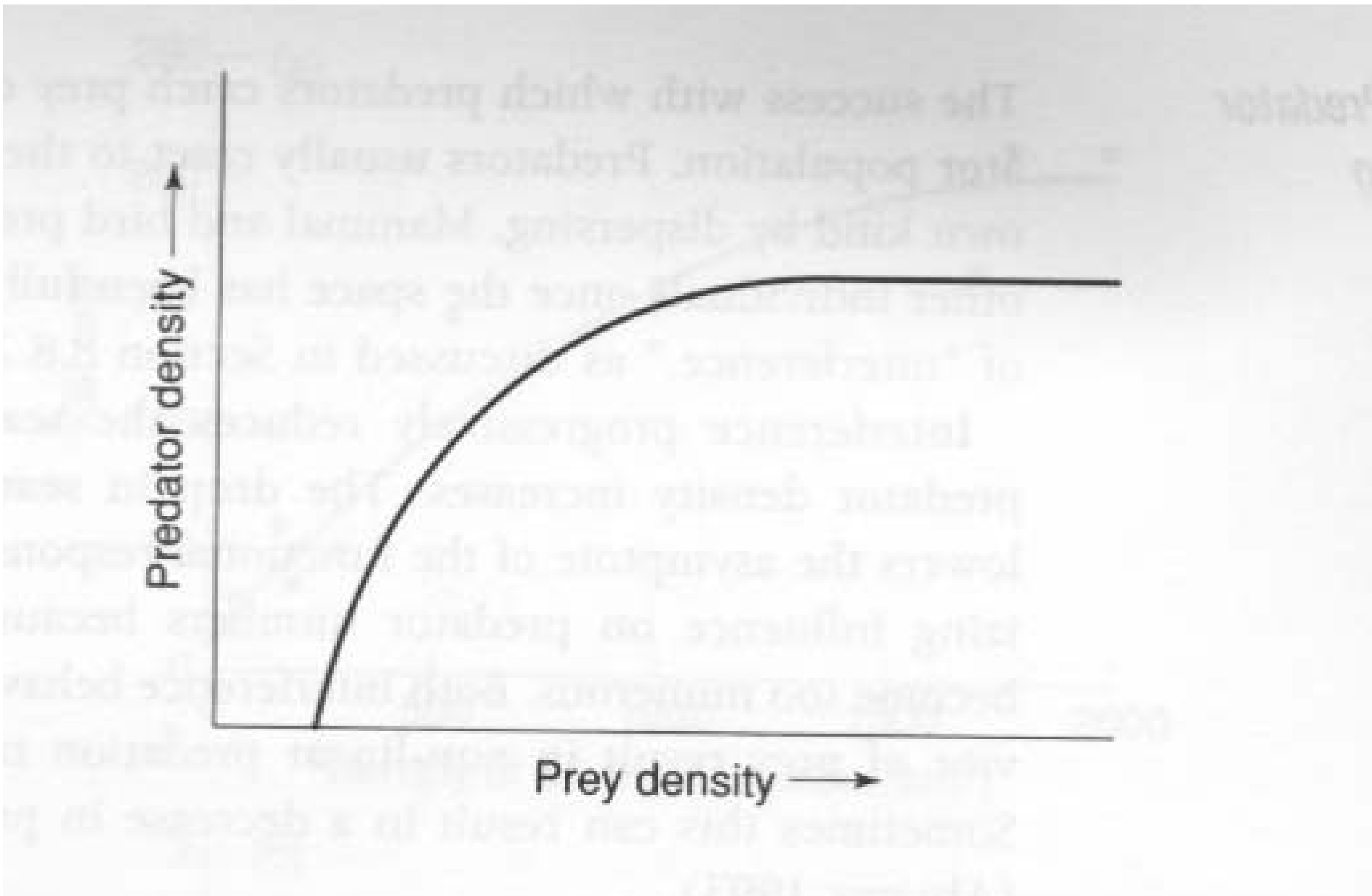
Aspects of Predation

- Predation: animals killing and eating other live animals
- Scavenging: animals that eat animals already dead
- Types of predation
  - Carnivory
  - Herbivory
  - Cannabalism
  - Compensatory predation
  - Non-compensatory predation

Aspects of predation

- Functional response
  - Behavior of predator changes with prey density
  - Search patterns, appetite, handling time
- Numerical response
  - Population processes of predator change with prey density
  - Survival, reproduction, movements
- Total response
  - # prey eaten/predator x predator density = prey mortality due to predation

Numerical response

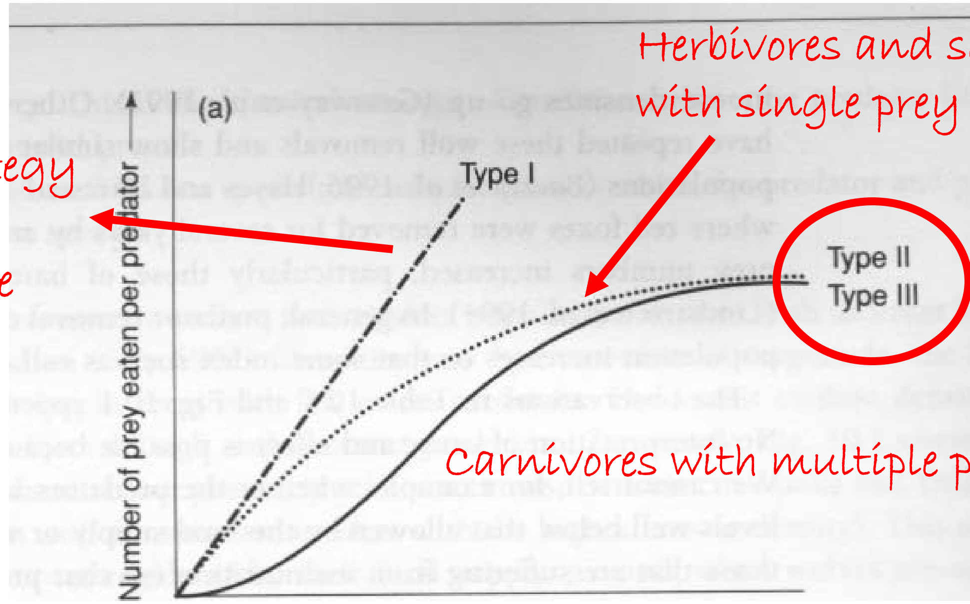


Functional response

Assumes:
random search strategy
unlimited appetite
constant search time

Herbivores and some carnivores with single prey

Takes into account handling time



Carnivores with multiple prey

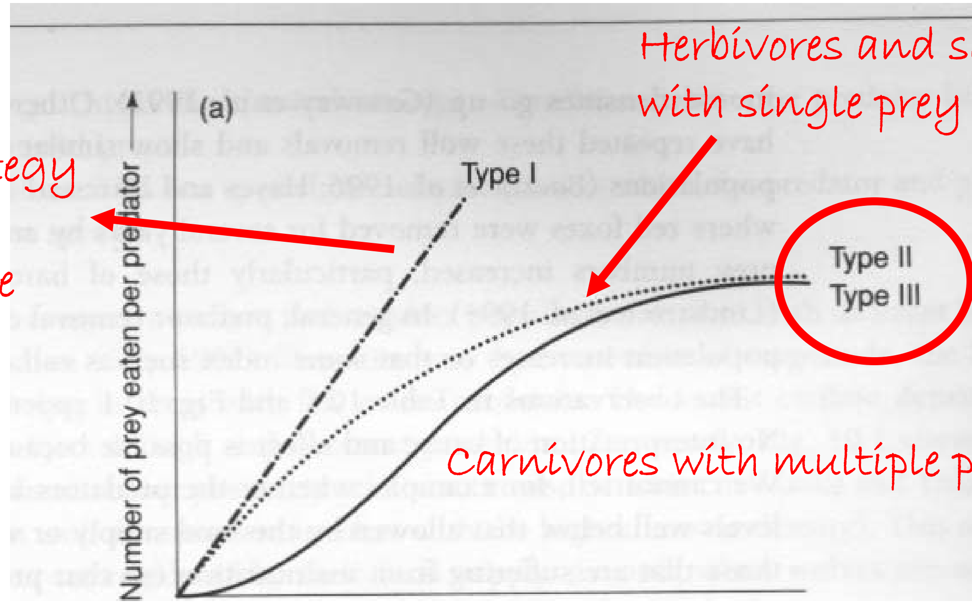
Types II vs III functional responses

- Type III similar to Type II except for response at low prey densities (sigmoid)
- Difficult to differentiate in real life
- Why the difference in Type III?
  - Predators cannot learn to catch rare prey
  - Prey switching—ignore uncommon prey until they become more common
  - At low densities of prey there is a refuge effect

Total response

- Multiply functional and numerical responses to derive total response
- $M = N_a P$
- #prey eaten/predator * #predators
- Expressed as proportion of total prey population

Functional response



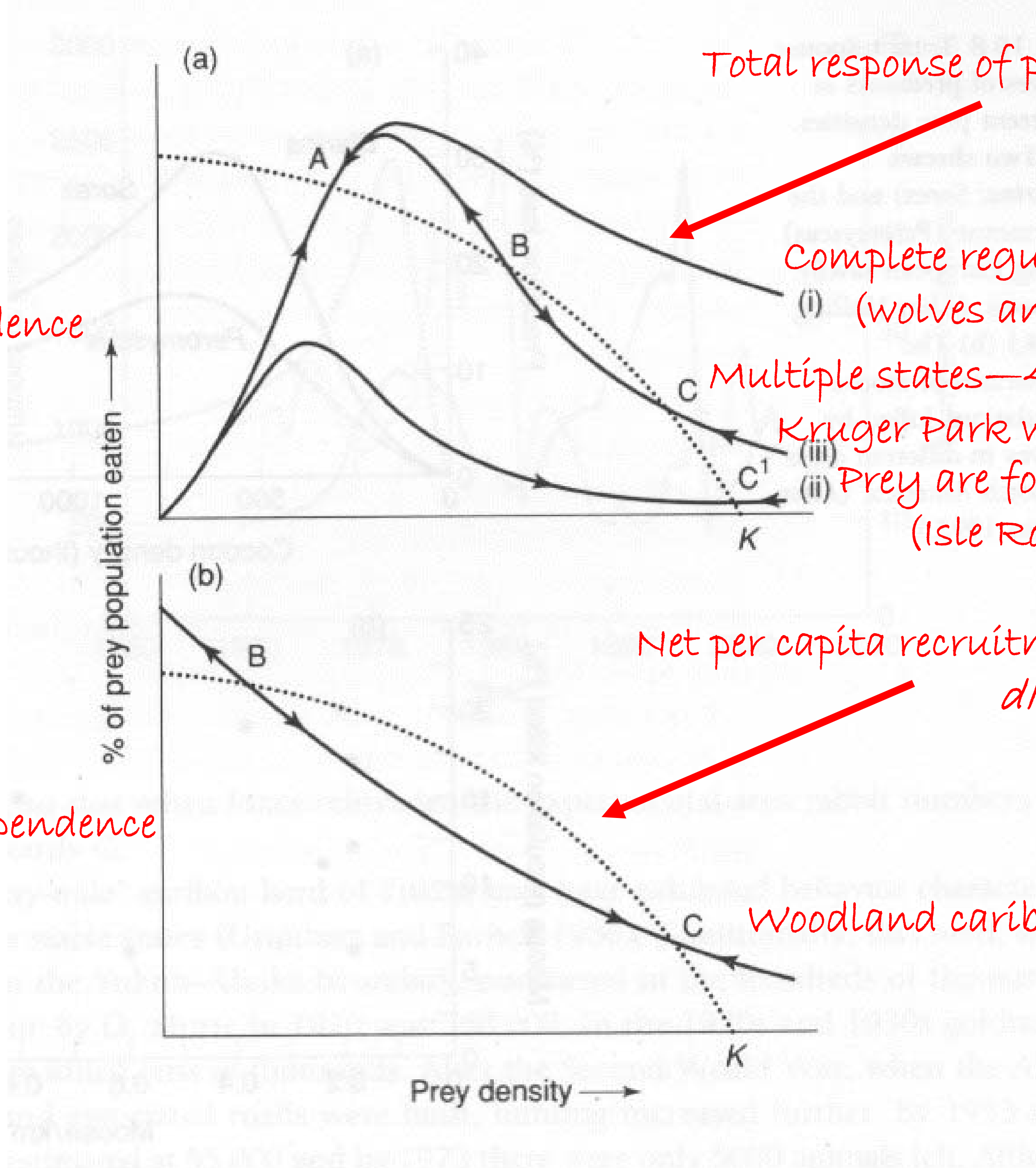
Assumes:
- random search strategy
- unlimited appetite
- constant search time

Herbivores and some carnivores with single prey

Takes into account handling time

Carnivores with multiple prey

When is predation regulatory?



Total response of predator

With some density-dependence (Type III)

Complete regulation (wolves and bears on moose)

Multiple states—40-mile caribou

Kruger Park wildebeest—lion

Prey are food-regulated (Isle Royale wolf-moose)

Net per capita recruitment of prey $dN/dT(1/N)$

Inverse density-dependence (Type II)

Woodland caribou—wolves in BC

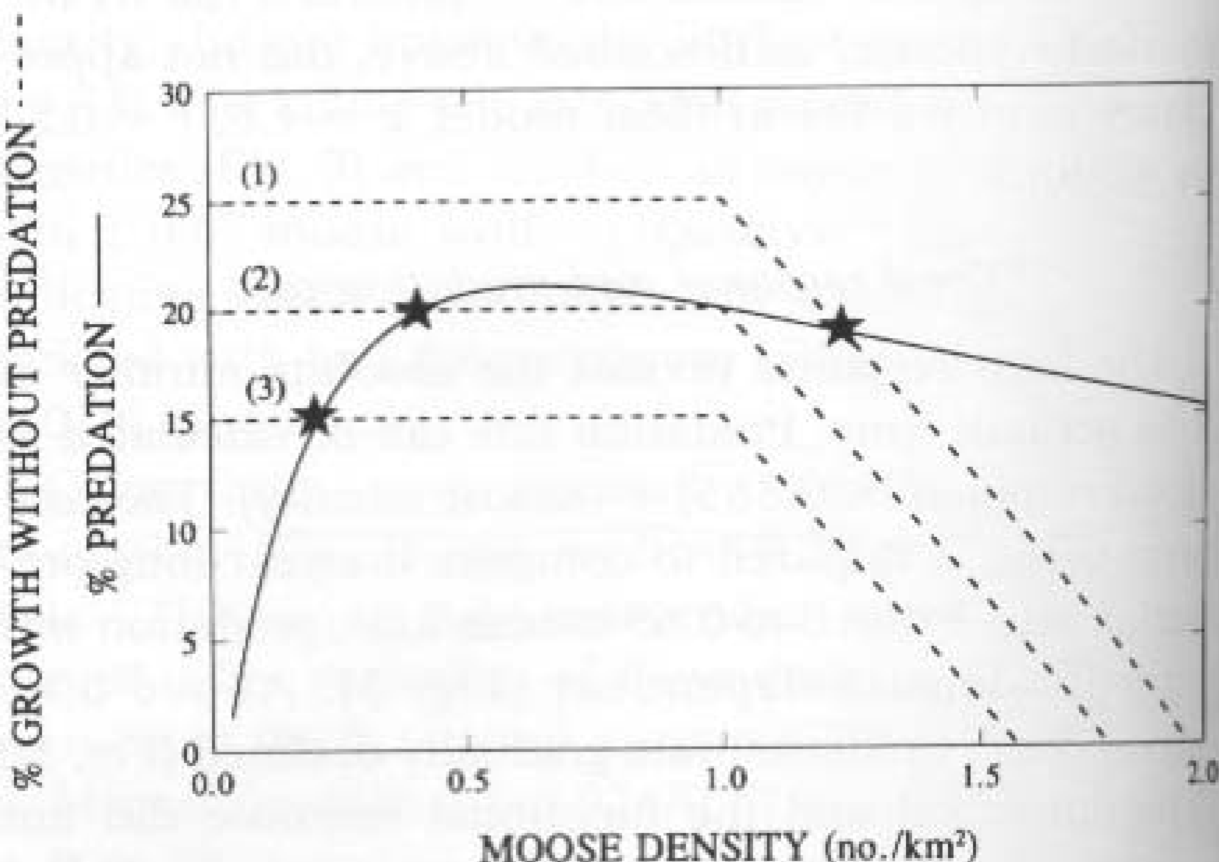


FIG. 7. Empirical model of moose–wolf dynamics as derived from field data on wolf predation rate (——) and moose population growth without wolf predation (– – –). Models 1, 2, and 3 illustrate possible stable equilibrium conditions (★) when the productivity level of moose is reduced by either deteriorating habitat quality or bear-induced calf mortality.

Predator-prey models in wildlife management

- Lotka-Volterra
  - Potential rate of increase in prey in the absence of predators
  - Decline in predator population in absence of prey
  - Lynx-hare

Recurrent fluctuation model

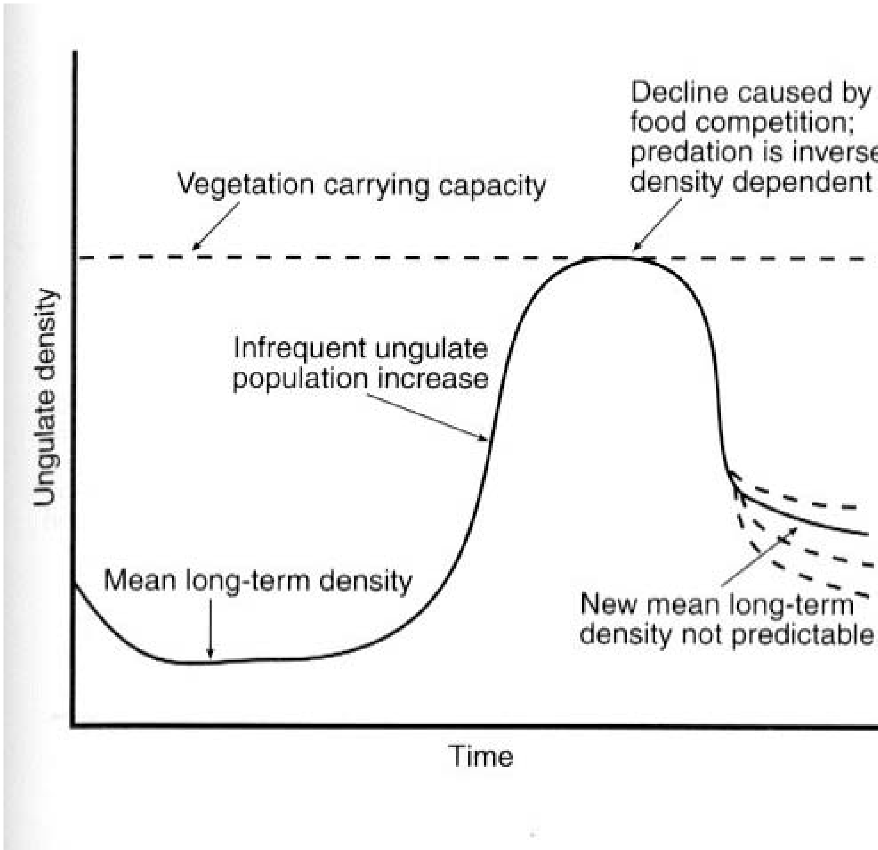
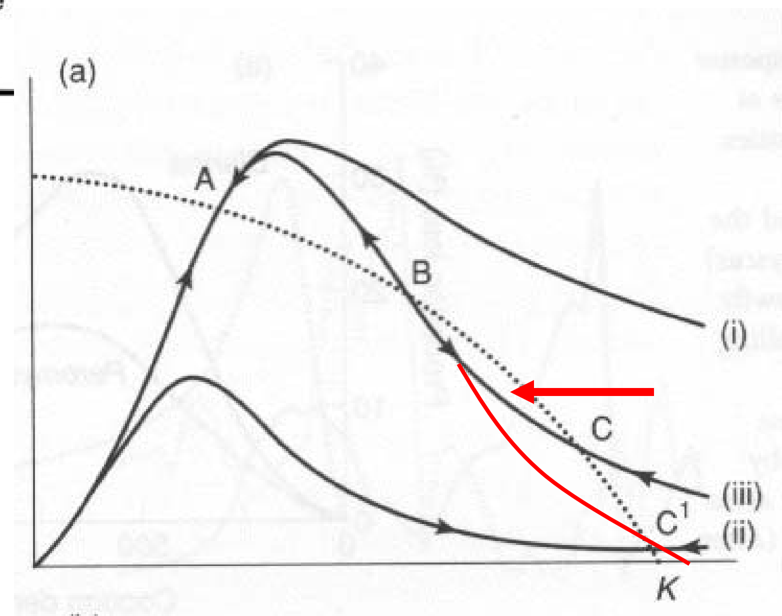
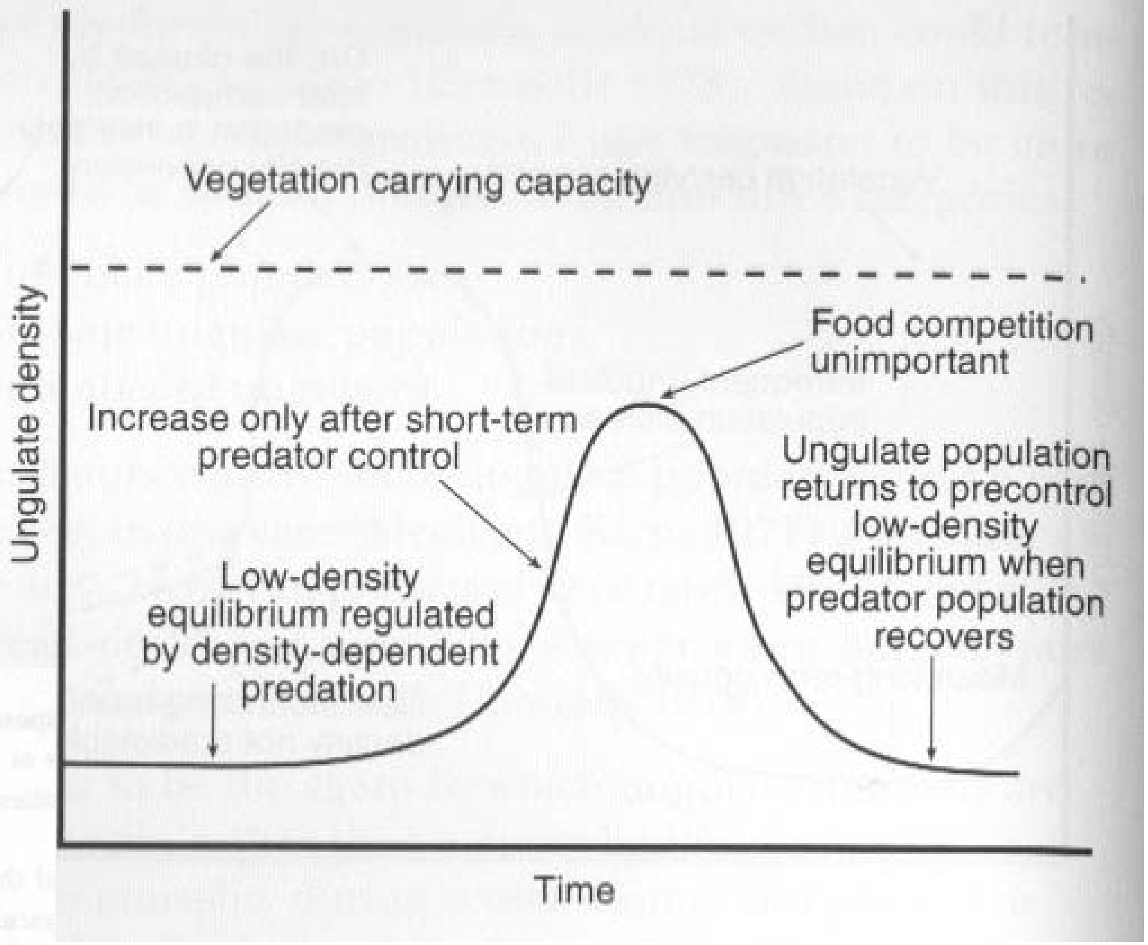


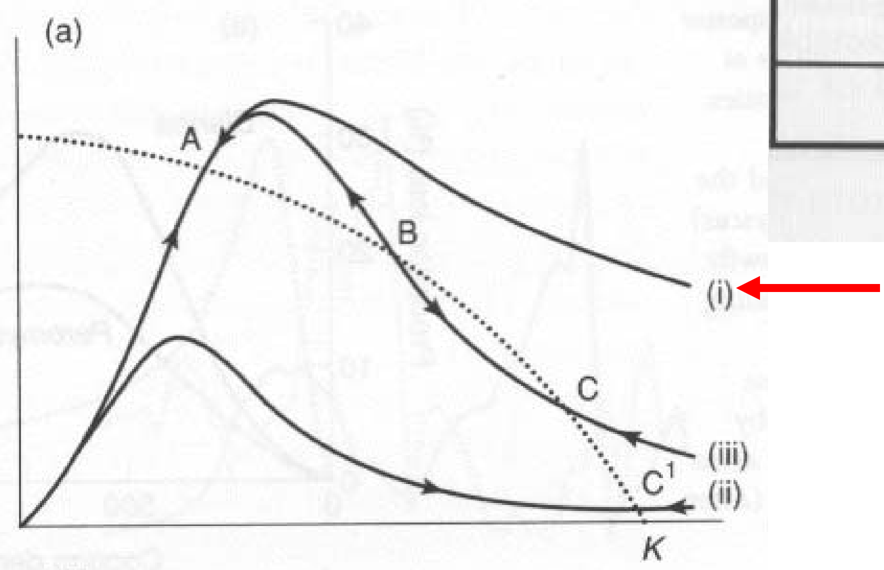
Figure 9–3 Conceptual model of ungulate density regulation under the recurrent fluctuations hypothesis (from Ballard and Van Ballenberghe 1997).



Low-density equilibrium

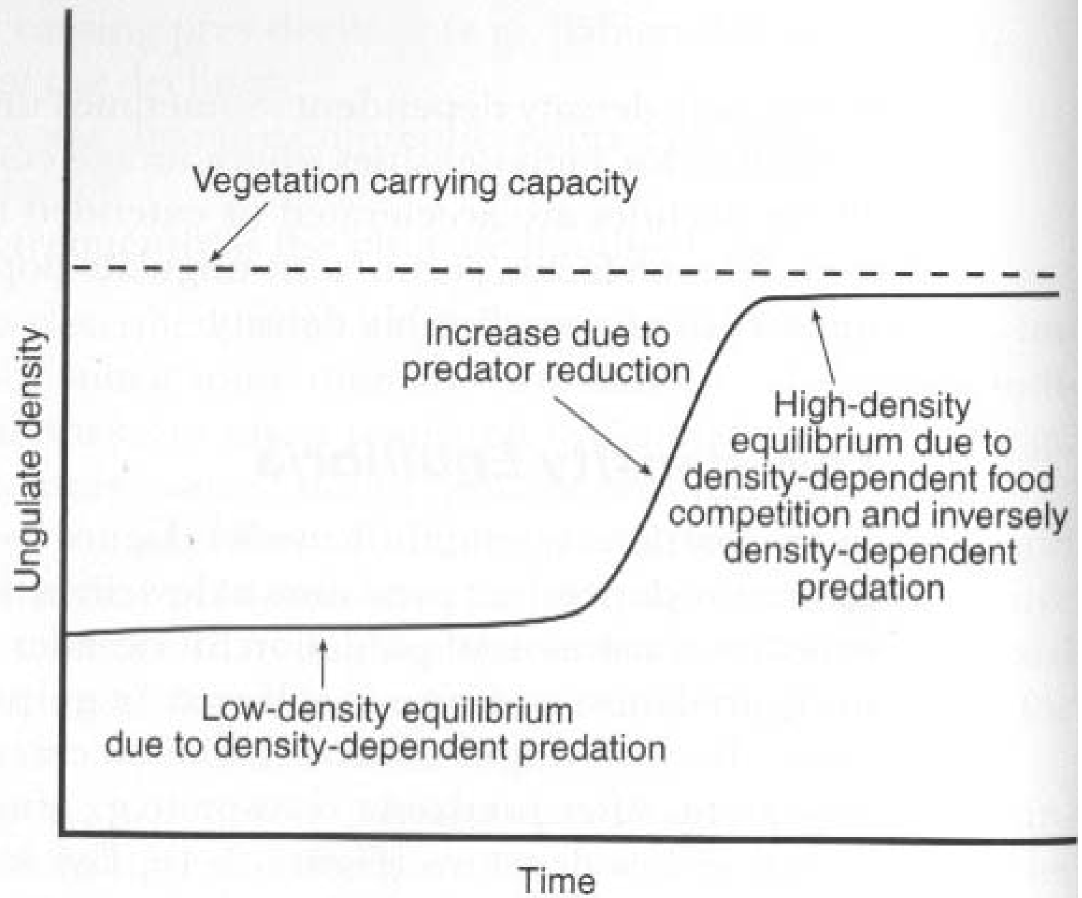
Figure 9–4 Conceptual model of ungulate density regulation under the low-density equilibrium hypothesis (from Ballard and Van Ballenberghe 1997).

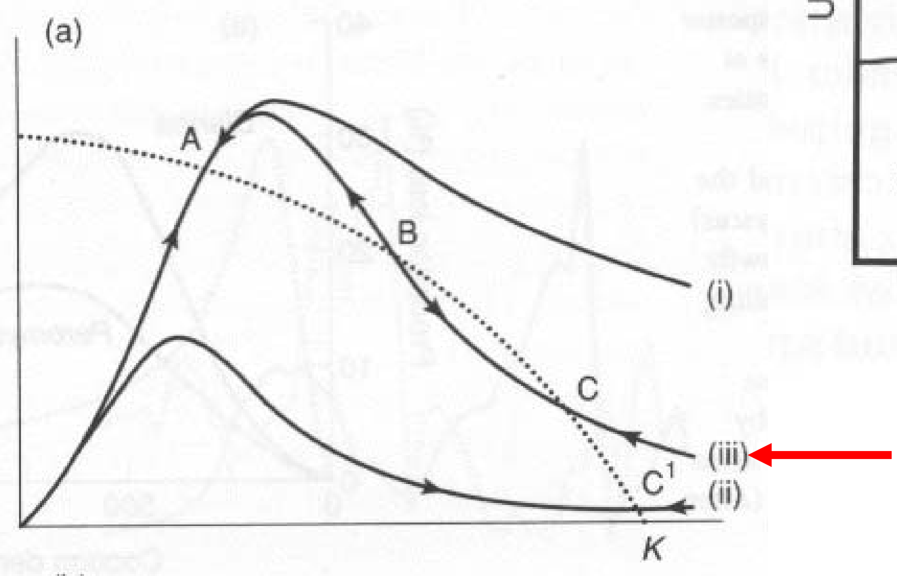




Multiple equilibrium model
(predator pit)

Figure 9–5 Conceptual model of regulation of ungulate densities under the multiple equilibrium hypothesis (from Ballard and Van Ballenberghe 1997).





Stable limit cycle model

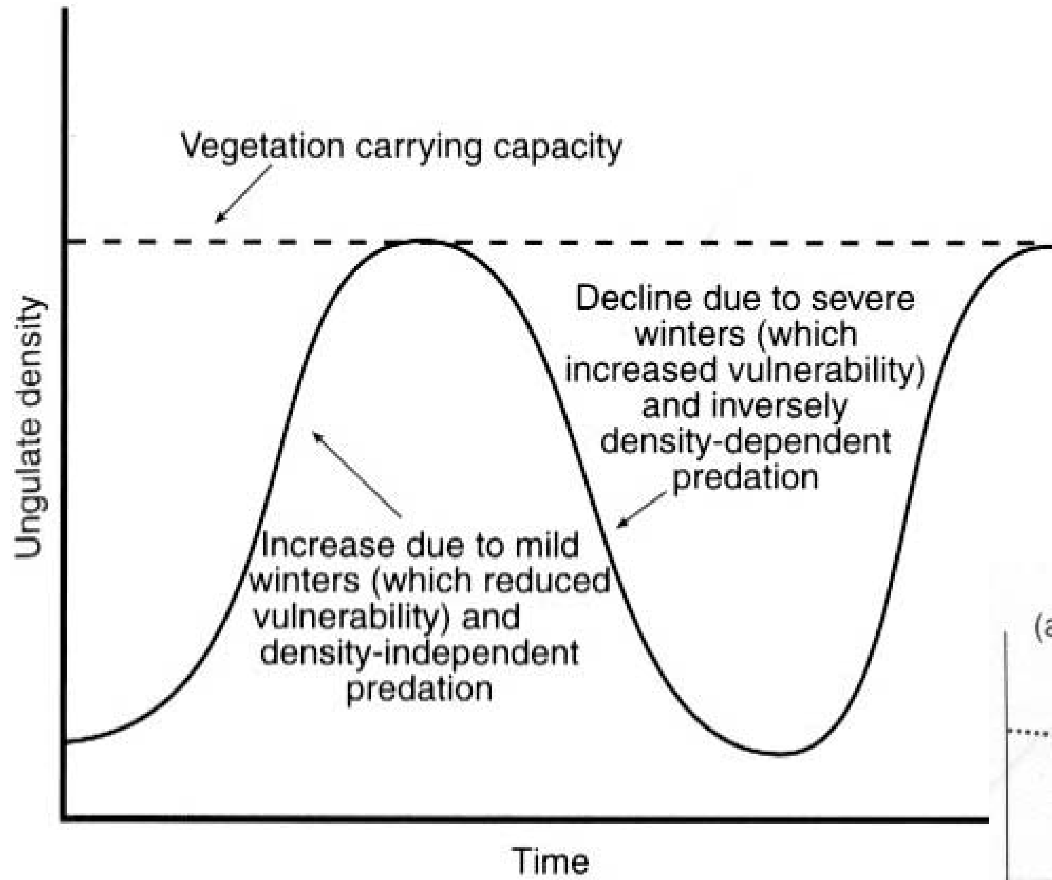
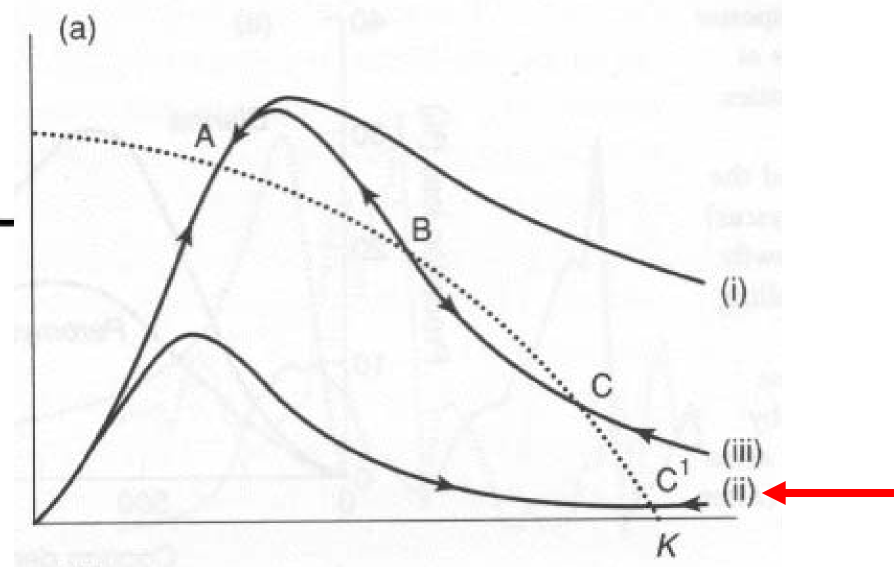


Figure 9–6 Conceptual model of regulation of ungulate densities under the stable limit cycle hypothesis (from Ballard and Van Ballenberghe 1997).



Predator control

- "unwanted stepchild" of wildlife management
- Principles
  - Can increase prey populations if prey is below K
  - Only if predation is primary limiting factor
  - Control needs to be severe (e.g. remove 50% of young wolves)
  - Implement just prior to predator or prey reproduction
  - Conduct over manageable geographic scale
  - Provide secure funding (very expensive!)

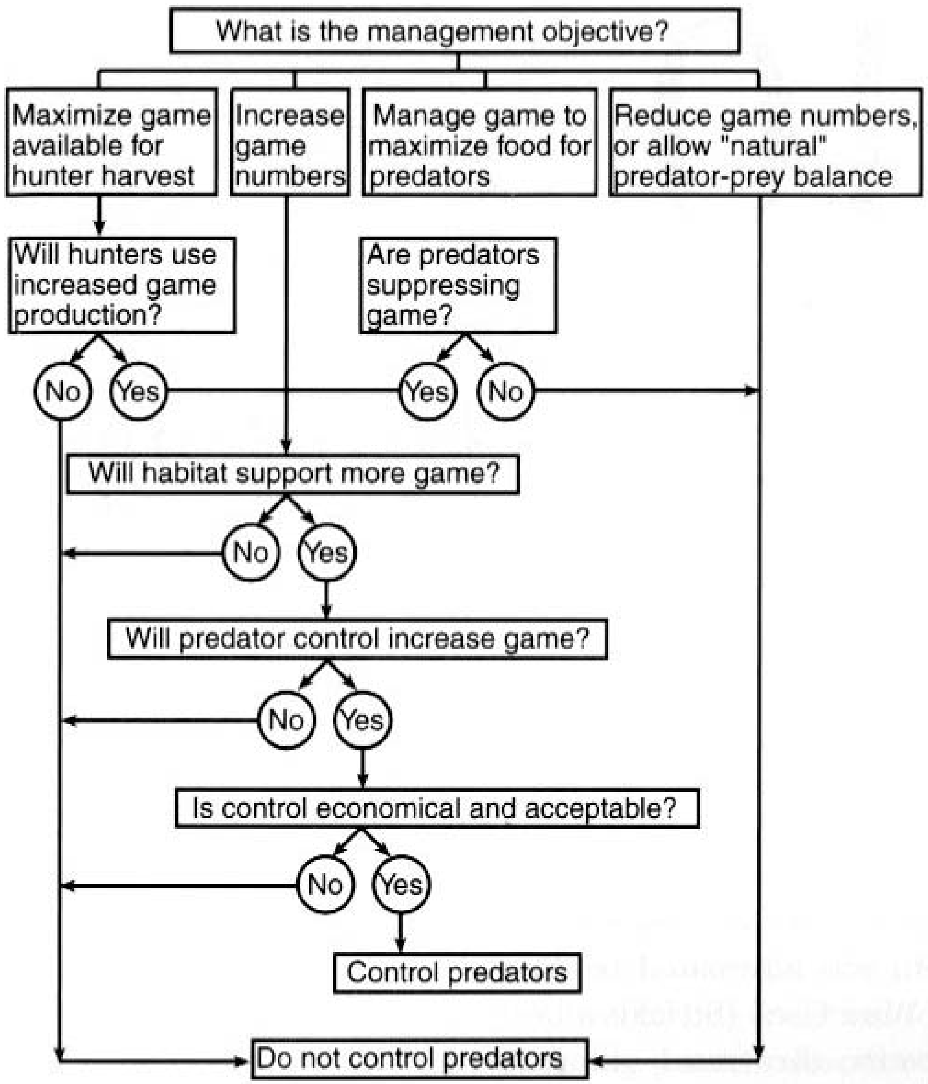


Figure 9–7 Decision matrix to determine when predator control is warranted (from Connolly 1978).