Do wolves help to protect forest regeneration? the role of large predators and ungulates in forest ecosystem

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EVROPSKÁ UNIE
MINISTERSTVO ŠKOLSTVÍ, MLÁDEŽE A TĚLOVÝCHOVY
OP Vzdělávání pro konkurenceschopnost
INVESTICE DO ROZVOJE VZDĚLÁVÁNÍ

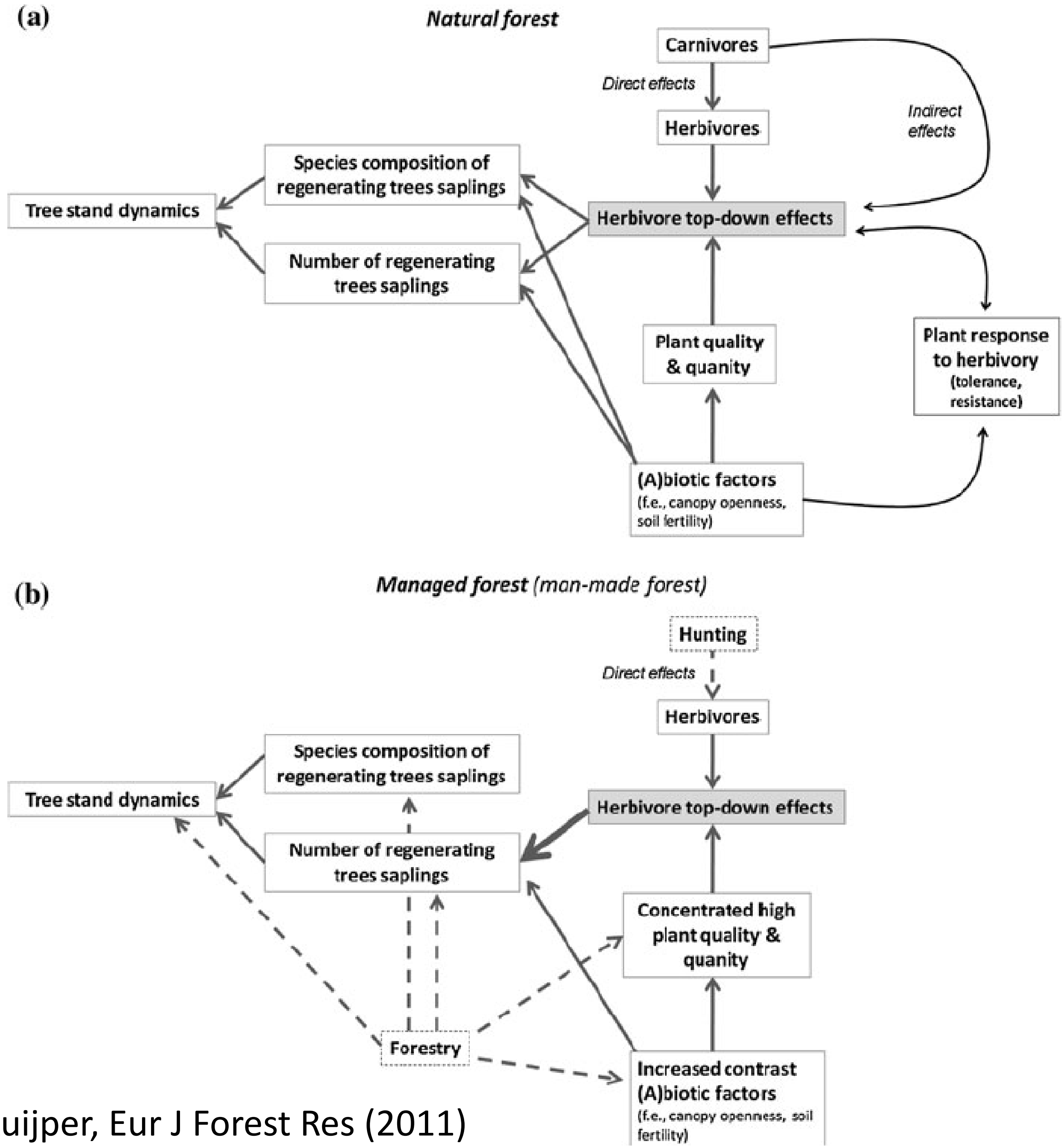
Tento projekt je spolufinancován Evropským sociálním fondem a Státním rozpočtem ČR InoBio – CZ.1.07/2.2.00/28.0018

Introduction

- In Europe, North America and New Zealand ungulate numbers have greatly increased over the past decades
- Different factors have been indicated in driving this increase:
  - increasing frequency of mild winters (Mysterud et al.2001),
  - changes in management rules (Milner et al., 2006),
  - changes in forestry practices (Bobek et al. 1984)
  - changes in the agricultural landscape (Mysterud et al.2002).

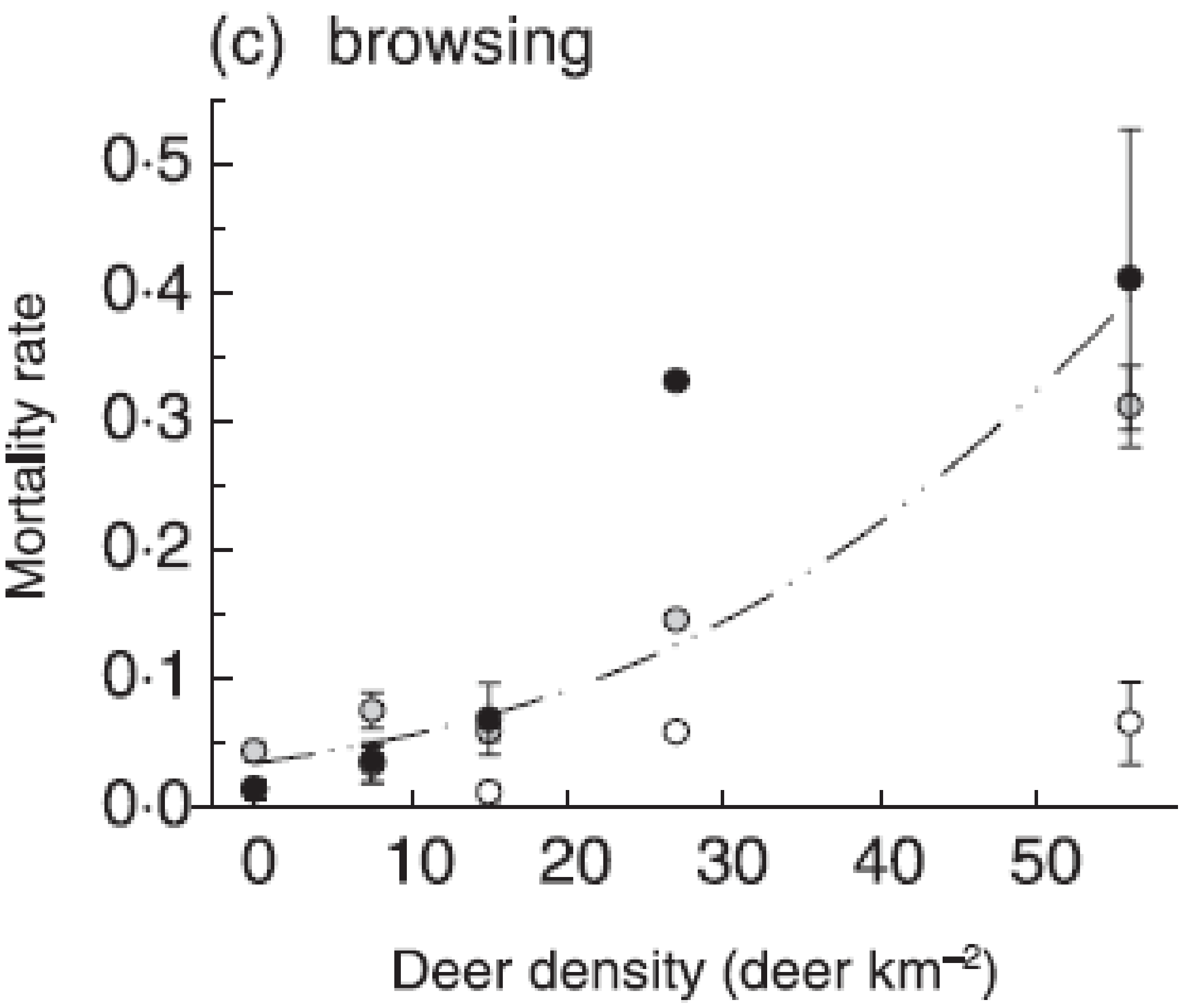
Introduction

- The growing numbers of deer have resulted in increased herbivore pressure which affected ecosystems in many ways, for example:
  - negative impact on tree regeneration
  - Decreasing abundance of preferred forage species
  - Decrease tree species and herbaceous vegetation diversity
  - decreasing songbird diversity and small mammal communities
  - Economical damage to forest plantations
  - enhancing the conflict between forestry and wildlife



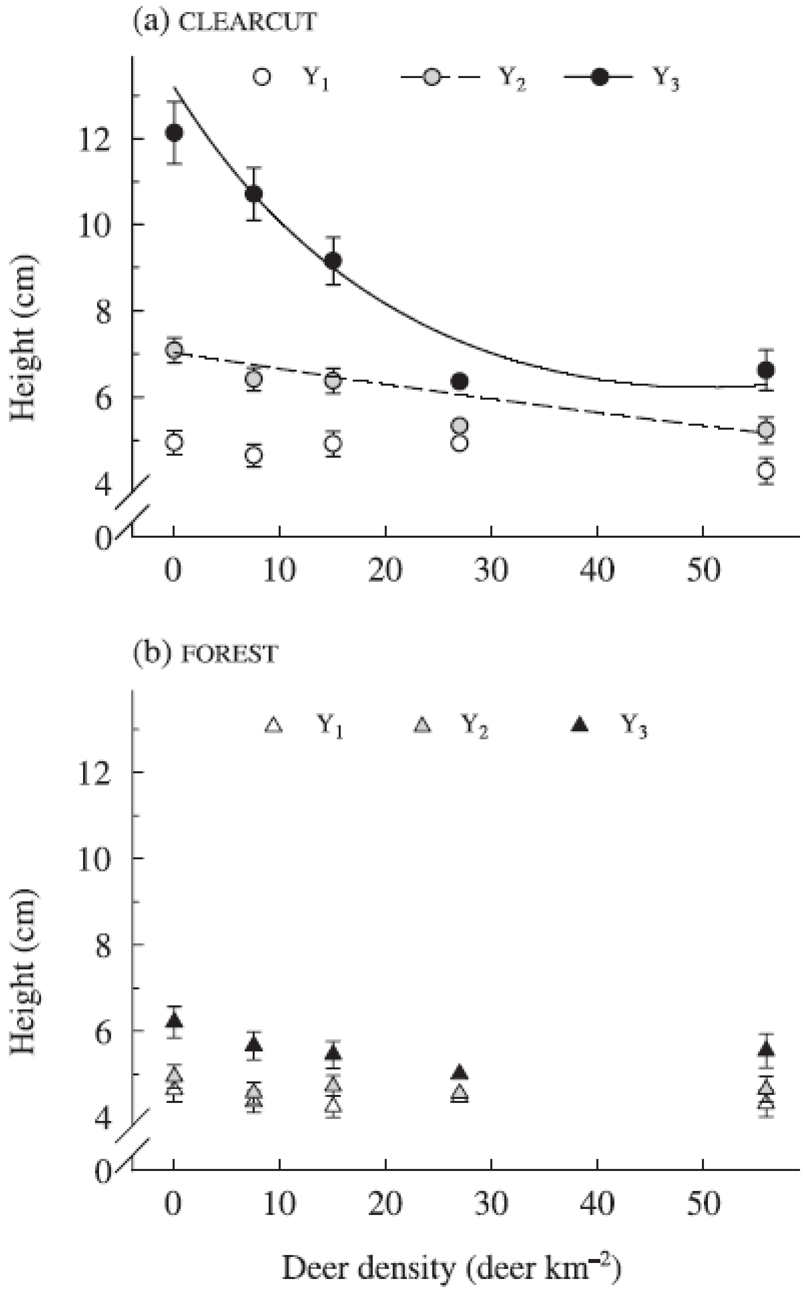
Kuijper, Eur J Forest Res (2011)

Relationships between white-tailed deer density and the annual mortality rate of balsam fir seedlings in clearcut and forest understorey



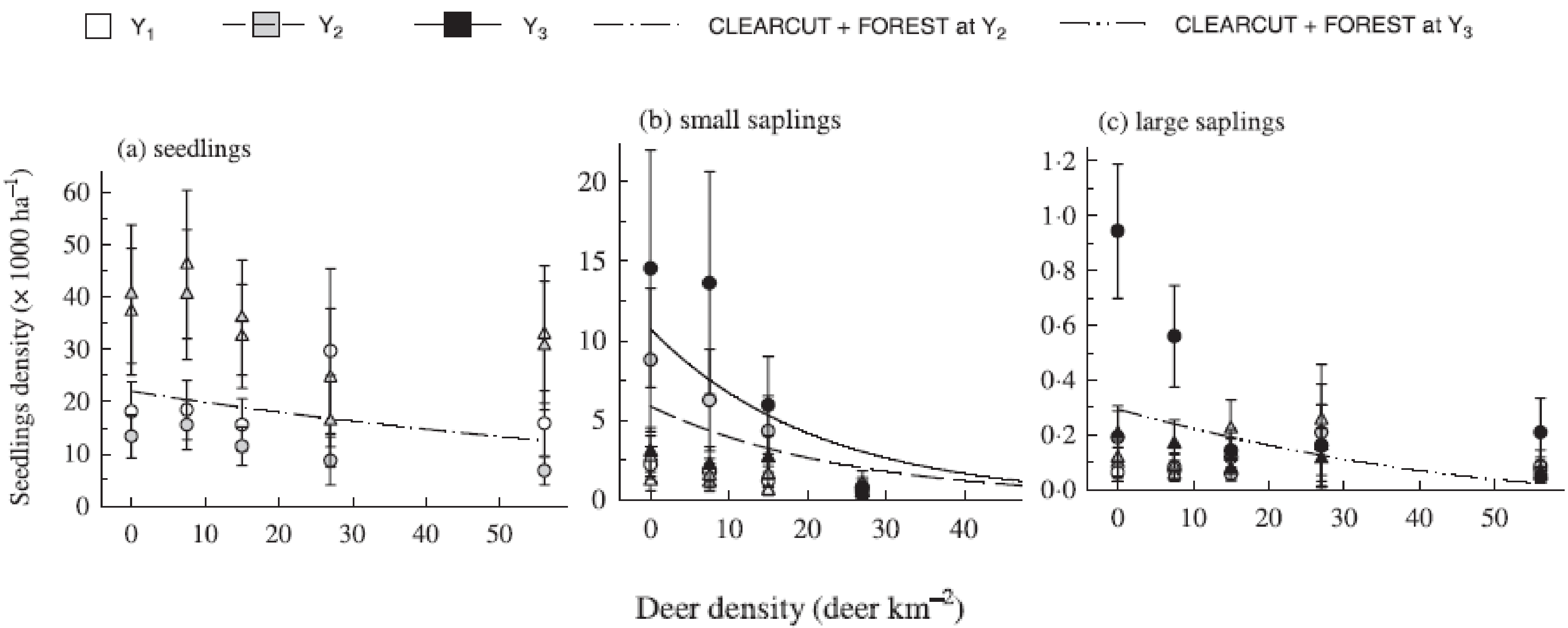
Tremblay, Huot & Potvin. Journal of Applied Ecology (2007)

Relationships between white-tailed deer density and height growth of balsam fir seedlings in (a) clearcut and (b) forest understorey



Tremblay, Huot & Potvin. Journal of Applied Ecology (2007)

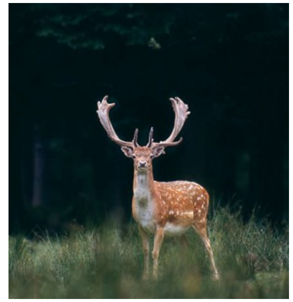
Relationships between white-tailed deer density and the abundance of balsam fir as:
(a) seedlings (> 1–10 cm); (b) small saplings (> 10–30 cm); and (c) large saplings (> 30–300 cm)

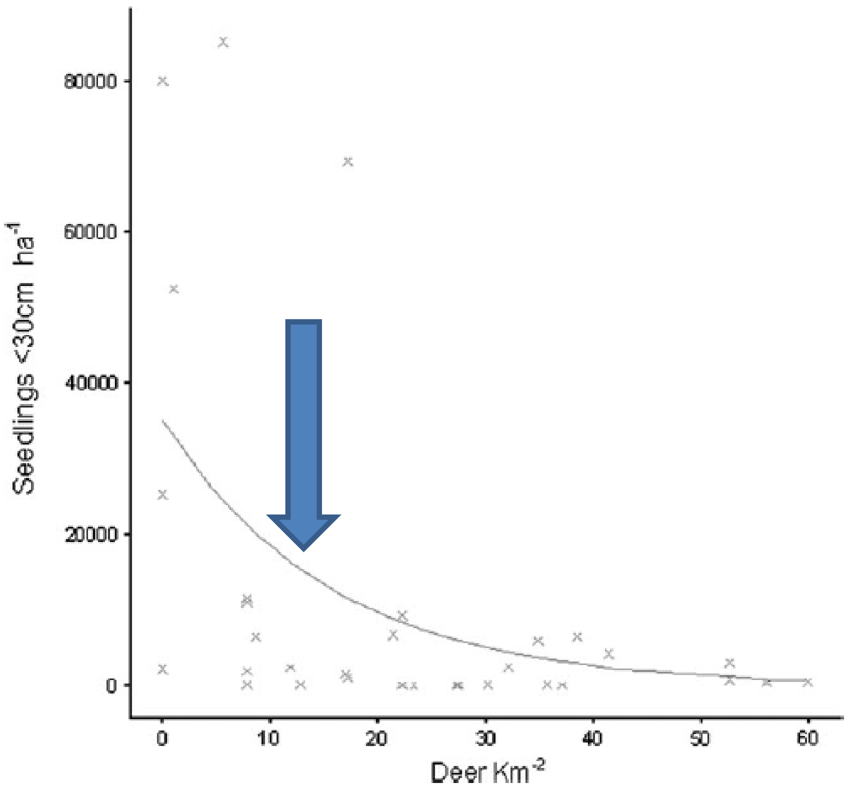


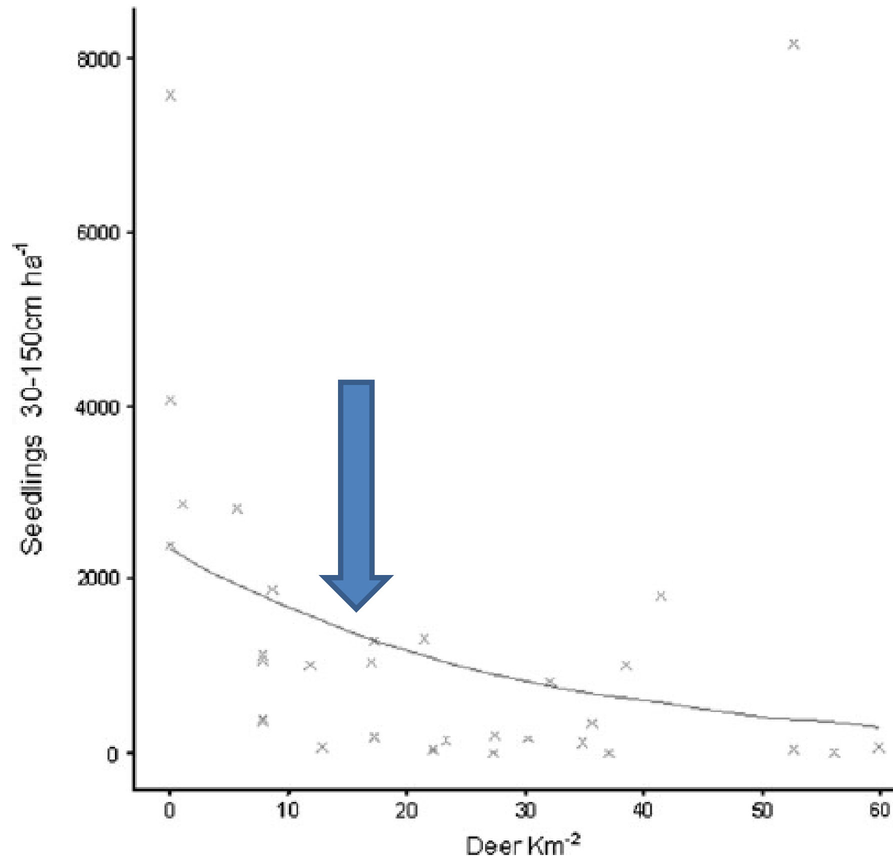
Tremblay, Huot & Potvin. Journal of Applied Ecology (2007)

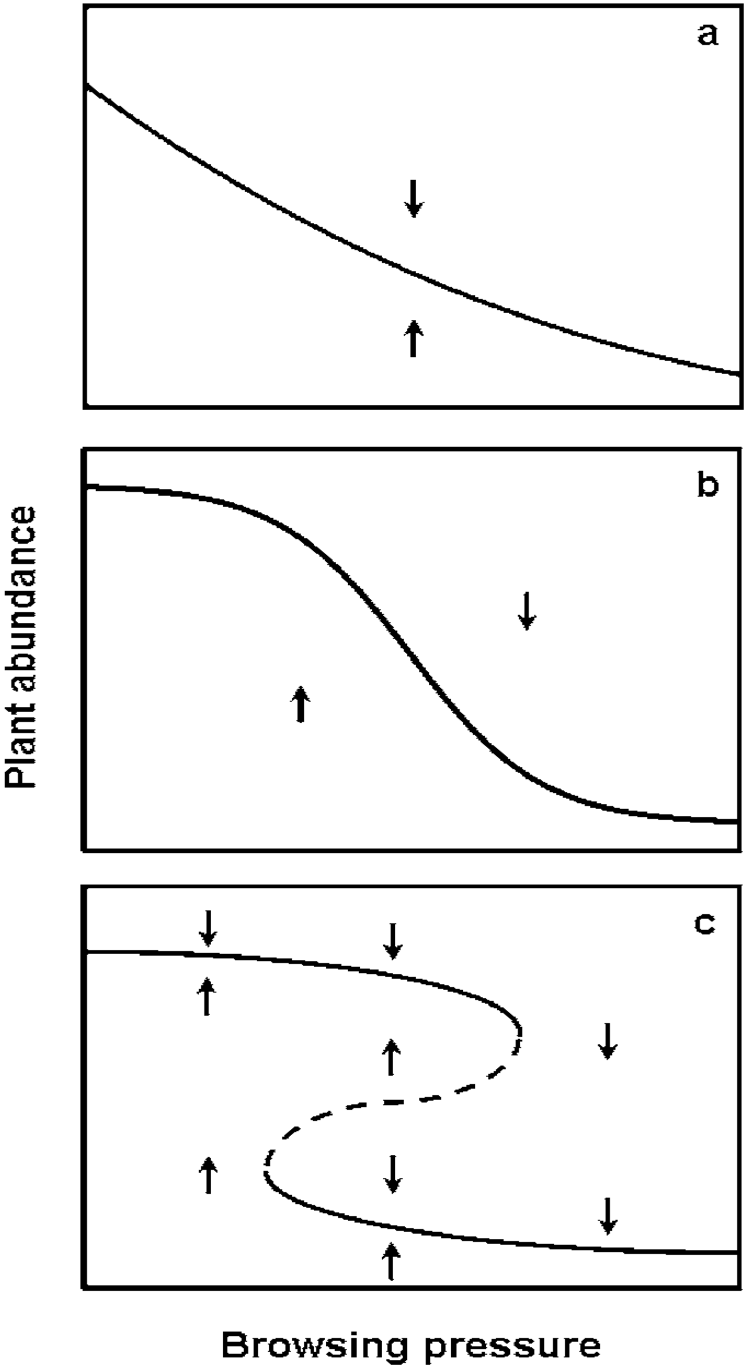
The effect of deer density on forest regeneration

(Gill and Morgan 2010 Forestry)









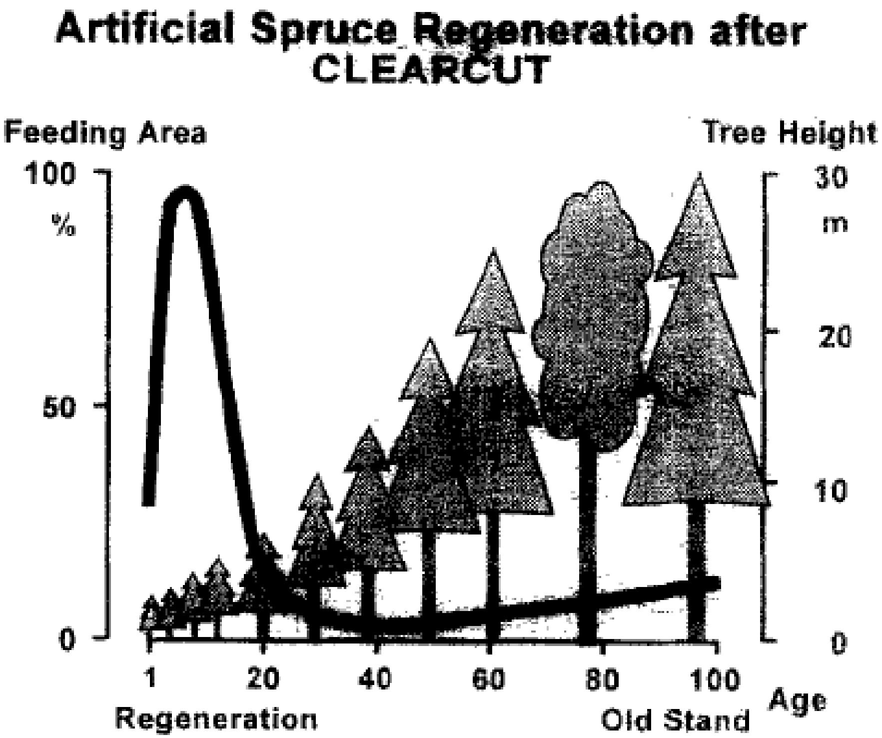
Three hypothetical relationships between the abundance of a forage plant and deer browsing pressure

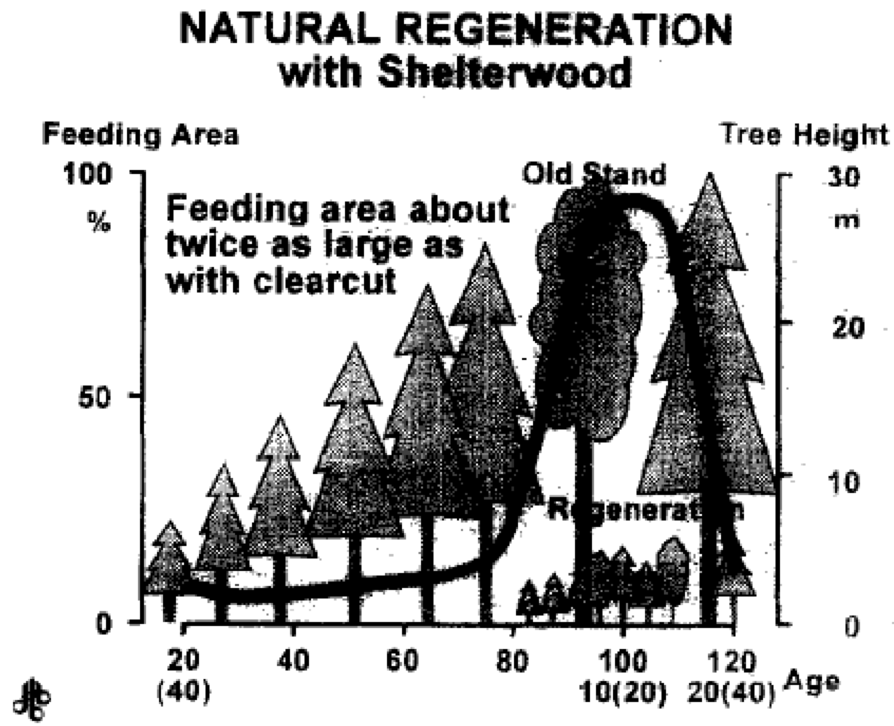
(a) Deer have only modest and monotonic effects on the population

(b) A reversible threshold exists beyond which plant abundance drops precipitously

(*c*) Browsing beyond a certain threshold point causes a nonlinear decline
that is not simply reversible. The plant population requires a large (or prolonged)
reduction in browsing as well as a disturbance factor that promotes an increase
of its abundance to recover. This requirement indicates an “alternate stable state.”
Arrows indicate dynamic changes at various points. Modified from Scheffer et al.
(2001).

Influence of the silvicultural system on feeding area of ungulates during the whole forest working cycle for equal site conditions (Reimoser, 1986).





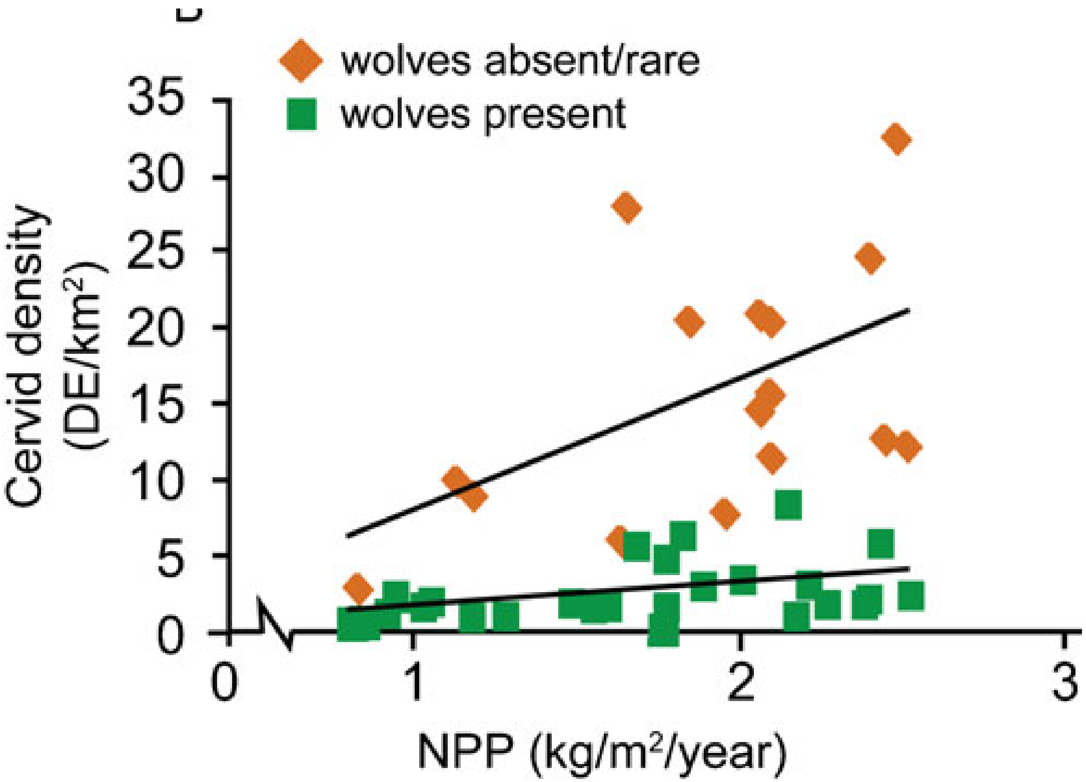
The role of predators

- Risk of predation is an evolutionary force that affects behaviors of virtually all animals
- Behaviors to avoid predation often result from a compromise between maximizing energetic intake and minimizing the risk of predation
- such behaviors include increased vigilance, reduced foraging time, reduced movements, habitat shifts, and changes in group size that they pose.

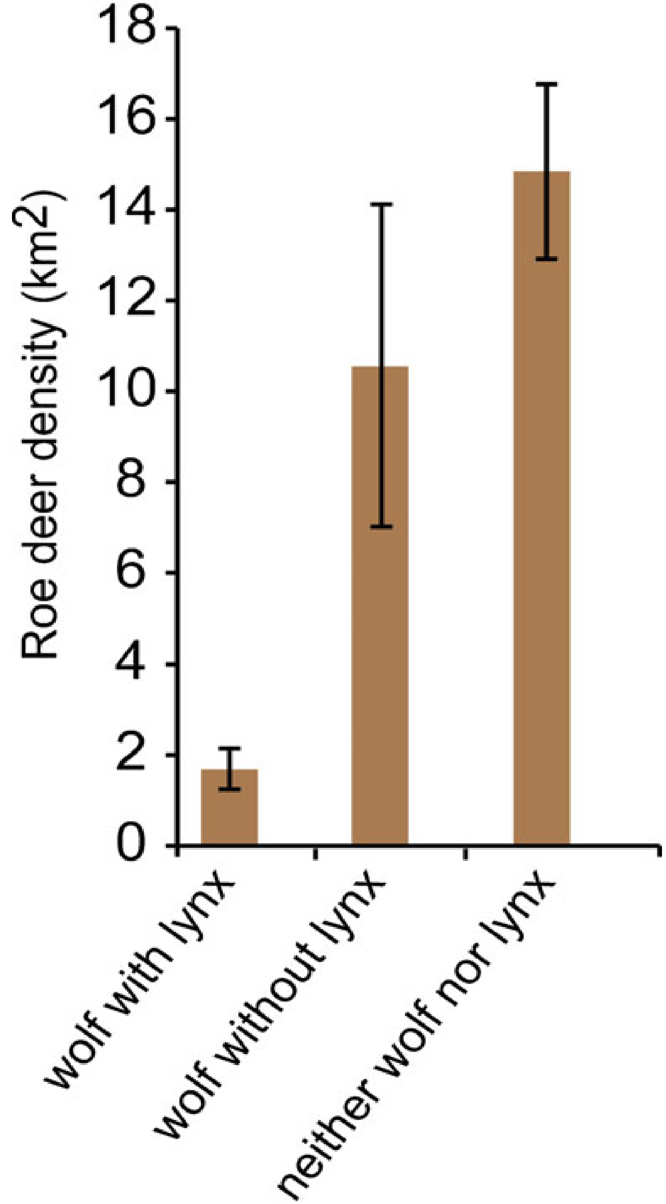
The role of predators

- Recent returns of large carnivores in Europe and North America have sparked considerable interest in how ungulates respond behaviorally to these predators and the risk that they pose.

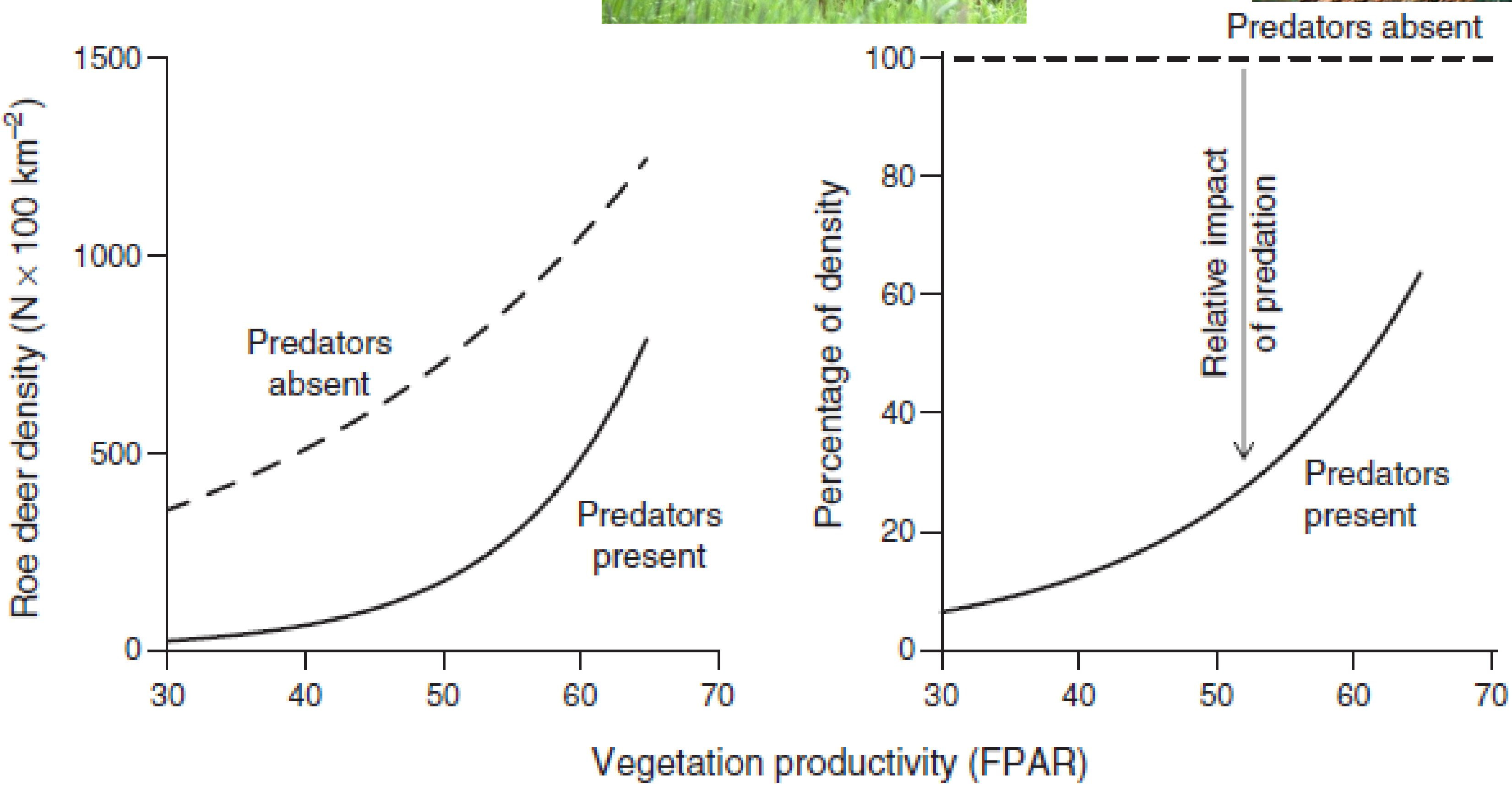
Cervid densities (y) as a function of net primary productivity
Ripple & Beschta 2012



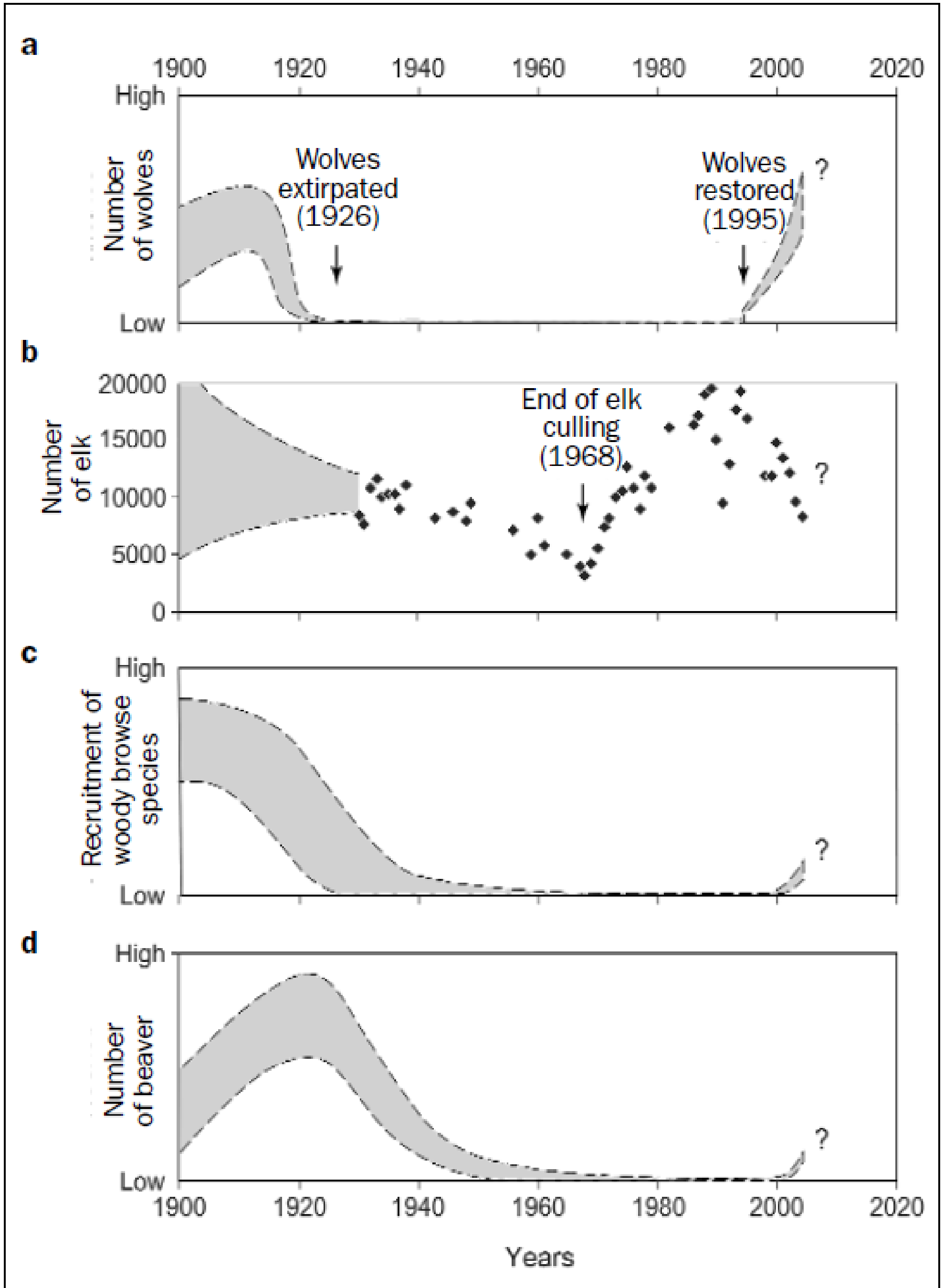
Mean roe deer densities in Europe by predator guild. Melis et al. (2009)

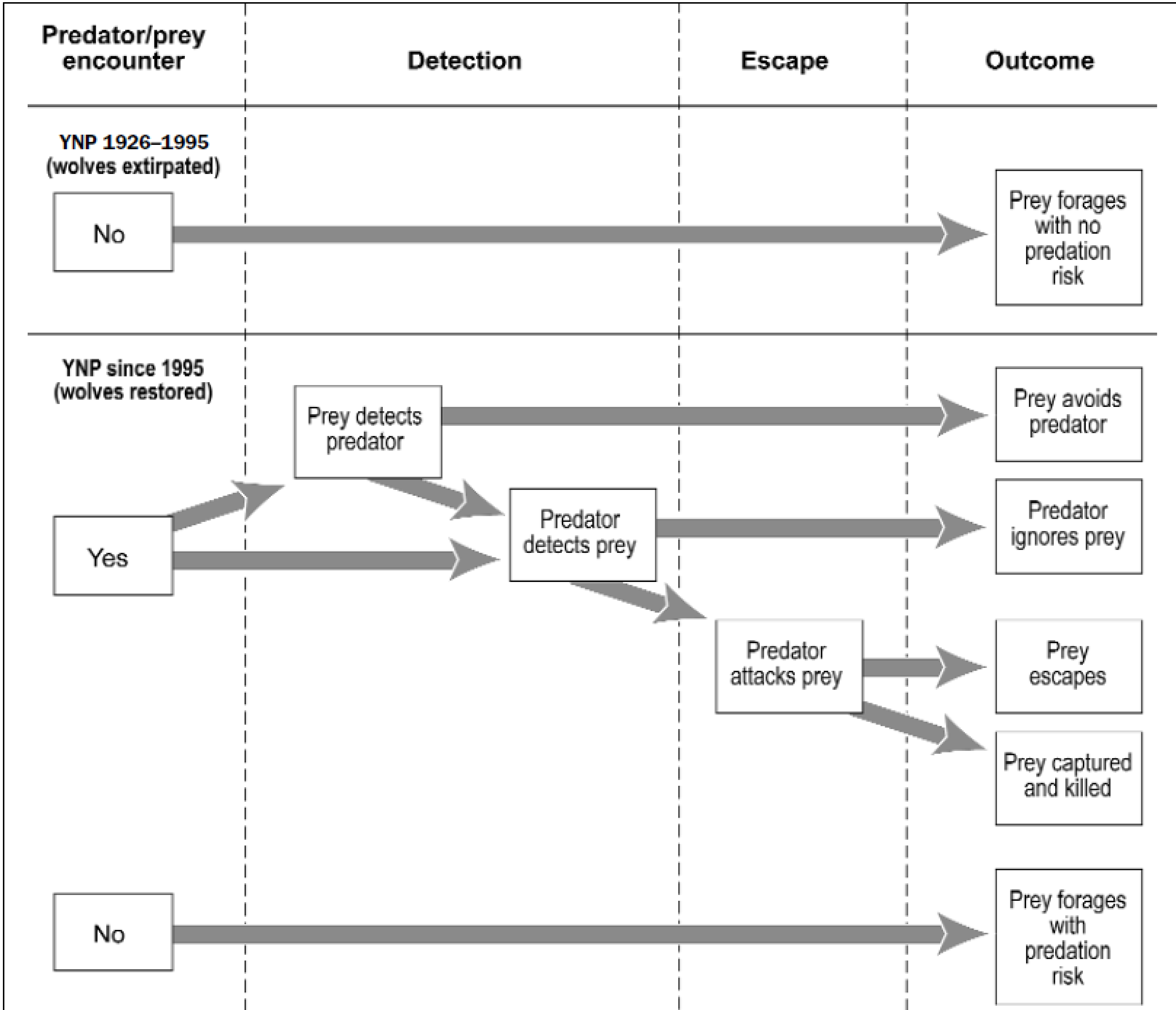


Graphical model explaining the combined top-down and bottom-up control of roe deer population density in Europe



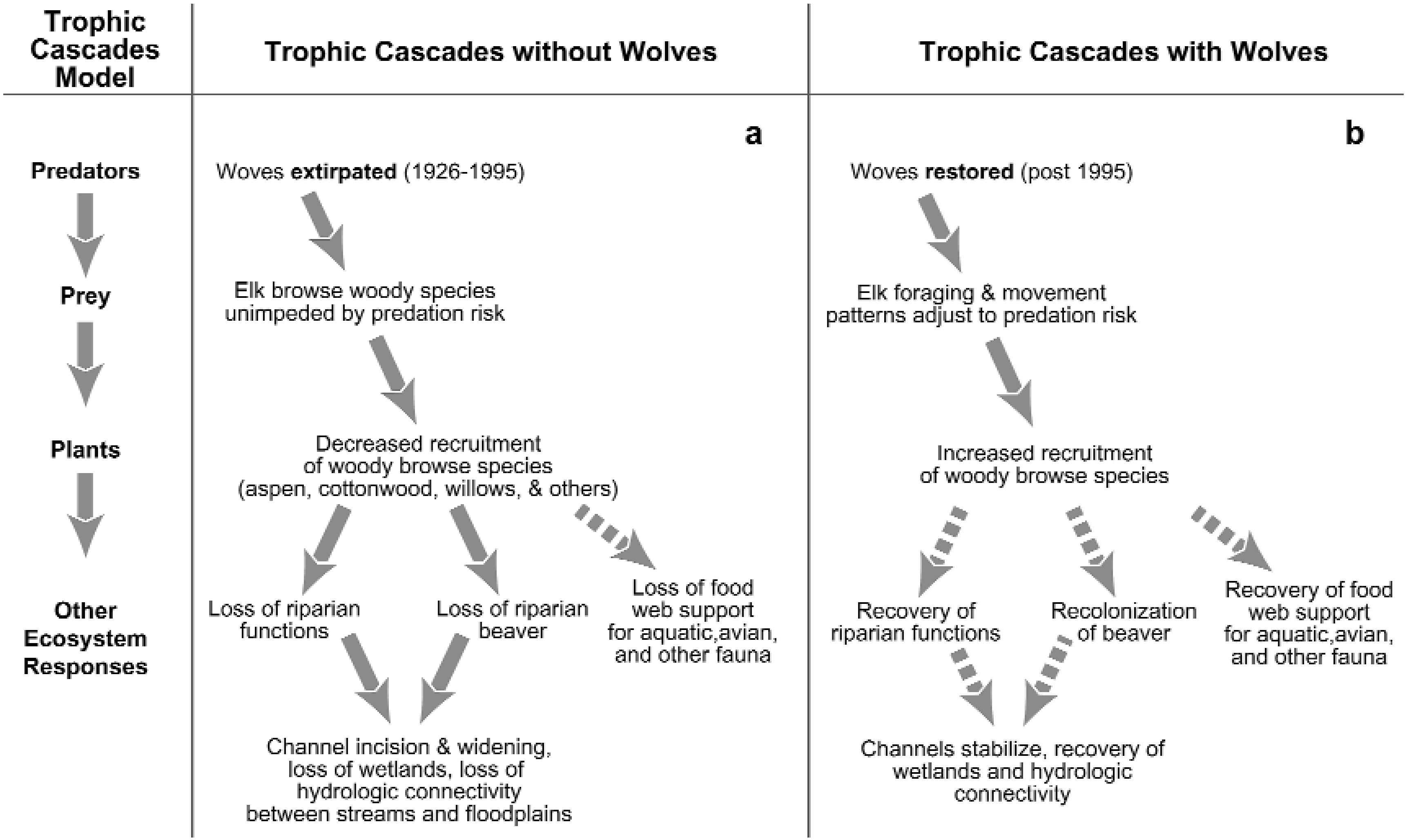
Historical trends for the northern range of Yellowstone National Park since 1900





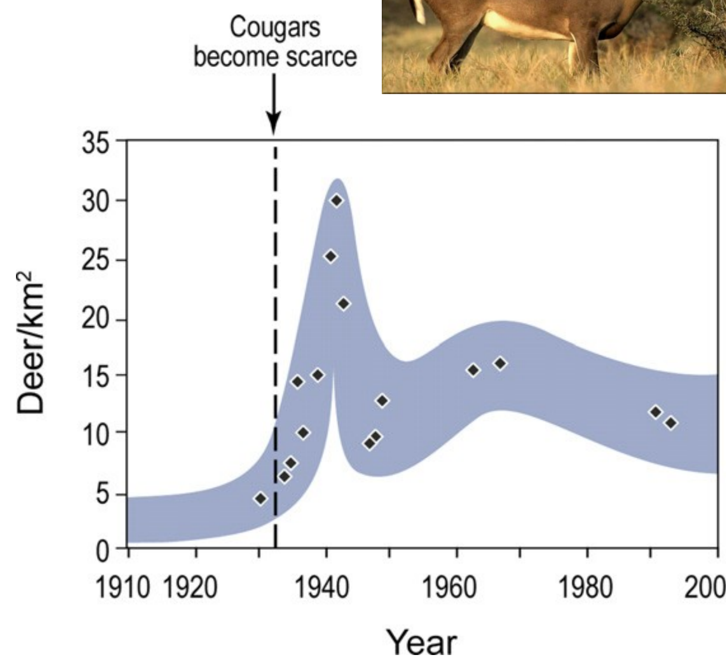
Predator/prey encounter
Detection
Escape
Outcome
YNP 1926–1995
(wolves extirpated)
No
Prey forages with no predation risk
YNP since 1995
(wolves restored)
Prey detects predator
Prey avoids predator
Yes
Predator detects prey
Predator ignores prey
Predator attacks prey
Prey escapes
Prey captured and killed
No
Prey forages with predation risk

Trophic interactions due to predation risk and selected ecosystem responses) for northern ecosystems of Yellowstone National Park

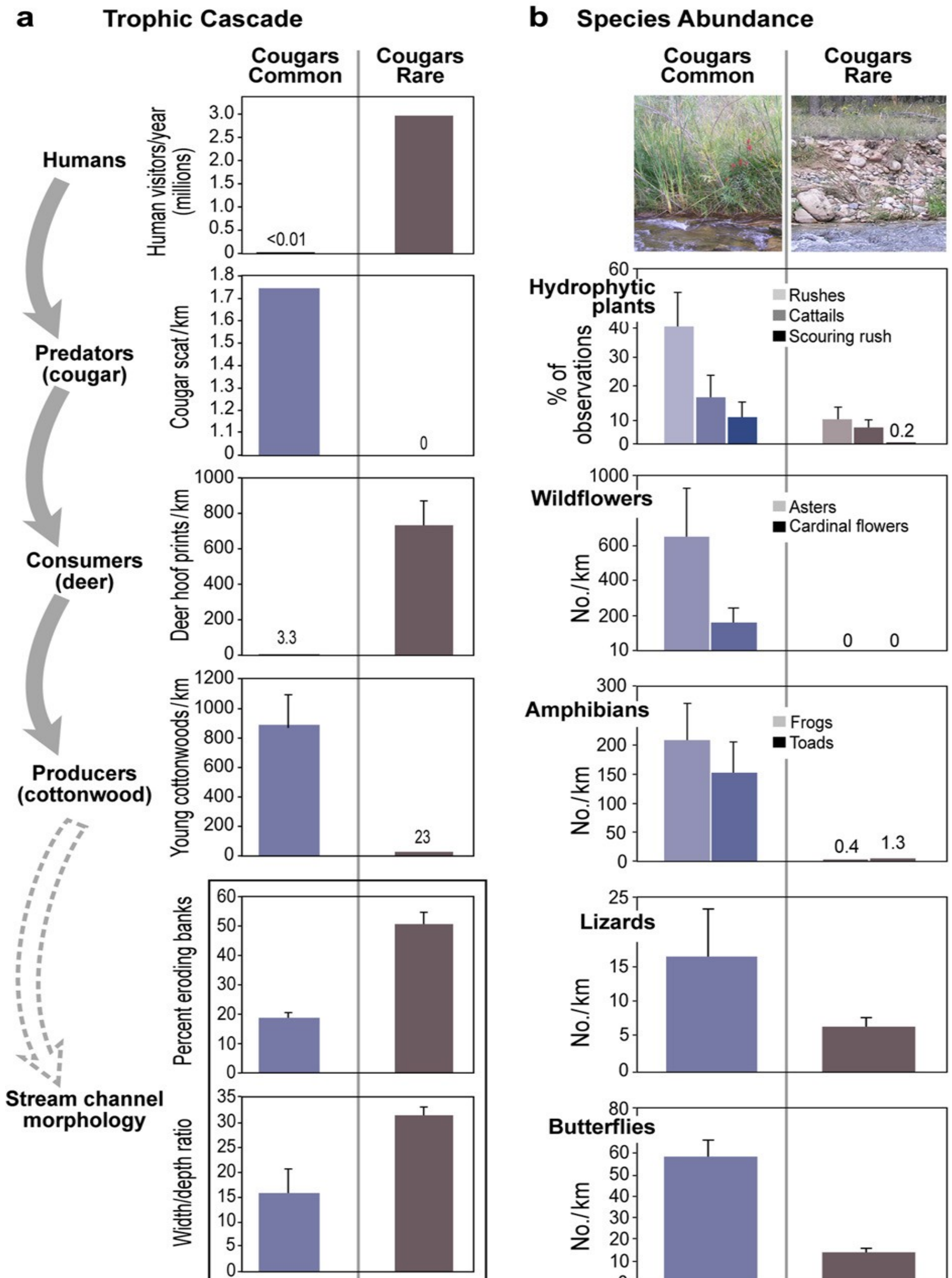


Willow along Blacktail Creek Yellowstone National Park in spring 1996 (left) and summer 2002 (right). after 7 years of wolf recovery.(Ripple and Beschta 2004 Bioscience)

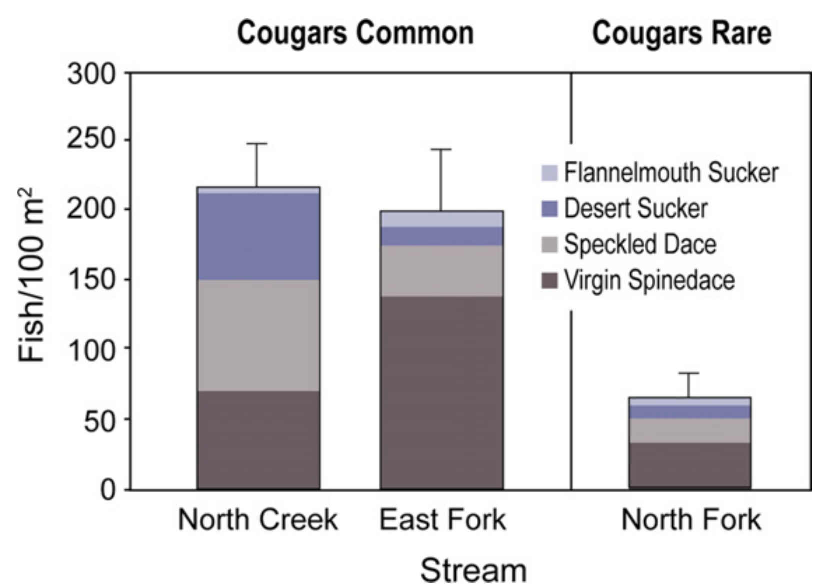
Zion Canyon along the North Fork of the Virgin River

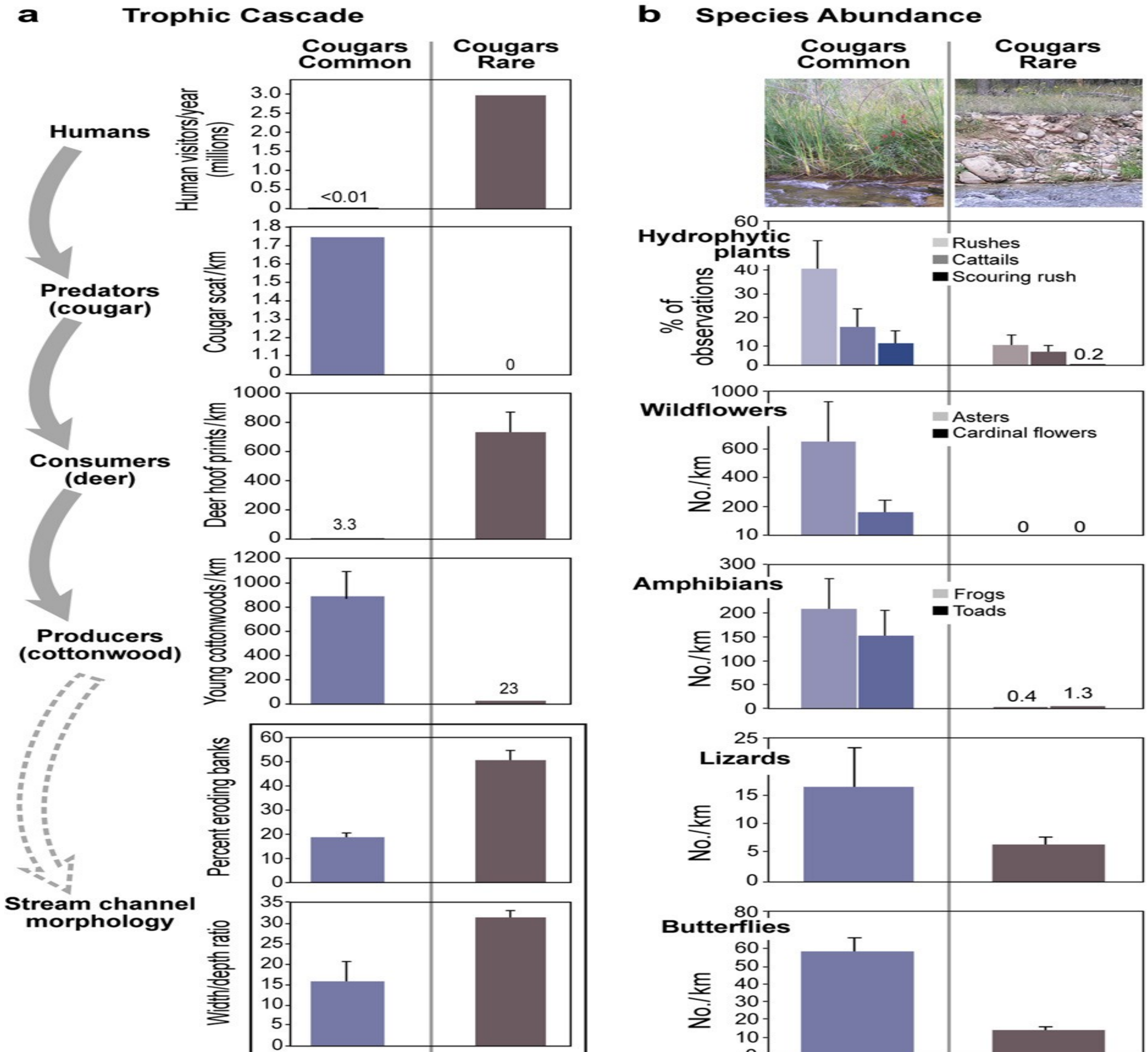


Zion National Park USA



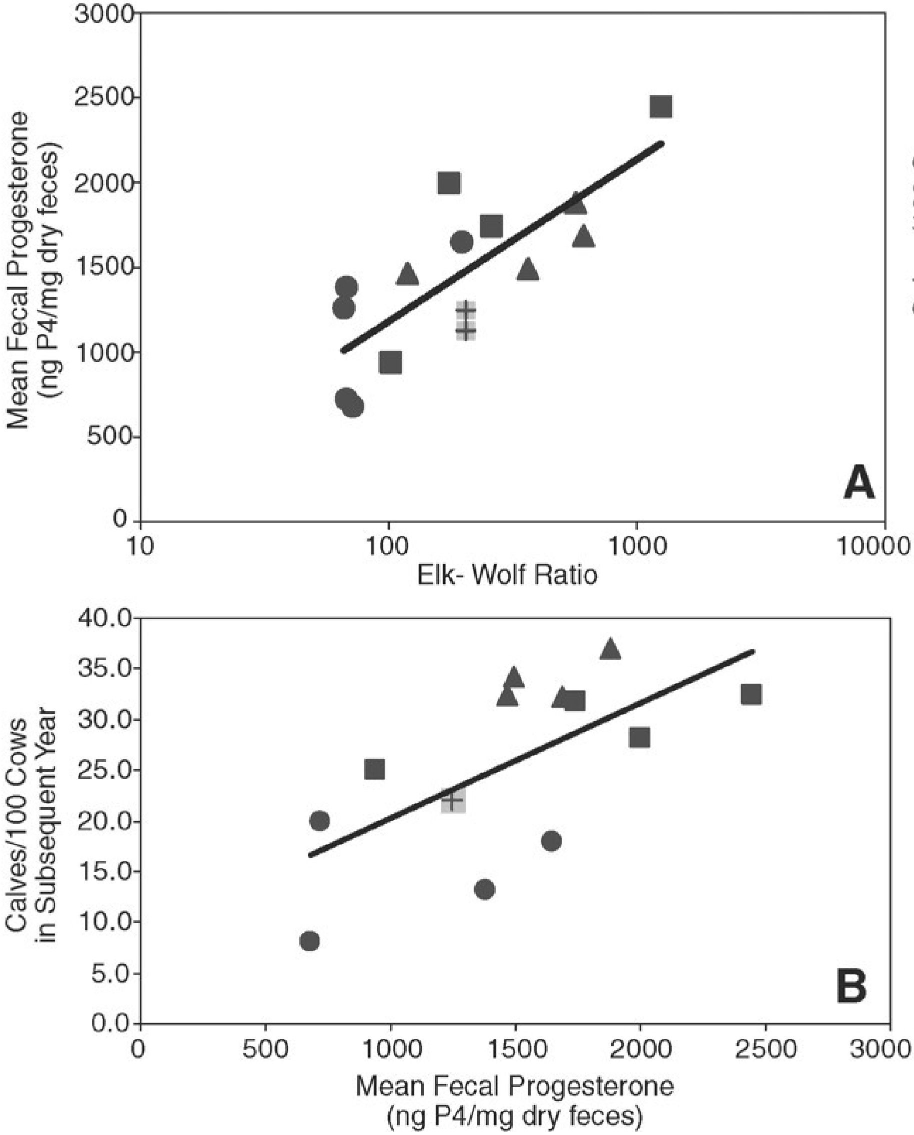
Ripple and Beschta Biol. Conserv. 2006





a
Trophic Cascade
Cougars Common
Cougars Rare
Humans
Predators (cougar)
Consumers (deer)
Producers (cottonwood)
Stream channel morphology
Human visitors/year (millions)
<0.01
Cougar scat/km
0
Deer hoof prints/km
3.3
Young cottonwoods/km
23
Percent eroding banks
Width/depth ratio
b
Species Abundance
Cougars Common
Cougars Rare
Hydrophytic plants
% of observations
Rushes
Cattails
Scouring rush
0.2
Wildflowers
No./km
Asters
Cardinal flowers
0
0
Amphibians
No./km
Frogs
Toads
0.4
1.3
Lizards
No./km
Butterflies
No./km

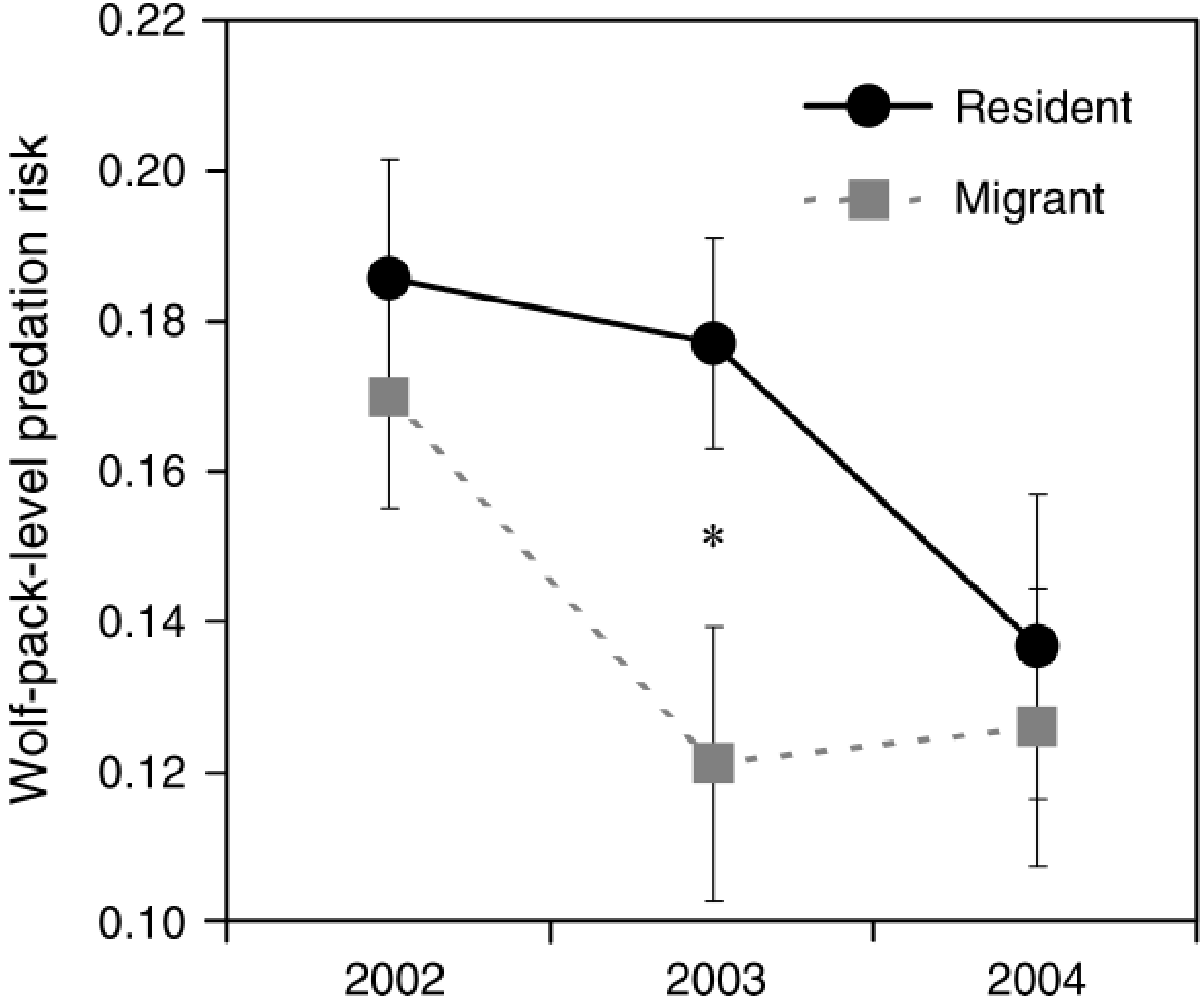
Relationship between faecal progesterone level in deer recruitment rate and wolf predation



Published by AAAS

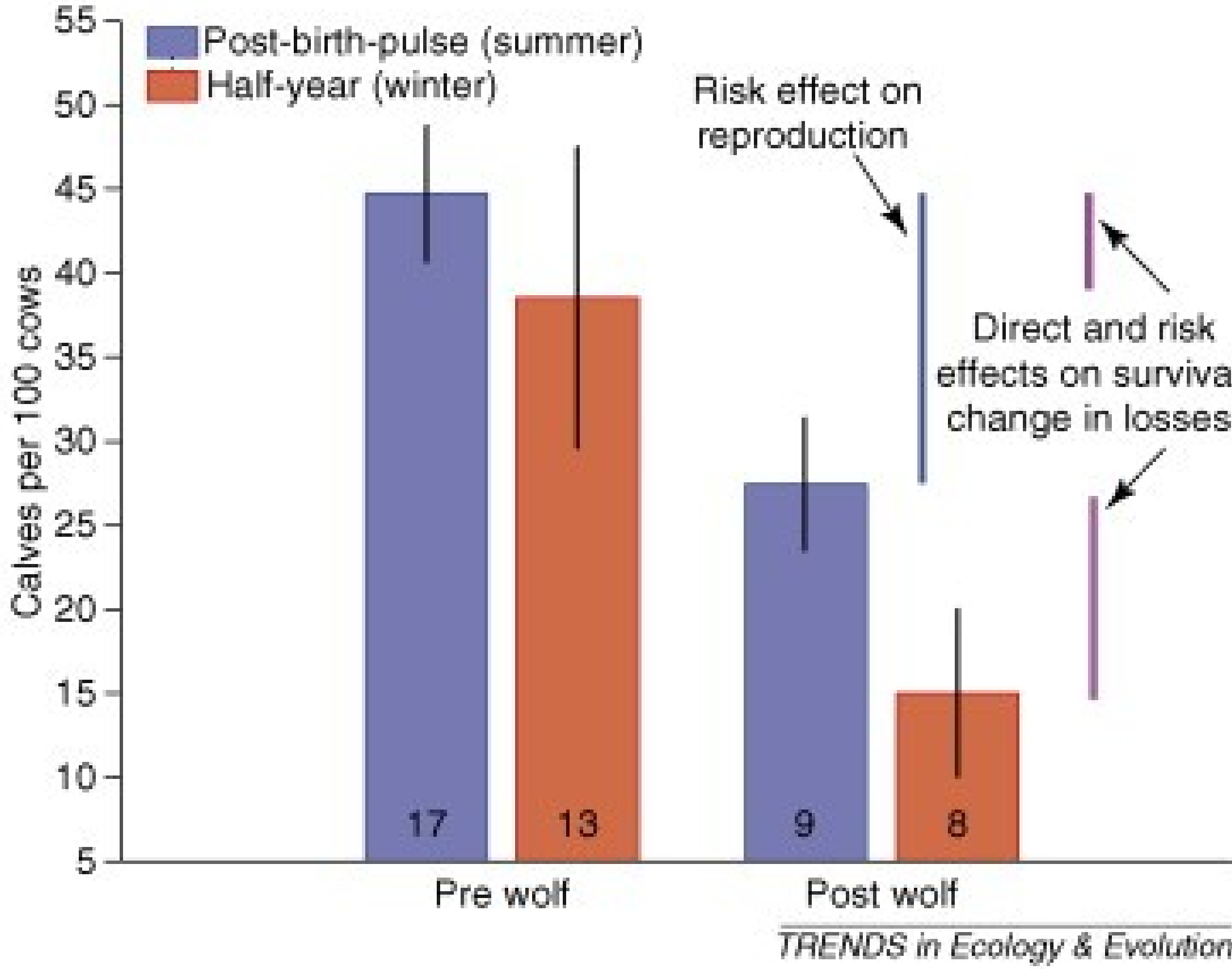
S Creel et al. Science 2007;315:960-960

Relative predation risk at the within-home-range scale for migrant (M) and resident (R) elk from the partially migratory Ya Ha Tinda elk herd, summers (1 June–30 September) 2002–2004.



Hebblewhite and Merrill (2008).

Impact of wolves reintroduction on deer reproduction rate in Yellowstone National Park



Do wolves (*Canis lupus*) help to protect forest regeneration against ungulates?

Introduction

- Ungulates can markedly change the forest structure
- Increasing deer densities in European forests over the four decades (from 1970) led to conflict interests of deer and forest management
- Browsing of tree seedlings, saplings and bark striping on older trees is the major problem of forest regeneration

The main problem of forest silviculture

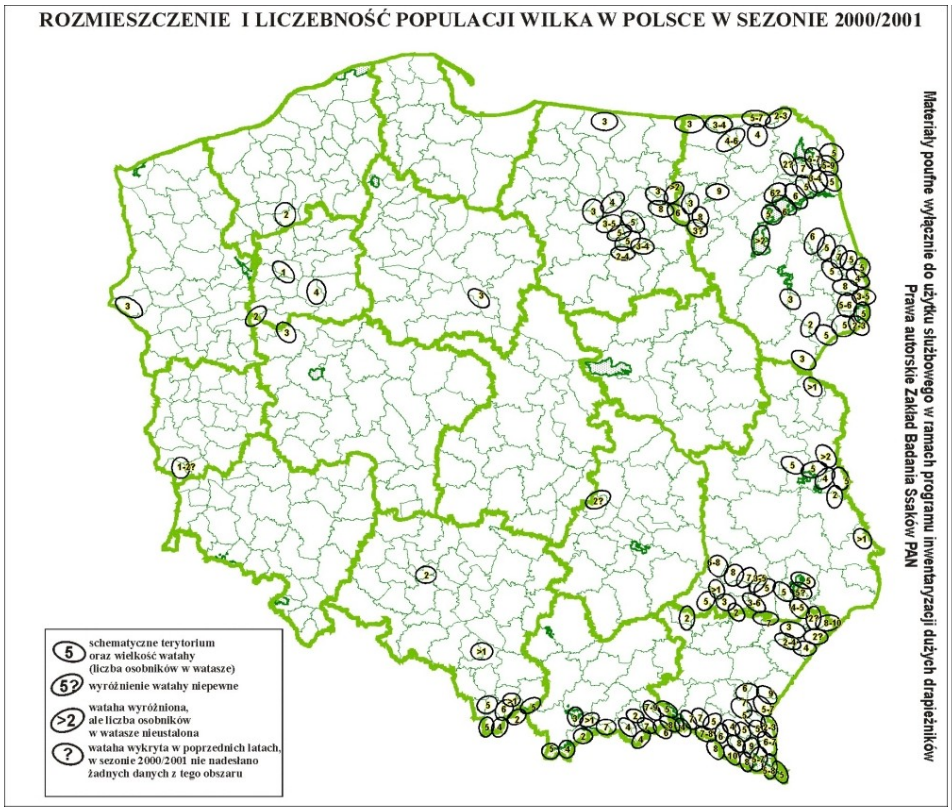
- From mammalian species ungulates create the highest impact on forest ecosystem in Poland
- Red deer (*Cervus elaphus*) is common deer species, their density ranged from: 1,4 to 8 deer/km^{-1} of forest
- Roe deer (*Capreolus capreolus*) to 24 ind./km^{-1} of forest
- Moose (*Alces alces*) – north-eastern and eastern parts of Poland

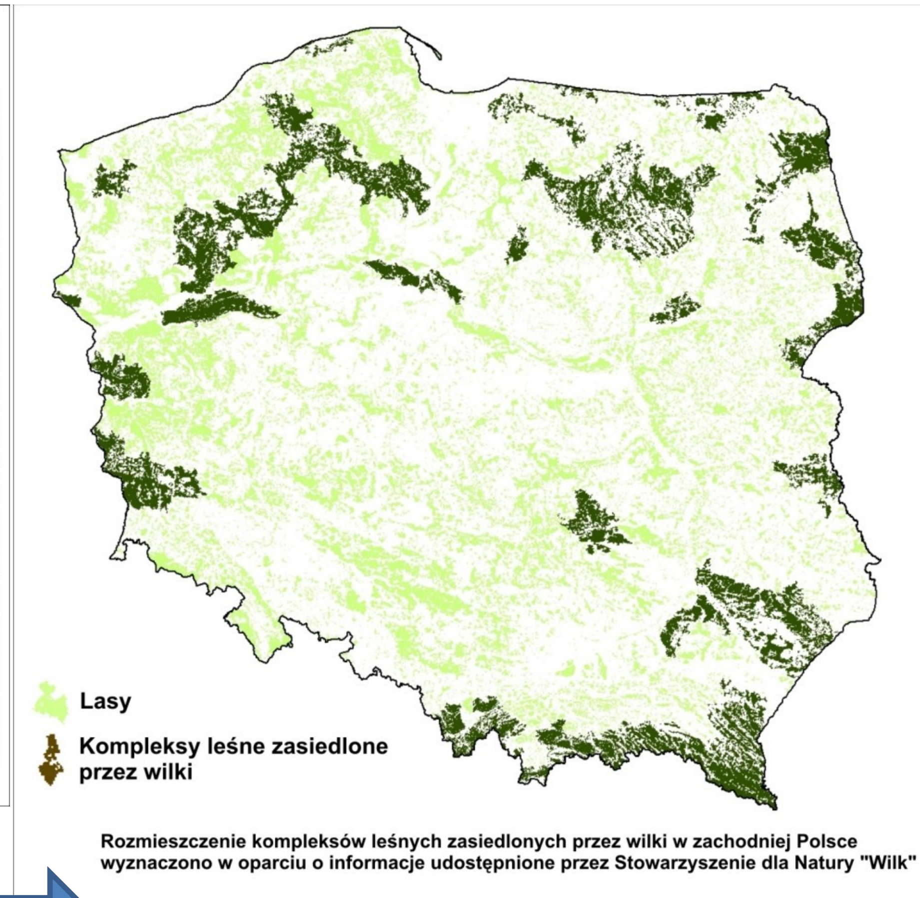
The aim of the study

- Trophic cascades:
- Apex predator (wolves) produces a strong direct effect on its prey and strong indirect changes in faunal and floral communities at other trophic level
- The aim of the study is to asses the effect of the wolves presence on forest regeneration

Methods and Materials

Wolves distribution in Poland 2001 - 2012





2000/2001
N=565

2011/2012
N=720

http://www.zbs.bialowieza.pl/artykul/552.html

Methods and Materials

We selected forest districts based mainly on forest cover (above 50%), which is the key parameter for stable red deer population.

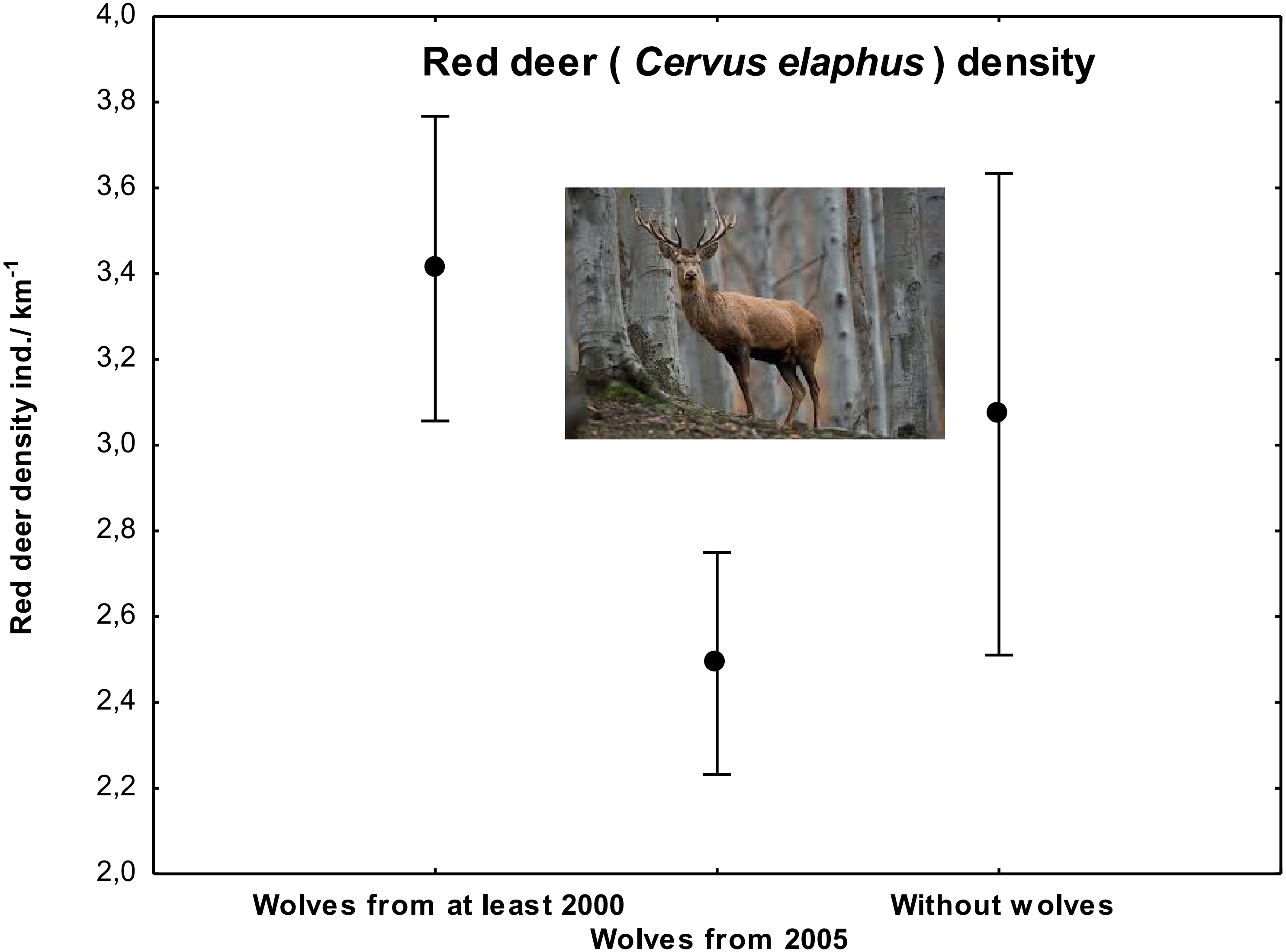
In total we chosen 114 forest districts which were divided into three categories:

- Without wolves (n=39)
- With wolves presence from at least 10 years (n=51) – „old wolves populations”
- With wolves presence from 5 years or less (n=24) – „young wolves populations”.

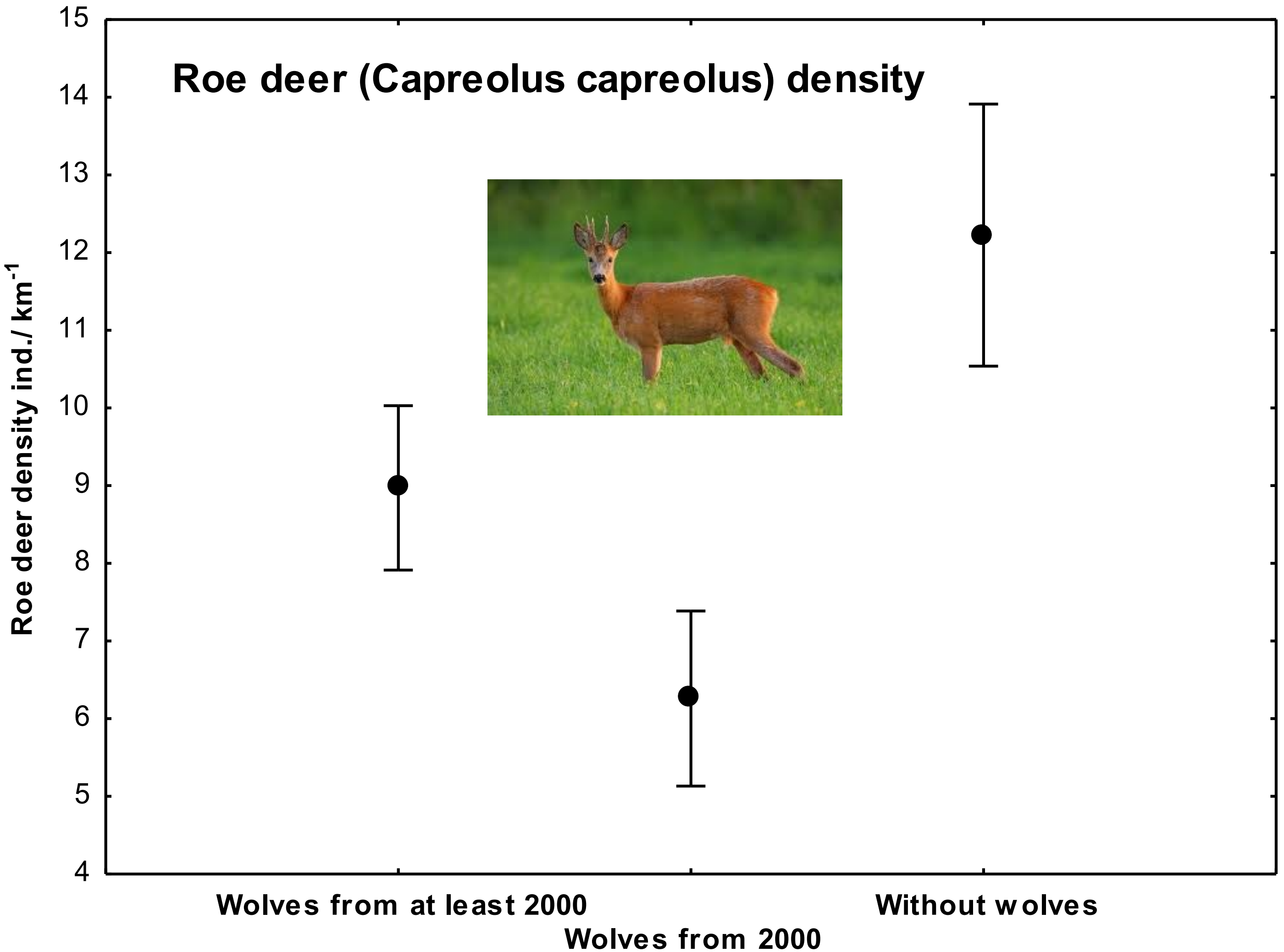
Methods and Materials

- Data about damages caused by deer (red and roe deer together) originated from forest districts and included following data in two scales low (20% - 50%) and high (above 50%) from period 2008 - 2012:
- area of damaged forest plantation [ha]
- area of damaged forest thicket [ha]
- Data about deer densities were obtained from forest districts (drive censuses).

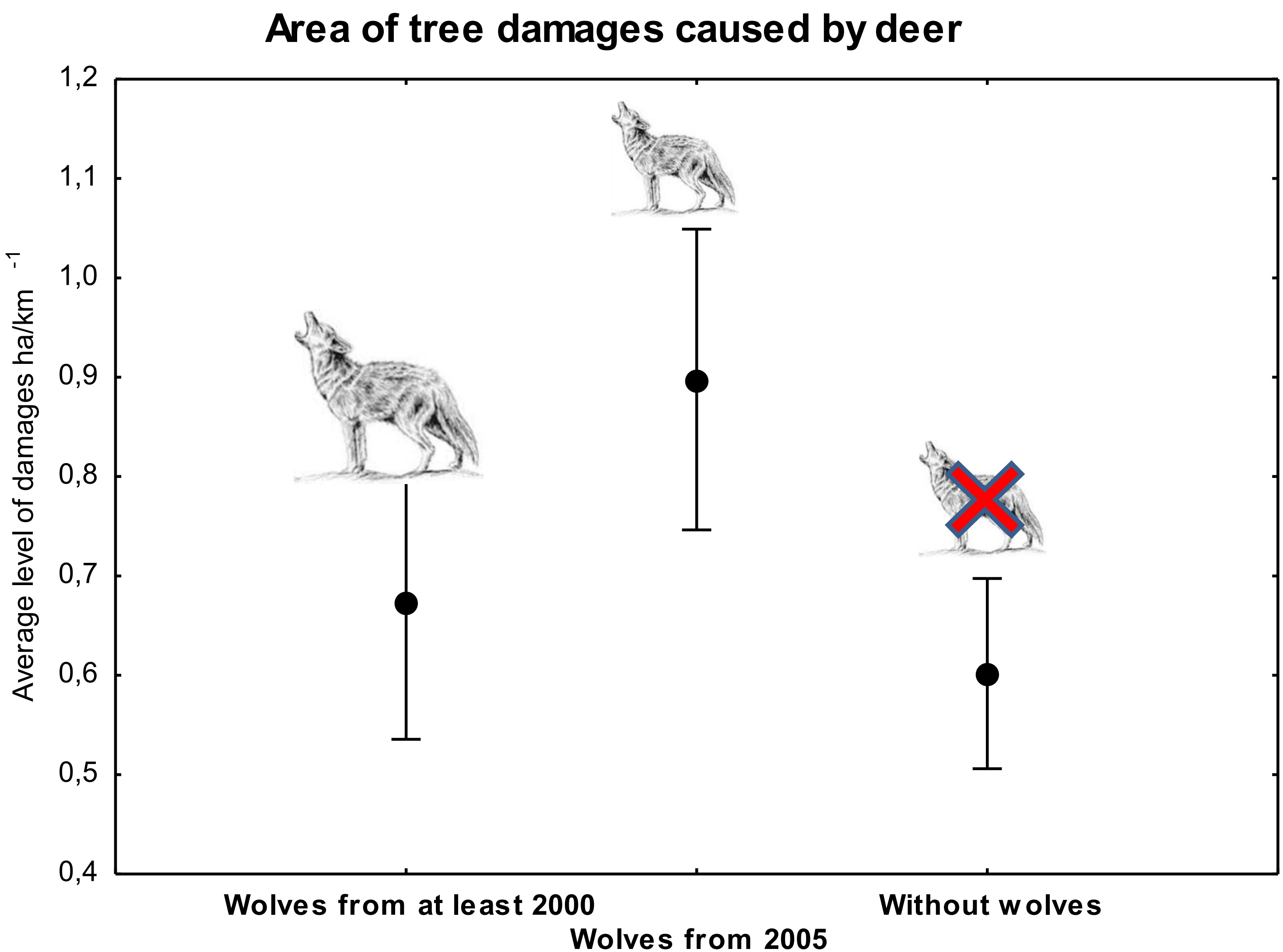
Red deer density



Roe deer density

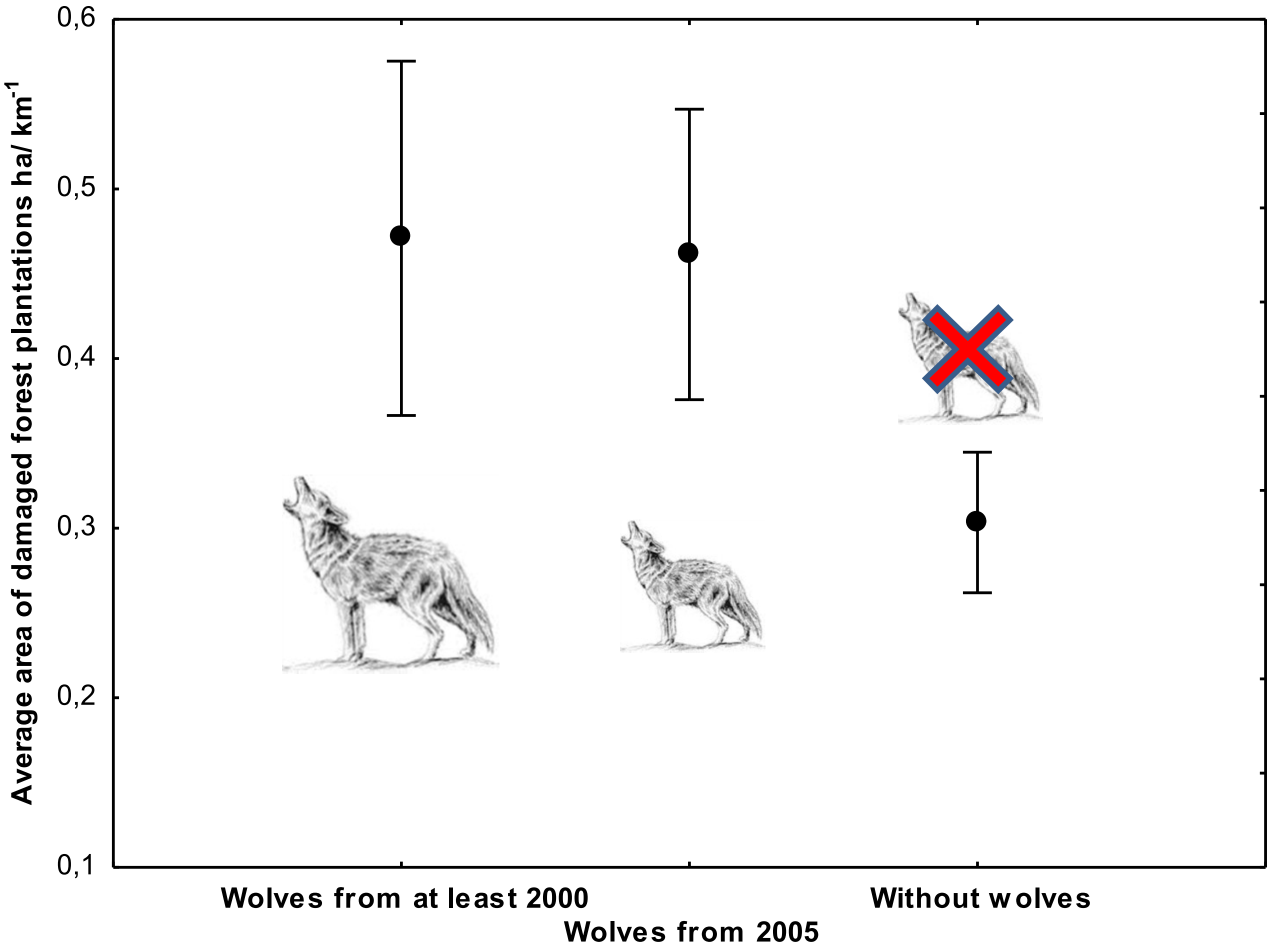


Results



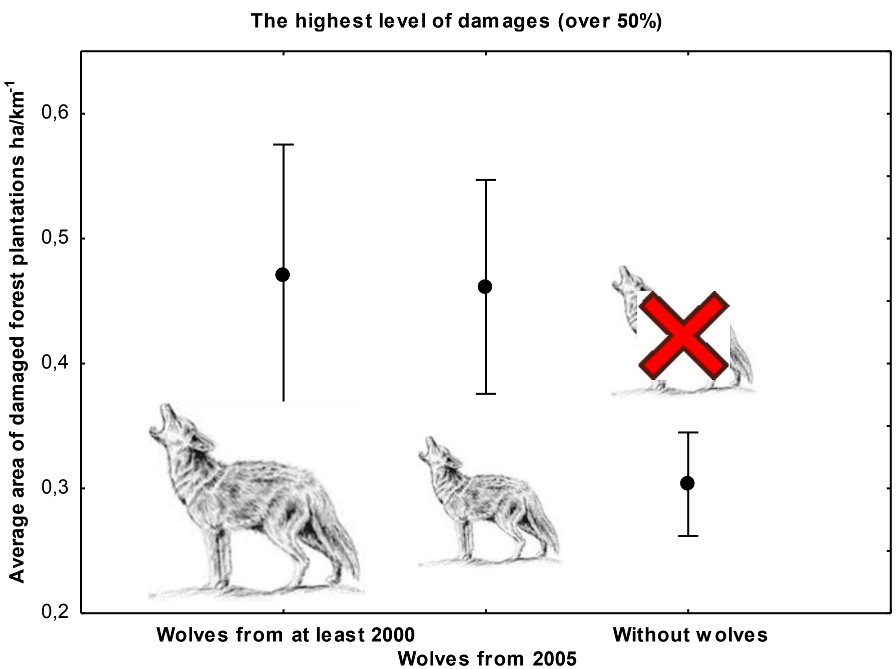
Area of tree damages caused by deer
Average level of damages ha/km -1
1,2
1,1
1,0
0,9
0,8
0,7
0,6
0,5
0,4
Wolves from at least 2000
Wolves from 2005
Without wolves

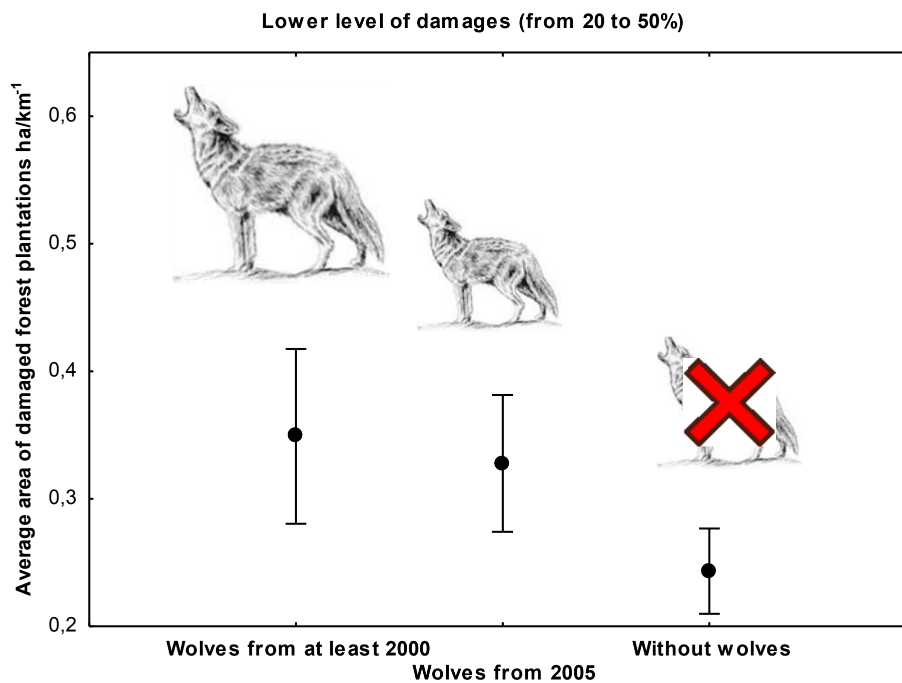
Results
forest plantations



Results

Forest plantations

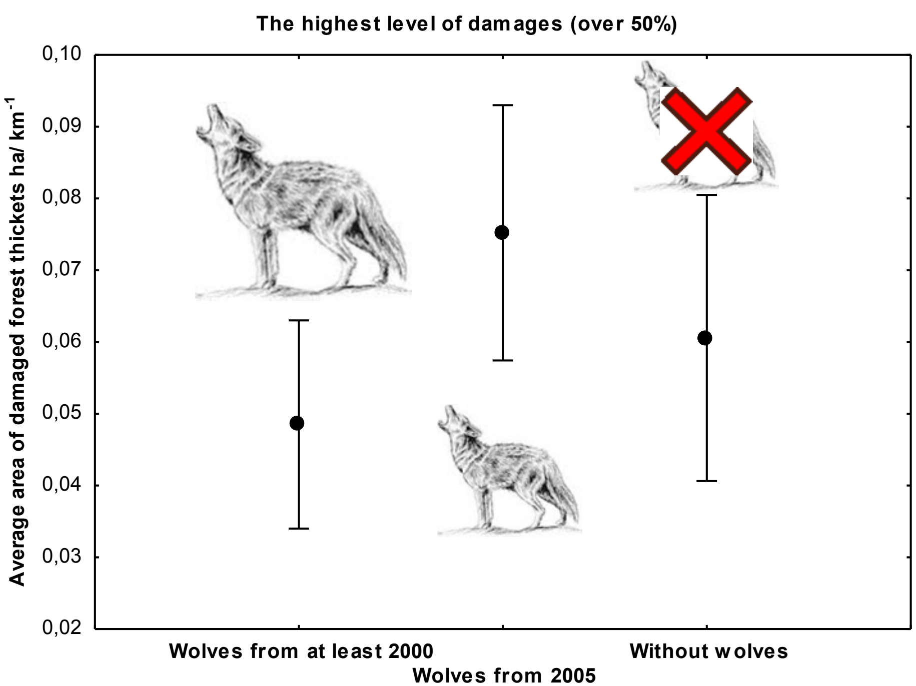


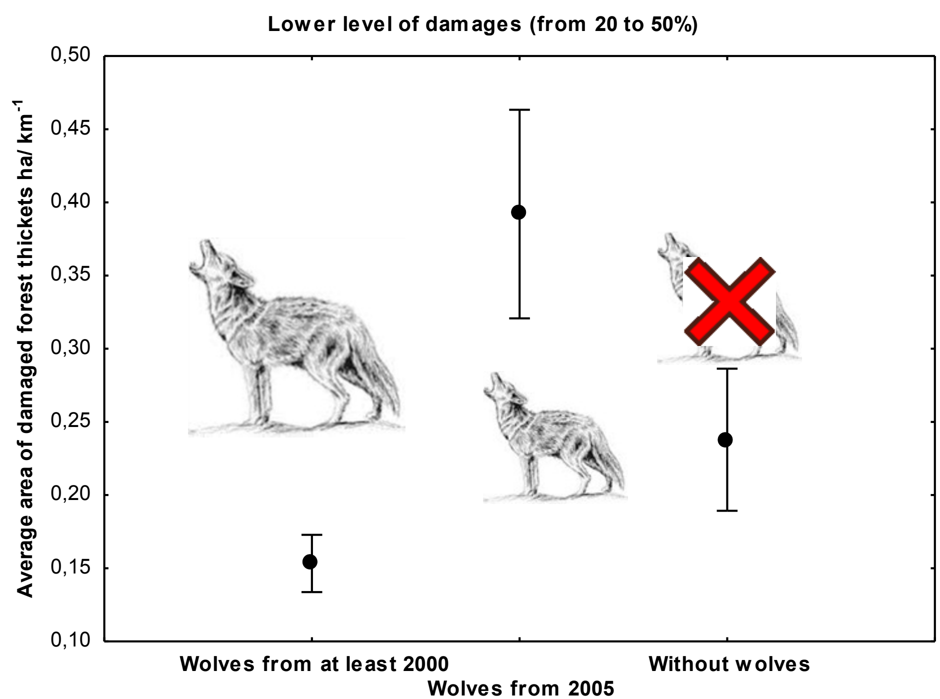


Results
forest thickets

Results

Forest thickets





Conclusions

- The lowest deer population density was occured in forests with young wolves populations. This may indicate a strong reaction to the appearance of deer predator in the environment.
- In forest districts with young wolves populations higher level of tree damages was observed only in forest thickets.
- Damages caused by deer on forest plantation was higher in forest districts both with stable and young wolves populations
- The highest intensity of seedling and saplings damages was observed in forest districts with young and old wolf populations

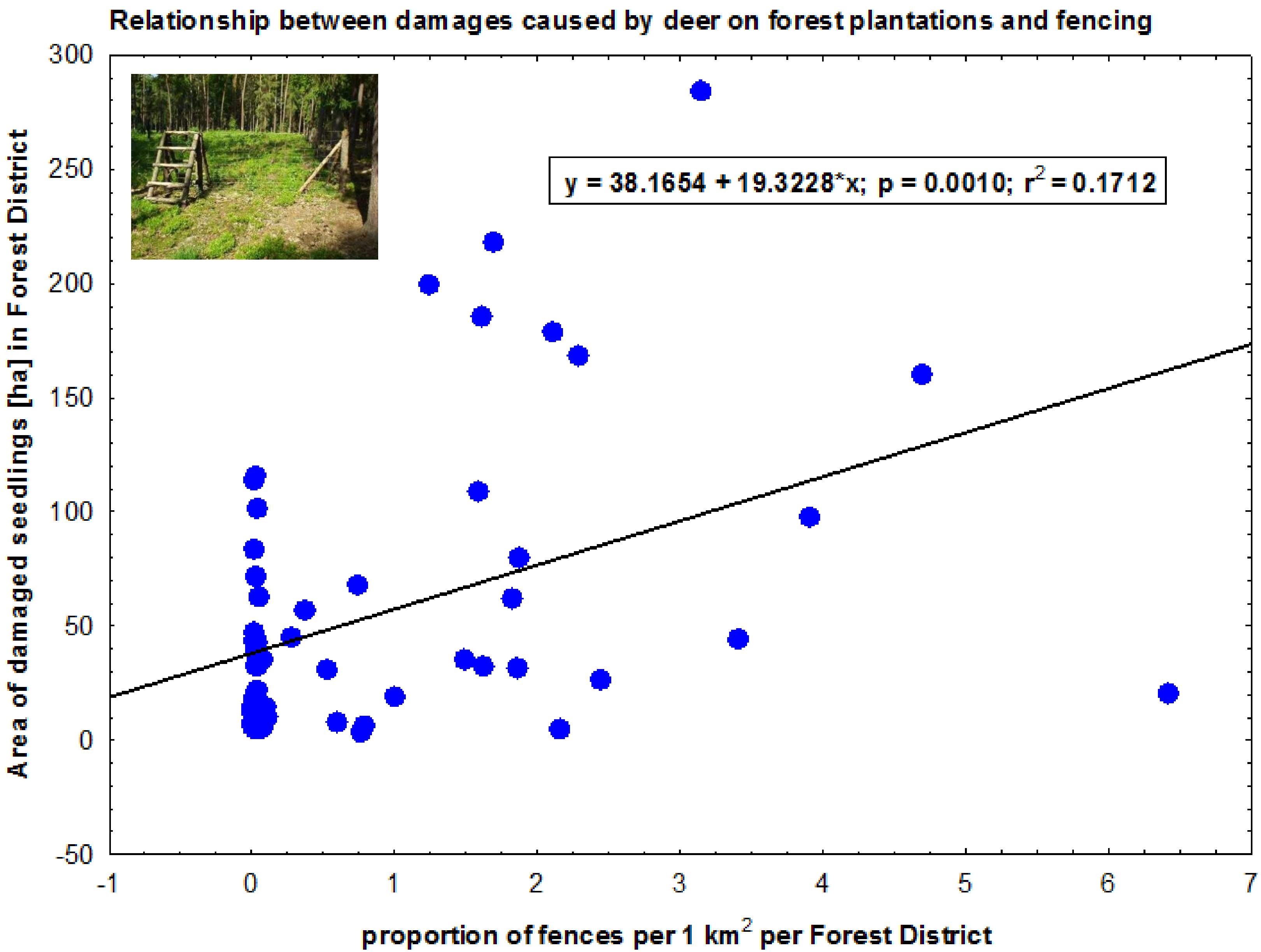
Conclusions:

- In forest districts without wolves higher level of tree damages in forest thickets was noted compared to stable wolves populations. However, in forest plantations where wolves were absent the level of damages was the lowest.

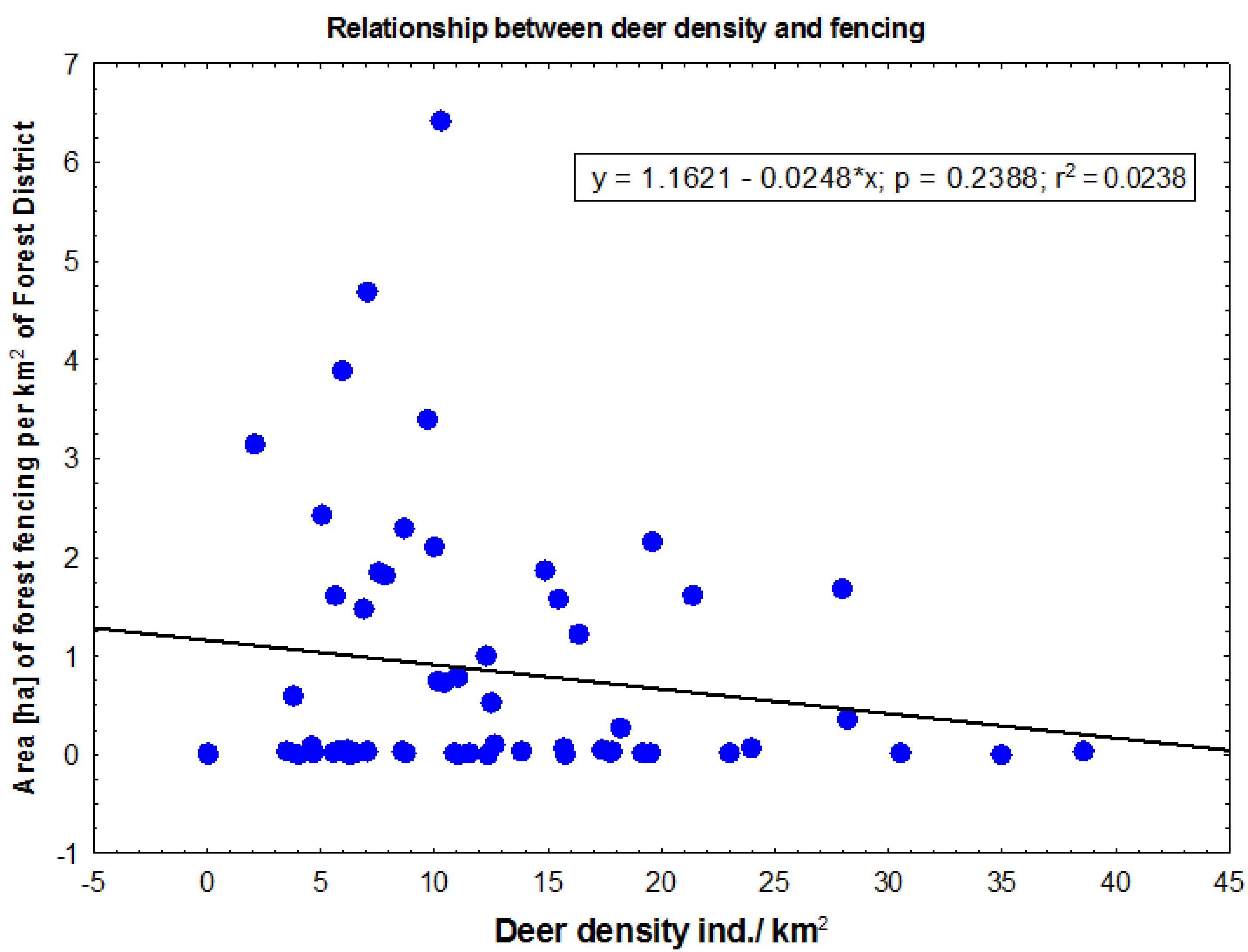
Probable explanations:

- Unknown effect of forest protection practice (e.g. protection of forest plantations by metal nets)
- Wolves presence generate changes in prey behaviour (bigger groups, differences in habitat selection)
- Weak effect of wolves on roe deer feeding behaviour
- Changes in deer feeding behaviour can occur in the range up to 20% of damages and can not be detectable by applied methodology.

Fencing of forest plantations and level of tree seedling damaged by deer



Relationship between deer density and fencing of forest plantations



Thank you for your attention