Applied insect ecology 2017 – 3
Numeric and functional response

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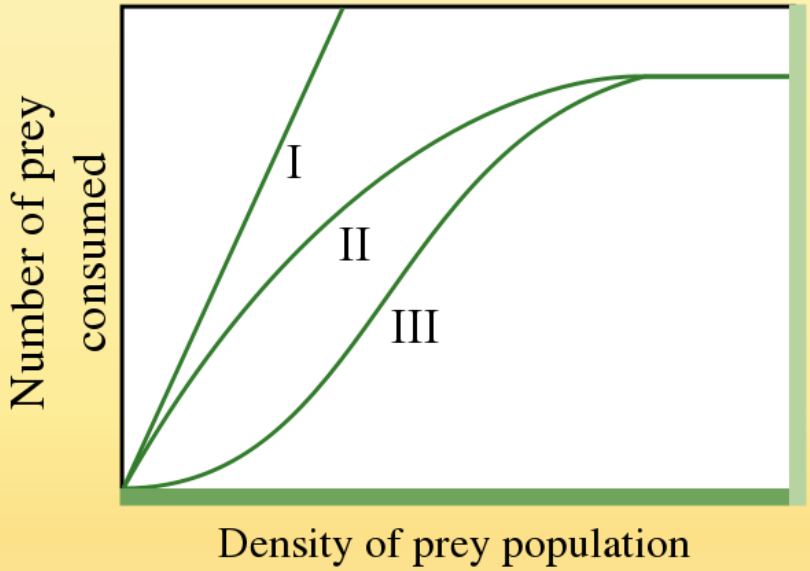
Entomologický ústav BC AV ČR

Functional and numeric response

- Množství nabízené potravy
  - Imigrace
  - Zůstávání na místě
  - Vliv na plodnost
  - Odpověď na nabídku (hustotu potravy)
  - Příjem potravy

Food availability

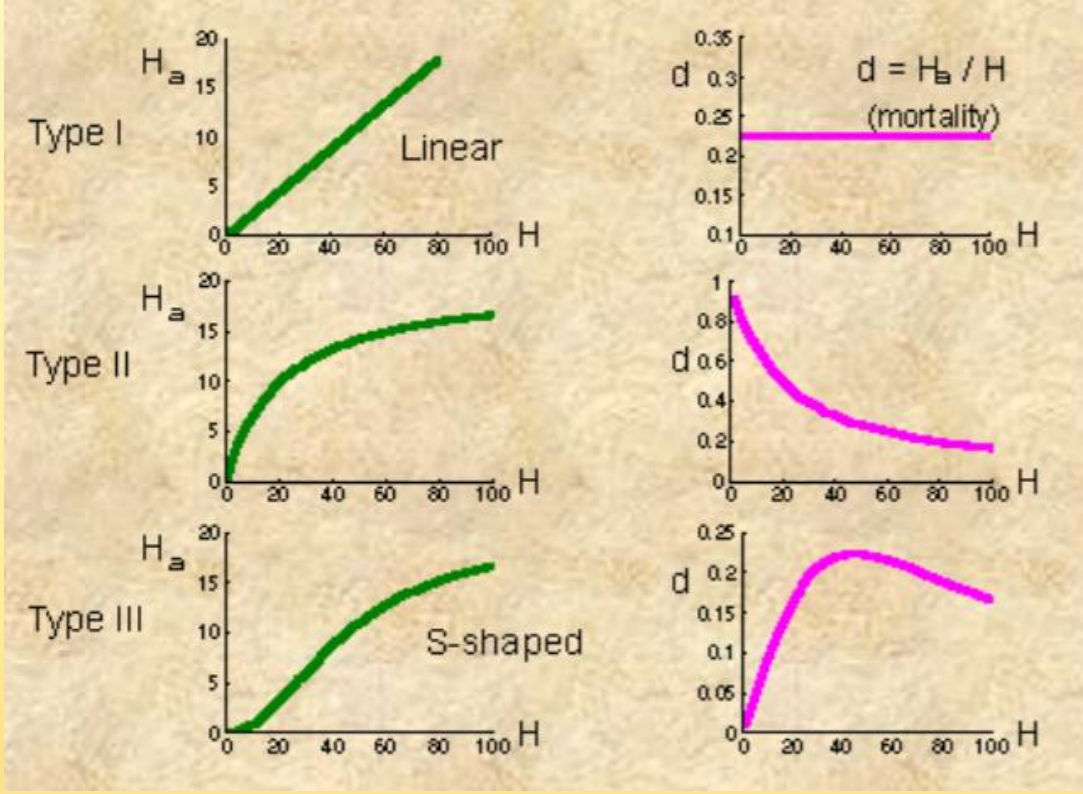
- Immigration
- Rest on site
- Fecundity + fertility
- Function of food offer = density
- Food intake



Functional response

- Množství nabízené potravy
  - Určitá stálá hustota
  - Určité počáteční množství

Food availability
constant prey number/density
initial prey number R



Functional response

- Typ 1

- Type I
  - Linear increase
  - Up to maximum = satiation
  - Searching time (constant)
  - Handling time (negligible)
  - F(R)=a.R or f=max
  - Often unrealistic
  - Use in Lotka-Volterra model

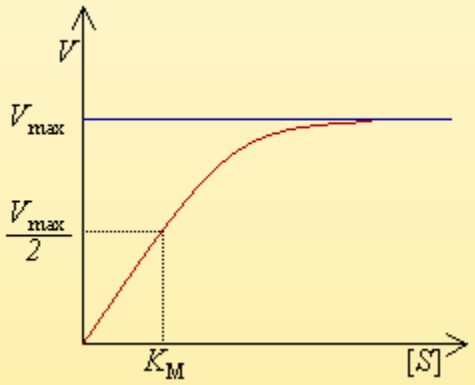
Functional response

- Typ 2

- Type II
  - Decelerating intake rate
  - Up to maximum = handling
  - Searching time (constant)
  - Handling time (important)
  - Mutually exclusive
  - F(R)=a.R / (1+a.h.R)
  - a=attack rate (at which the consumer encounters food item per unit of food density
  - h=handling time (average time spent on processing a food item)

Functional response

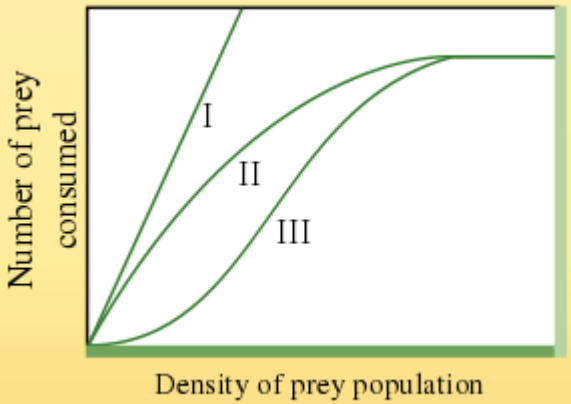
- Typ 2



- Type II
  - Monod equation
  - Growth of microorganisms
  - Michaelis Menten equation
  - Rate of enzymatic reactions

Functional response

- Typ 3



Type III

- low density – accelerating
- high density – decelerating intake rate
- maximum = handling
- Searching time
- Handling time
- Learning time
- Prey switching

Functional response

- Typ 3

Type III

- Learning time

  experience – improvement of

  searching and attacking efficiency

  handling efficiency

  a, h not constant $f(R) = \frac{aR}{1 + ahR}$

Sawfly larvae (above) and adult (below)

Functional response

- Typ 3

Type III

- Prey switching

  select more common of two or more

Functional response

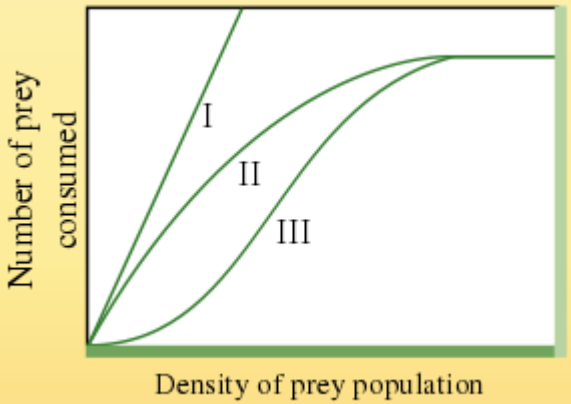
- Nasycení

Predator satiation

- predator saturation
- escape from natural enemies
- safety in numbers
- aphids
- plant seeds
- periodical cicada

Functional response

- Určení typu

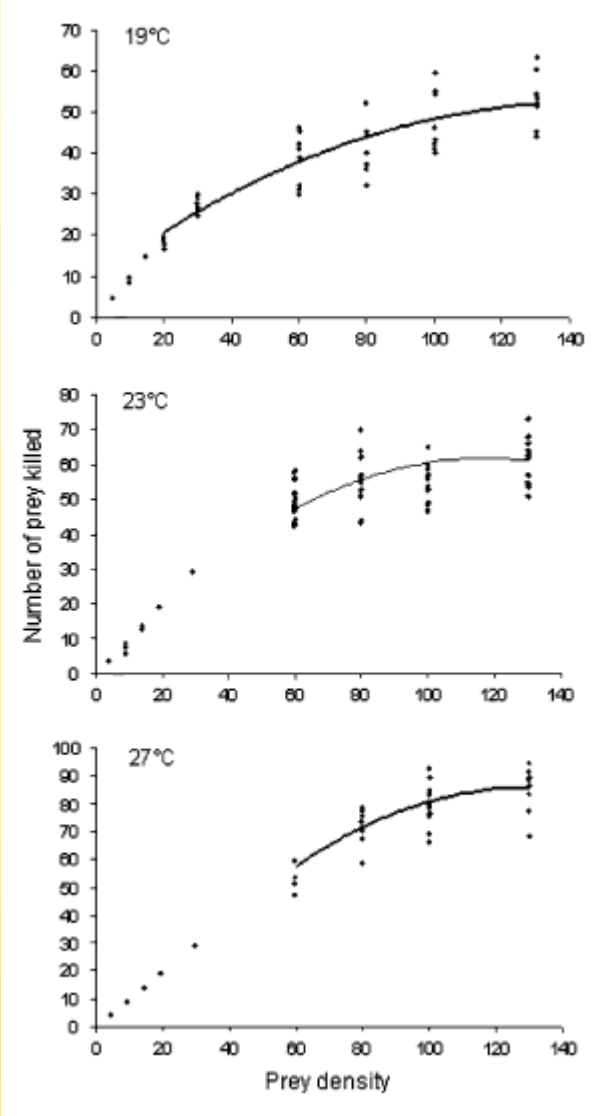


Type determination

- prey depletion method
- prey densities: 5, 10, 15, 20, 30, 60, 80, 100, 130 aphids per leaf
- 10 replications with predator
- control without predator
- 24-h period
- corrected mortality
- Ne = N0 (Nd – Nc) / (N0 – Nc)
- N0 = initial number
- Nd = mortality in treatment
- Nc = mortality in control

Functional response

- Typy

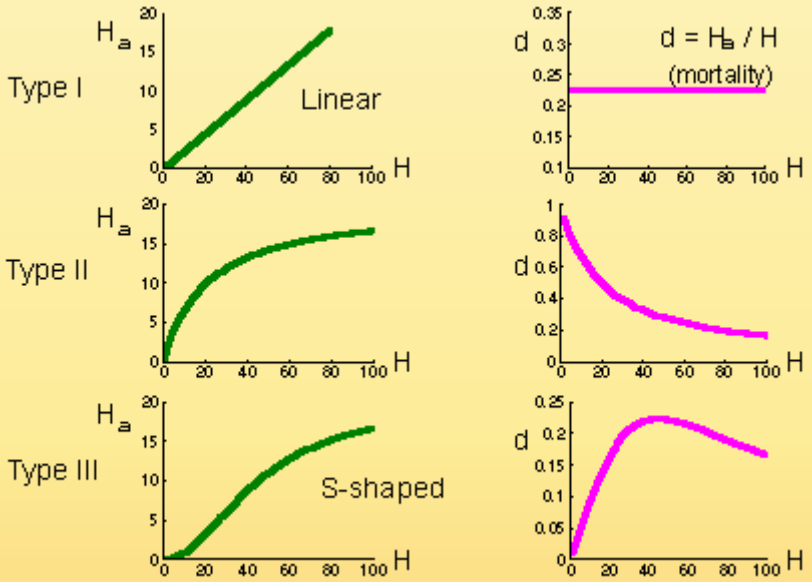


Type determination

- polynomial logistic regression
- Ne/N0 = exp (P0+P1.N0+P2.N0^2+P3.N0^3) / (1+exp (P0+P1.N0+P2.N0^2+P3.N0^3))
- negative linear parameter (P1) and negative quadratic parameter (P2) = functional response is type II
- positive linear parameter (P1) and a negative quadratic parameter (P2) = functional response is type III
- Ne = N0.{1–exp[a.(Th.Ne–T)]}
- Ne = N0.{1–exp[(d+b.N0).(Th.Ne–T)/(1+c.N0)]}
- a = attack constant, T = total time available (24 h),Th = handling time per prey

Functional response

- Typy



Type determination

I: passive predators like web spiders

II: small mammals destroy most of gypsy moth pupae in sparse populations of gypsy moth

III: predators responding to kairomones

birds switch to the most abundant prey

Functional response

- Typy

Efficiency

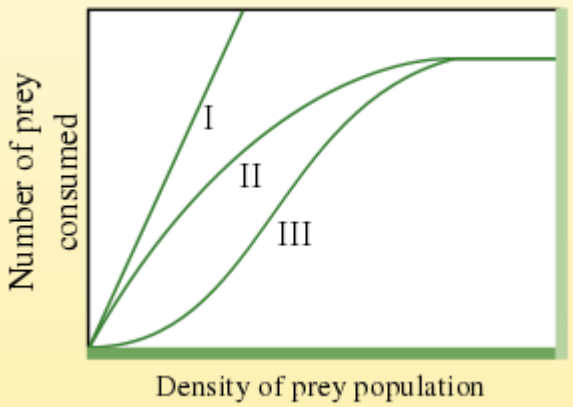
- predict success or failure of a predator as a biocontrol agent
- numerical response
- intrinsic growth rates
- host patchiness
- competition
- environmental complexities (abiotic and biotic factors)

Handling includes:

- chasing
- killing
- eating
- digesting

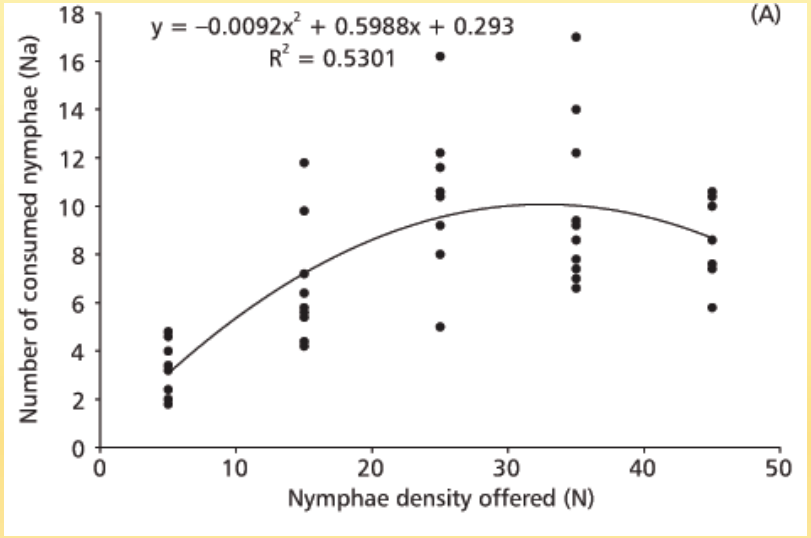
Functional response

- Typ 4



Type IV

- decrease of predation at very high densities
- lethal plant defence paradox
- Reduviidae vs. Coreidae
- spider
- *Coccinella* vs. *Aphis nerii*

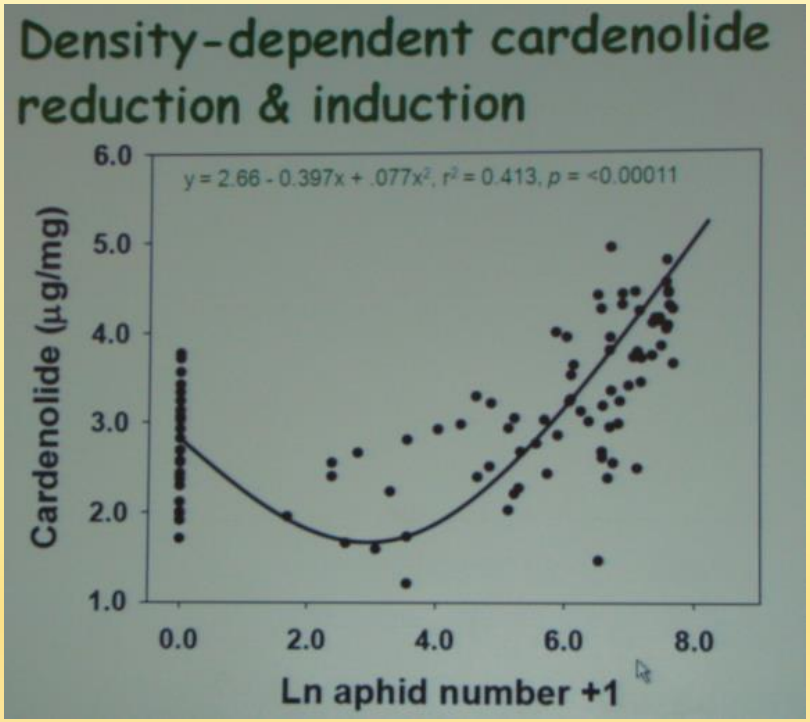


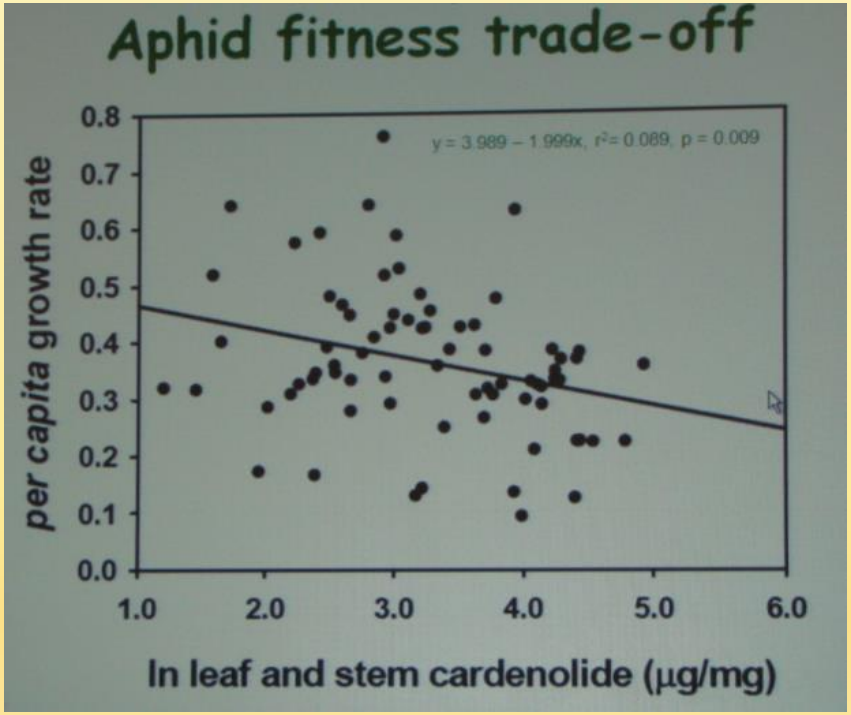
Functional response

- Typ 4

Type IV

  - lethal plant defence paradox



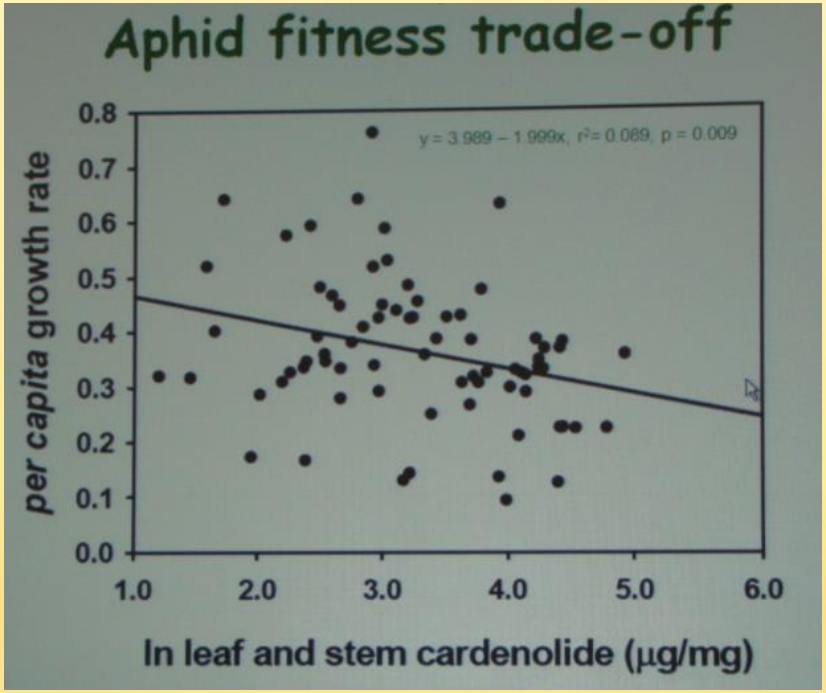


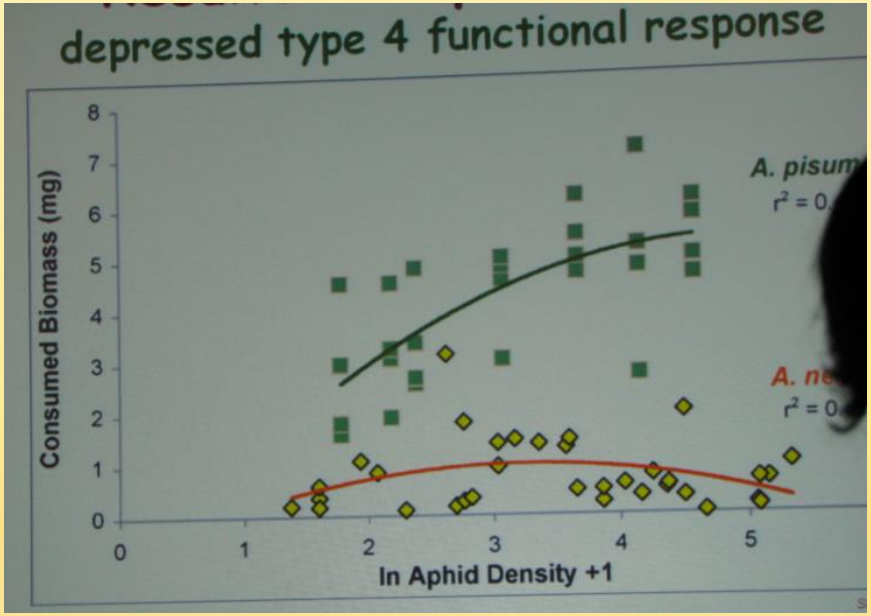
Functional response

- Typ 4

Type IV

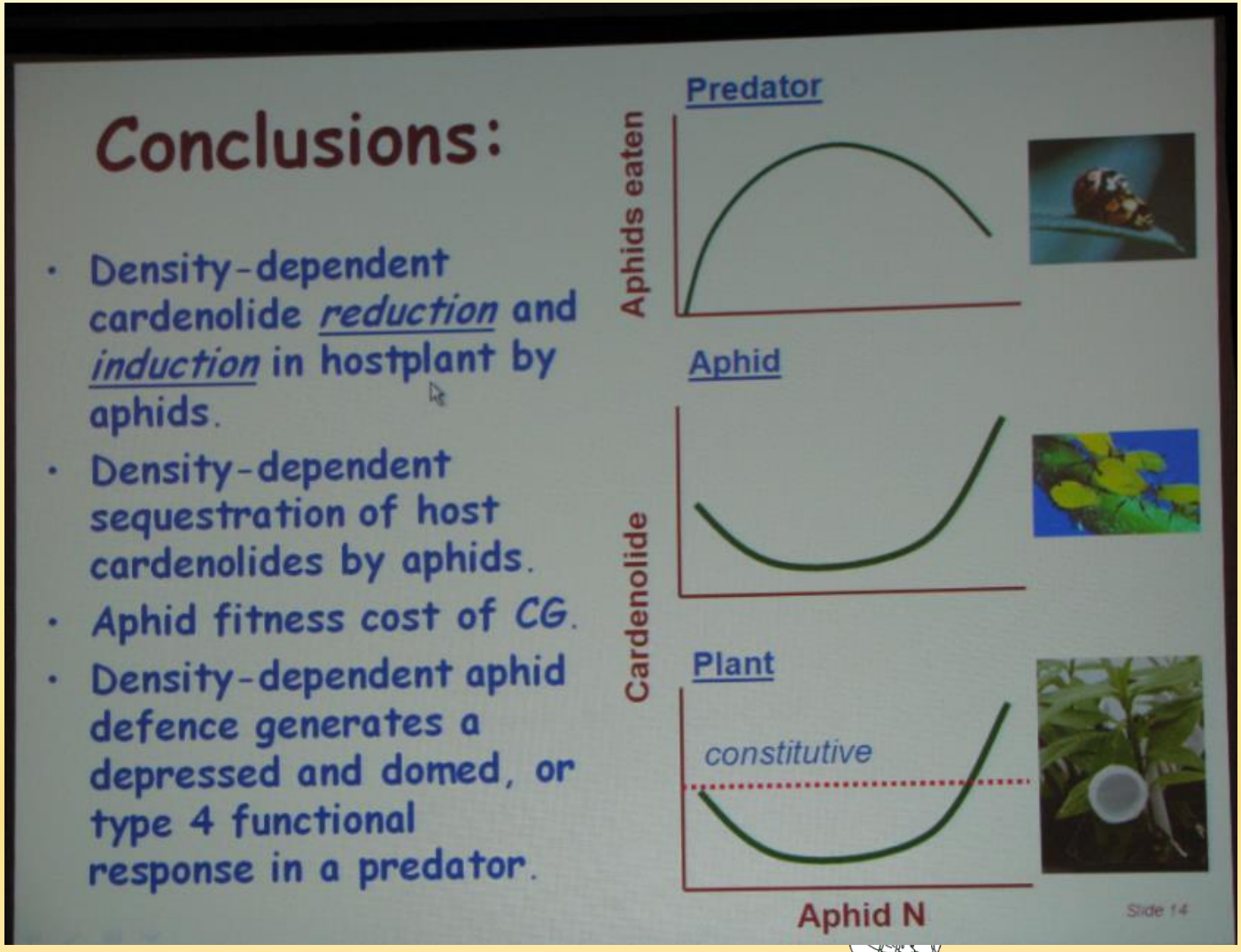
  - lethal plant defence paradox





Functional response

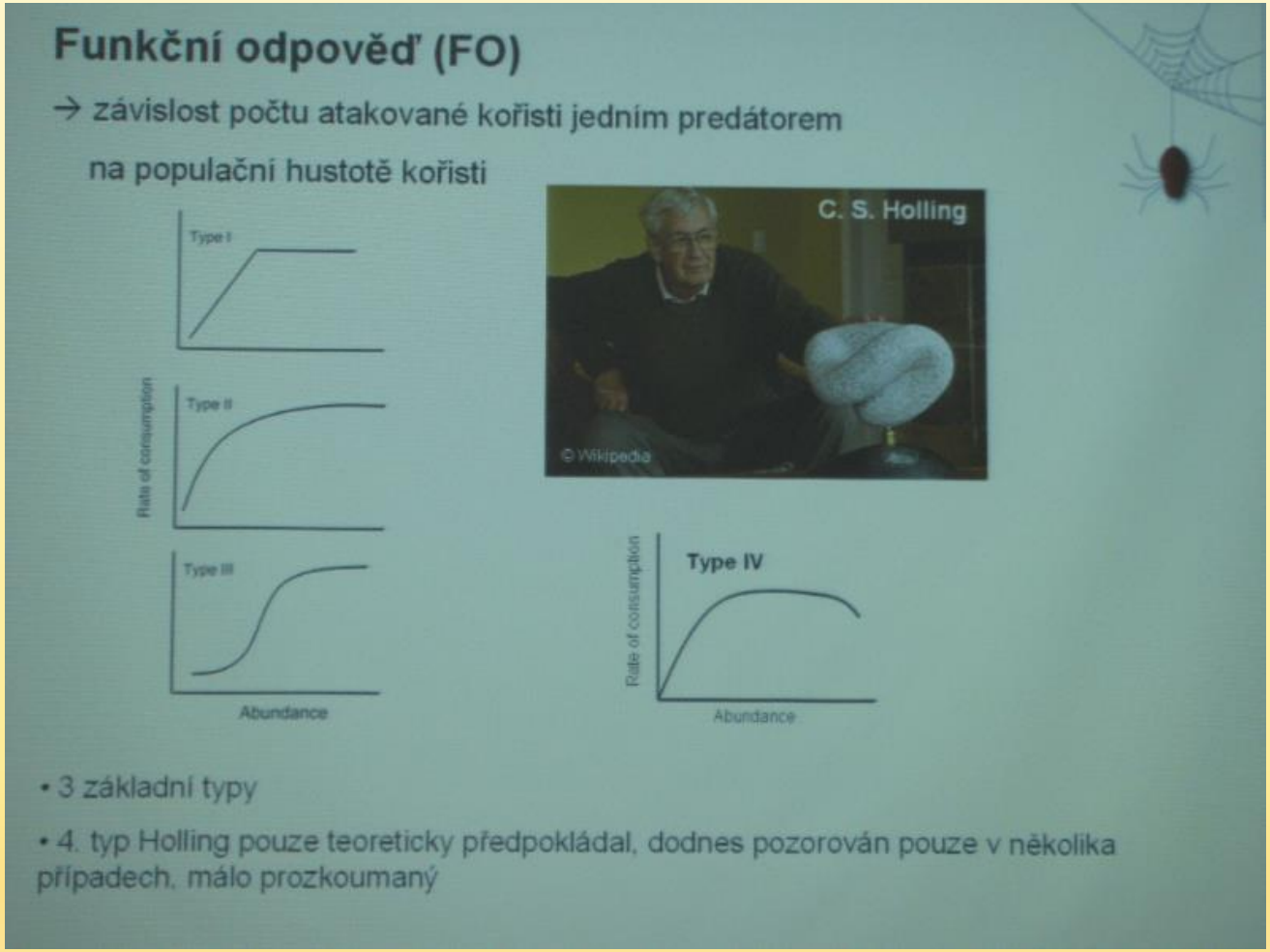
- Typ 4 Type IV



Functional response

- Typ 4

Type IV



Functional response

- Typ 4

Type IV