

How lions favour grazers



I changed my topic to reflect positively on the animals that Hans love so much !

How lions favour grazers



a special talk for my former PhD-student Hans !

How lions favour grazers



Herbert Prins
Wageningen

a scale-dependent tri-trophic relation

Lions are dangerous



They can prey on anything that moves: here on Oryx



... anything that moves ...



Zebra



smallish prey



African buffalo fall victim



White rhino



Yes: and even elephant

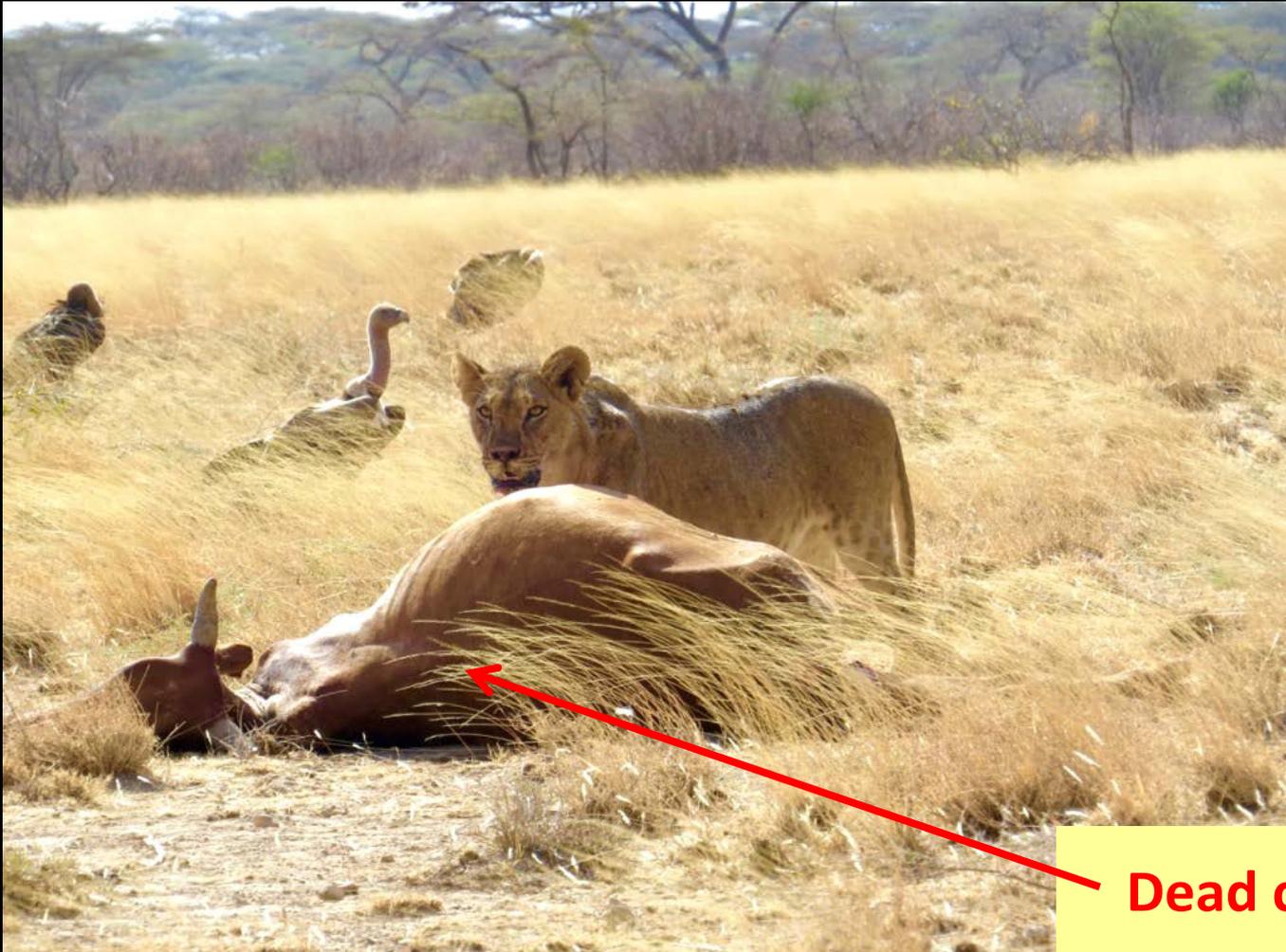


Where there are lions, there is a “landscape of fear”



... the kill can be anywhere ...





Title of my talk: **“How lions favour grazers”**
..... so how is this possible ?

Message 1:

- if there are large predators, the risk is everywhere



Conjecture 1:

- the landscape modifies that risk

**Typical modern savanna in Africa
... anywhere a lion can lurk**



**I was here with
Hans, Barbara
and Paul Loth,
but that is not the
point**

**Typical modern savanna in Africa
... anywhere a lion can lurk, but ...**





Next issue that we need to comprehend:

Food is not everywhere 'good'



Impala

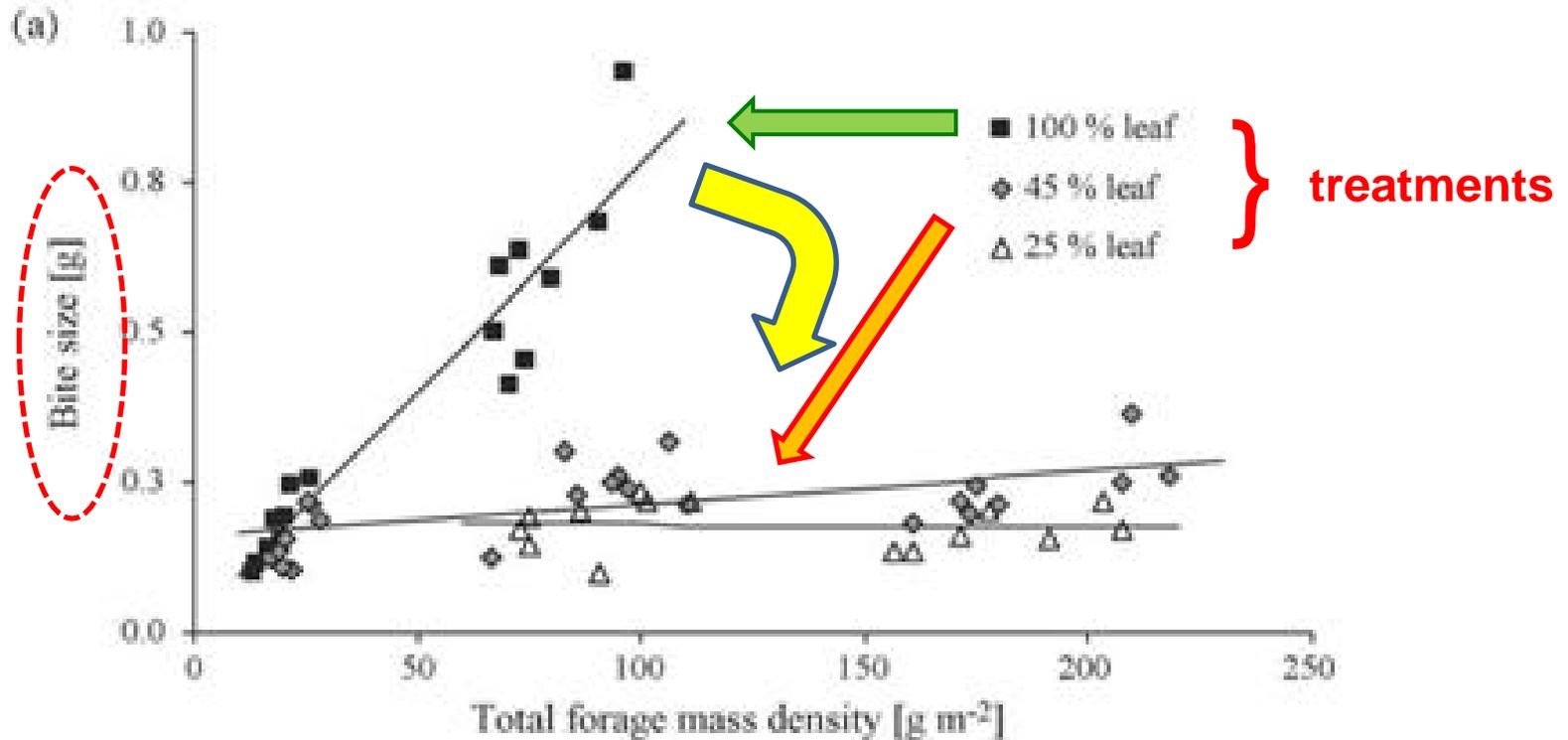


Kob du Buffon



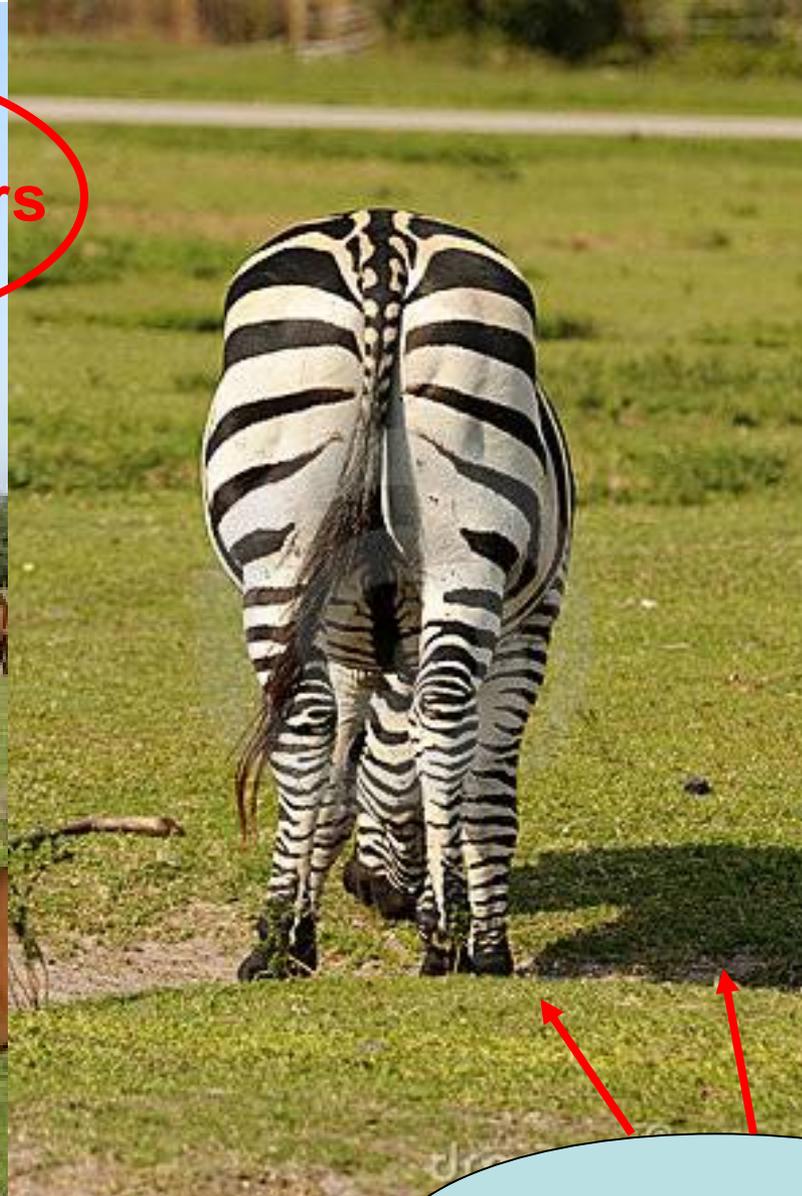
Wildebeest

Experimental work we carried out with Nguni cattle in South Africa



**A few grass stems already reduce food intake
considerably for RUMINANTS**

**This is
what most grazers
need**



a grazing lawn



Message 2:

- not everywhere the food for herbivores is 'good'



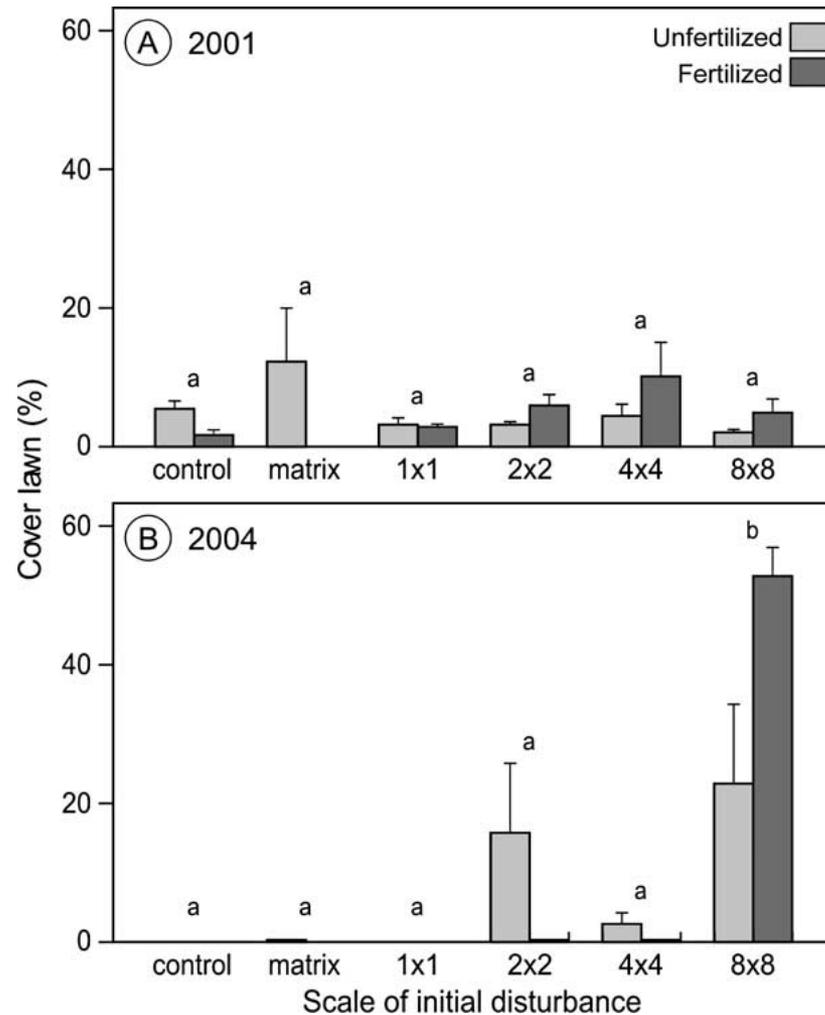
Knowledge 1:

- the landscape modifies the quality for herbivores (that is, geology, hydrology, soil, aspect)

Knowledge 2:

- herbivory itself modifies that quality too

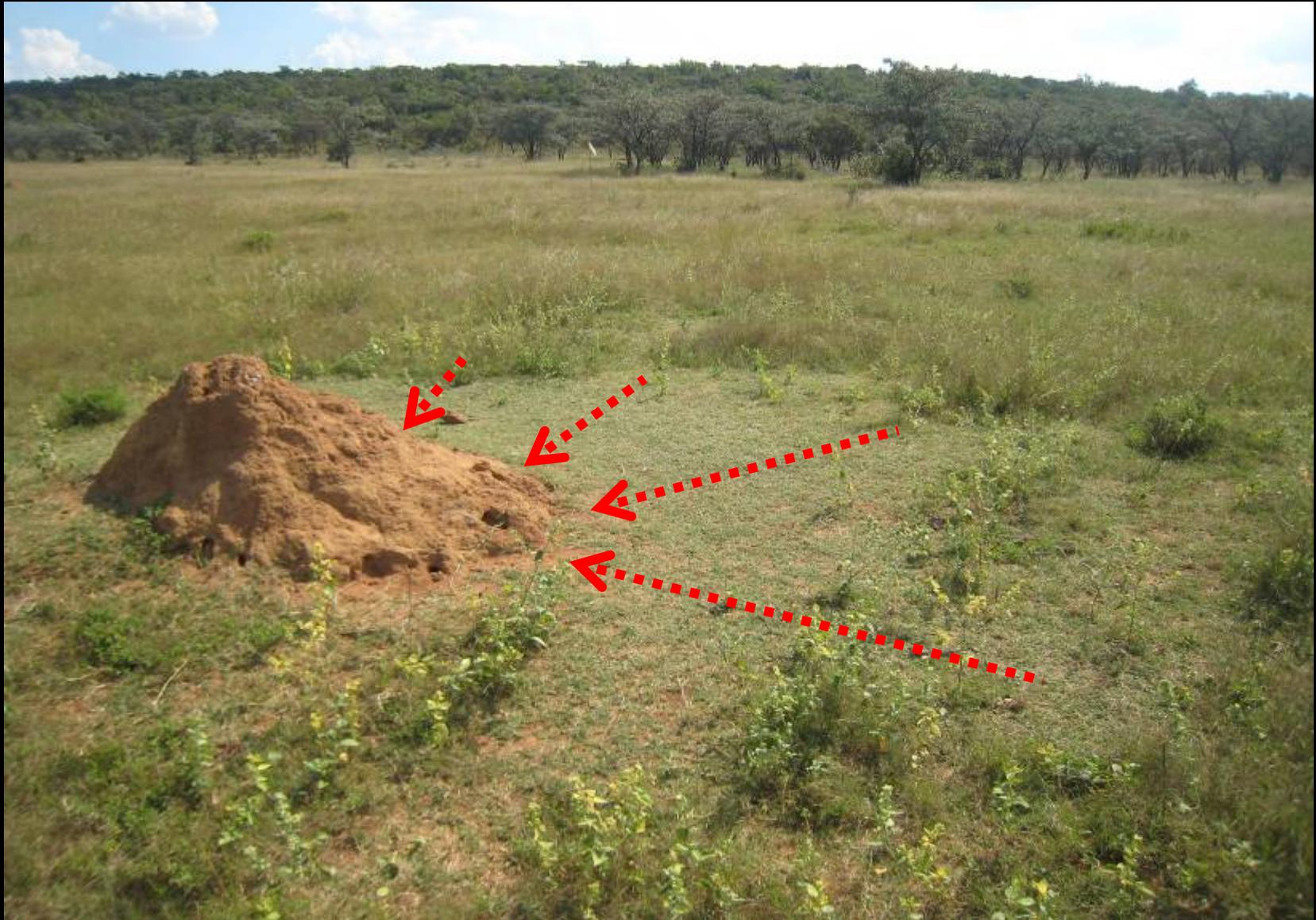
NEXT:



Lawn formation “kicks in” at a scale of 8 x 8 m

Joris Cromsigt & Han Olff (2008) Oikos 117: 1444-1452

**This suggests that lawns
cannot expand if they are too small**



Message 2:

- not everywhere the food for herbivores is 'good' but on grazing lawns it is.

Knowledge 1:

- the landscape modifies the quality for herbivores (that is, geology, hydrology, soil, aspect)

Knowledge 2:

- Herbivory itself modifies that quality

Knowledge 3:

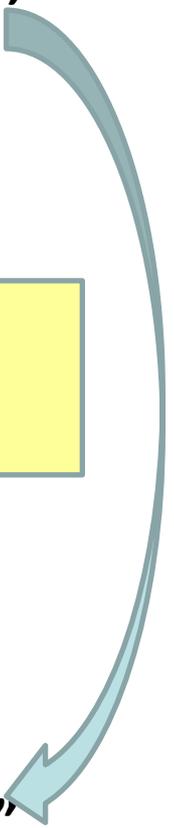
- This herbivory effect is scale-dependent

Message 1:

- if there are large predators, the risk is everywhere

Conjecture 1:

- the landscape modifies predation risk: "landscape of fear"



Scale effects:

exciting but not easy to study

**Let us have a look at the experiments at
Welgevonden**

**What can we learn from Welgevonden
Game Reserve (WGR), South Africa ?**





Treatments:

Mown 1x, 2x or 3x per year (or Not)

Fertilised: Urea or Phosphorus (or Not)

Scale effects:

100 x 100 m

50 x 50 m

25 x 25 m

10 x 10 m

5 x 5 m

3.3 x 3.3 m

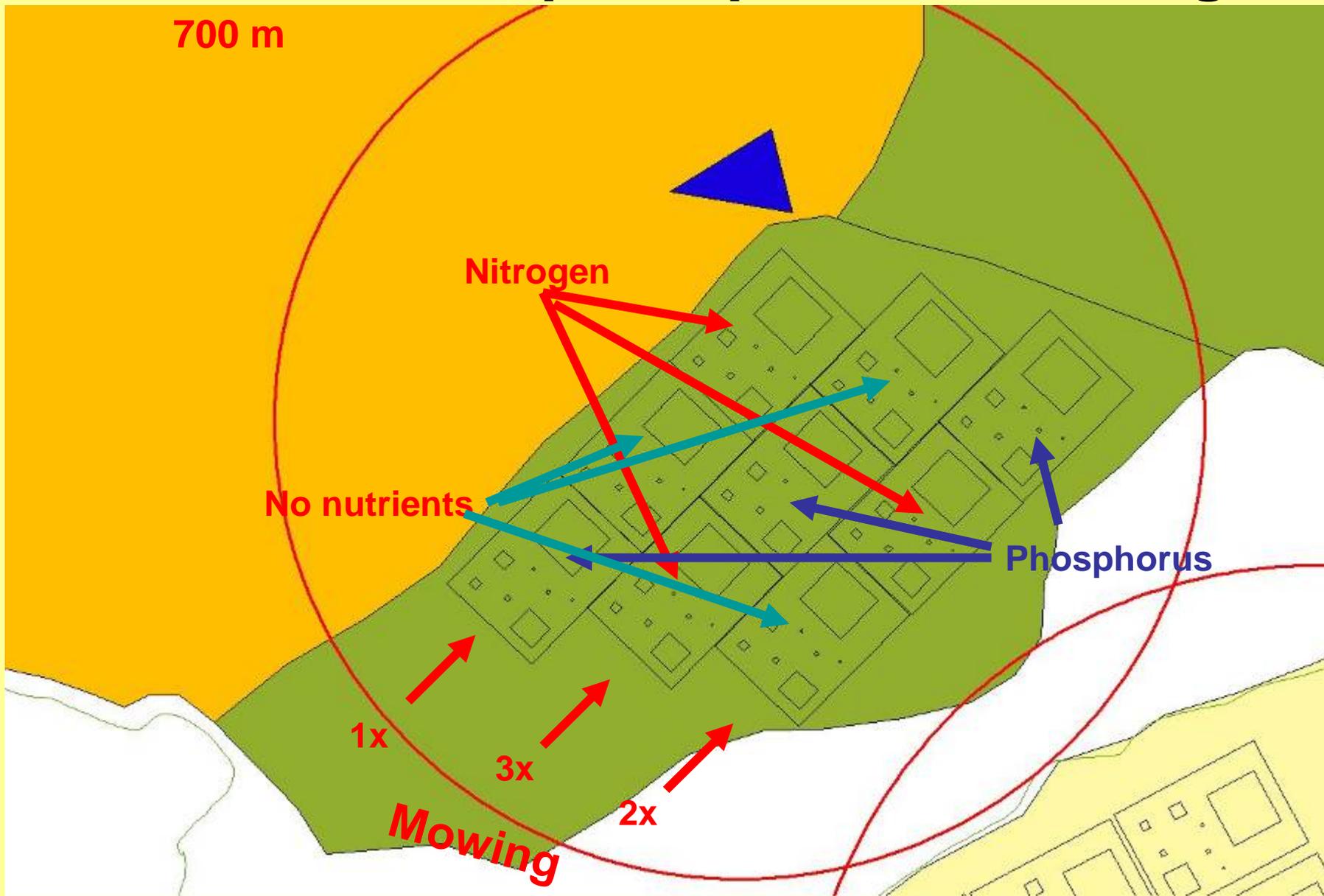




scale



Proper experimental design



Very strong effect on RUMINANTS, warthog and rhino



11 years in the experiment:

- **Since the fertilisation / mowing calf survival of wildebeest and foal survival of zebra increased,**
- **White rhinos are concentrating on the grazing lawns, like wildebeest but not zebra,**
- **Lions now also know where our experiments run, and we have abandoned the small plots,**
- **But first we measured the effects!**



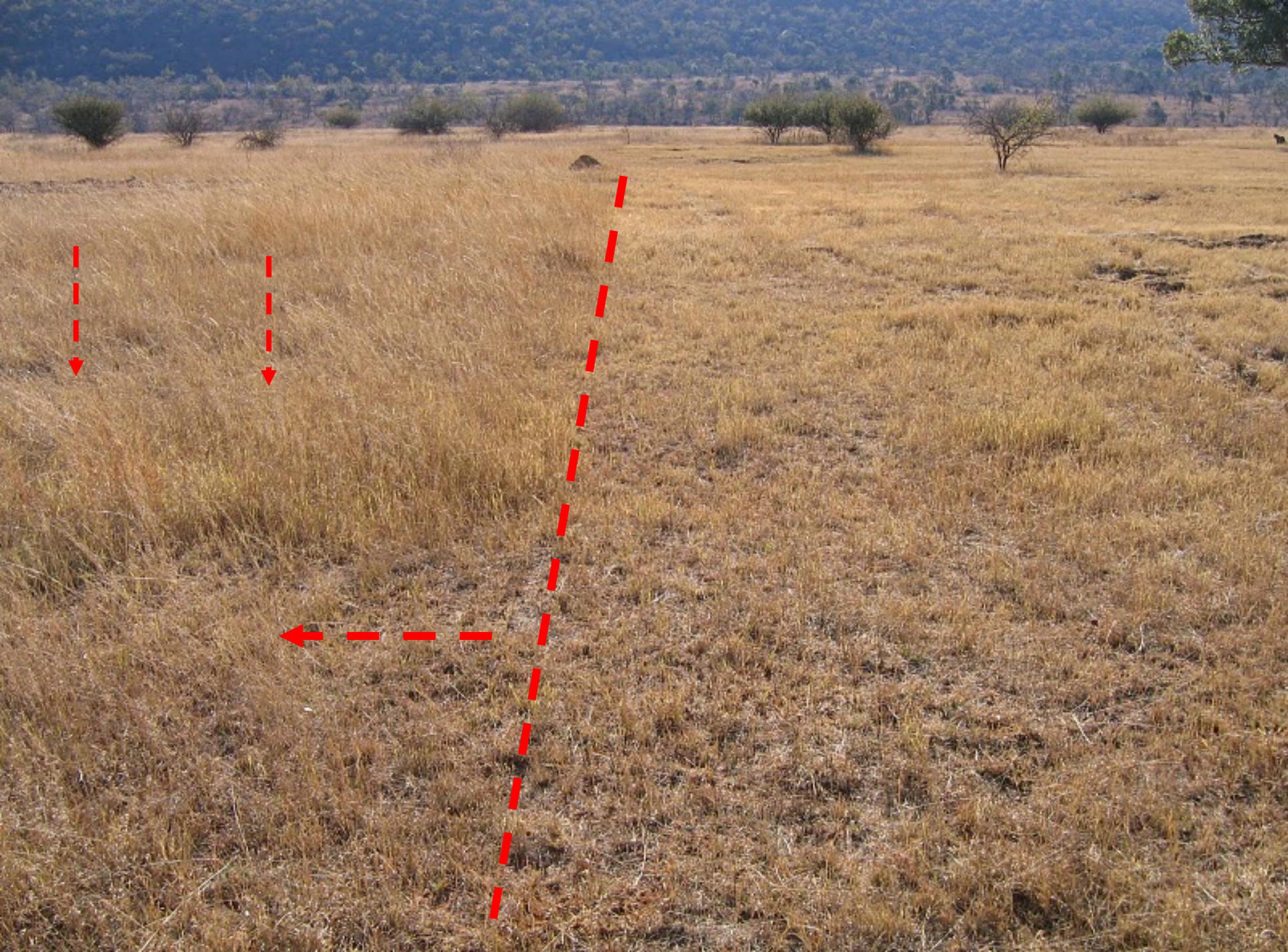
**Wendy's walk: Cynodon expands in the
100 x 100 m plots**



**Site 30: *Cynodon* establishes in the largest plots
(100 x 100 m) only**



**Sekwa Plains: *Cynodon*
expands from the
largest plots but in
some cases also from
50 x 50 m and even 25
x 25 m**





**Site 55: *Cynodon*
expands from the
largest plots (100 x
100 m)**

11 years in the experiment:

- In low herbivore density areas, even 3x mowing and fertilising does not remove the *Hyparrhenia*,
- In high herbivore density areas lawns are now expanding out of the mown and fertilised areas.
- Plots smaller than 25x25m are too small for *Cynodon* establishment or *Cynodon* expansion.
- *Cynodon* is good for many grazers, such as cattle !

A savanna landscape featuring tall, golden-brown grasses in the foreground and middle ground. In the background, there are several trees with dark trunks and green foliage. The scene is brightly lit, suggesting a sunny day. The overall atmosphere is that of a natural, open environment.

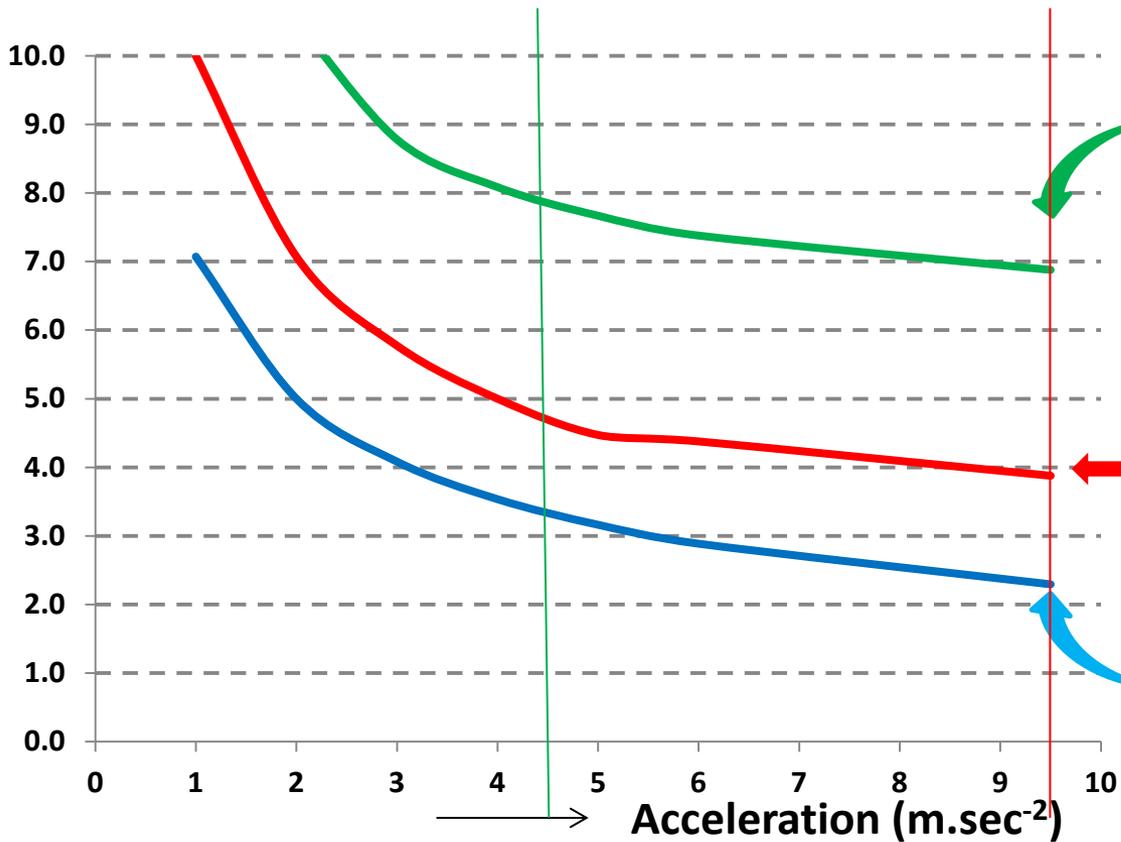
Of course, **you** see the lioness





Terminal speed maximised at 60 km.hr⁻¹

Time (sec)
needed



to reach
100 m

to reach
50 m

to reach
25 m

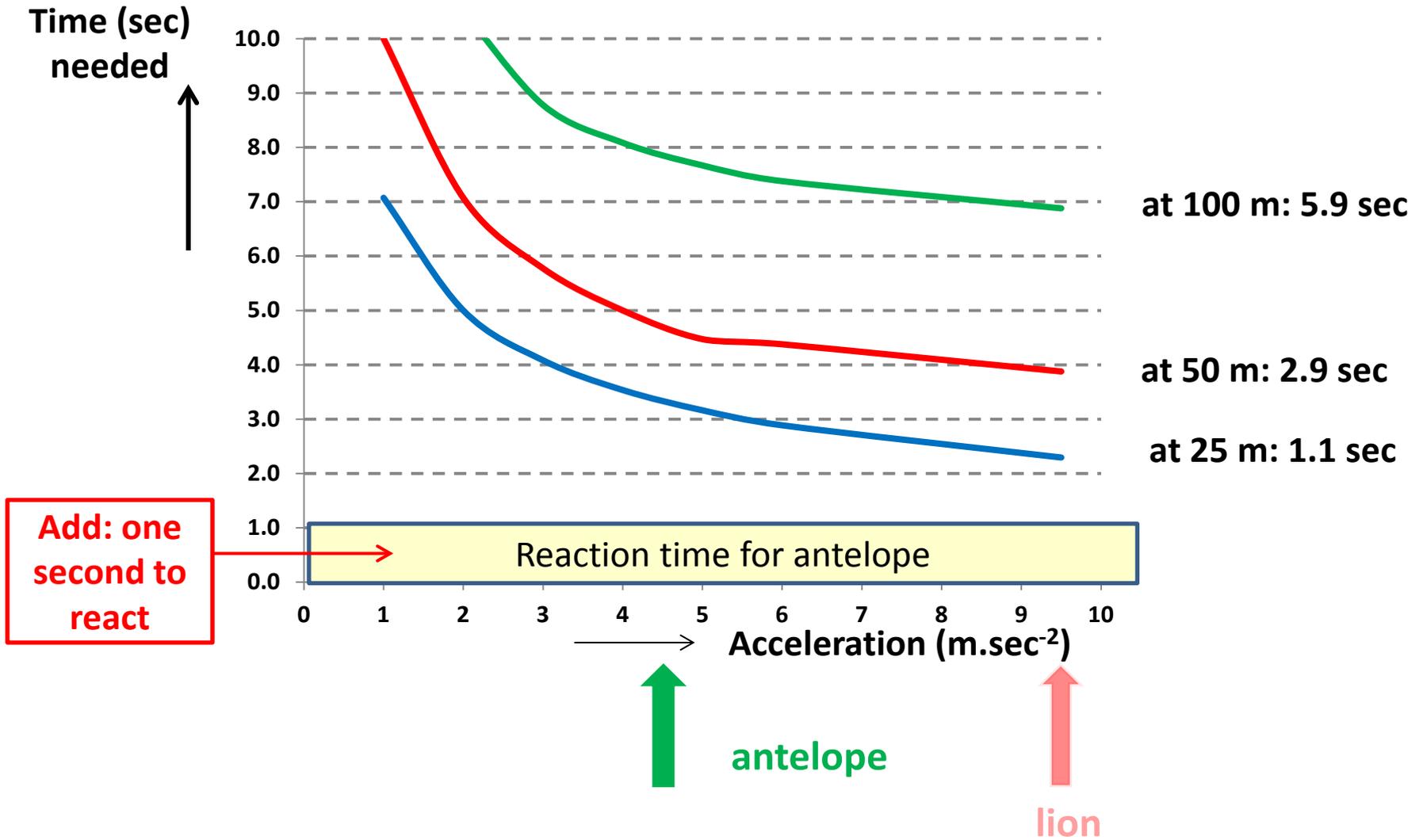
(human)

antelope

lion

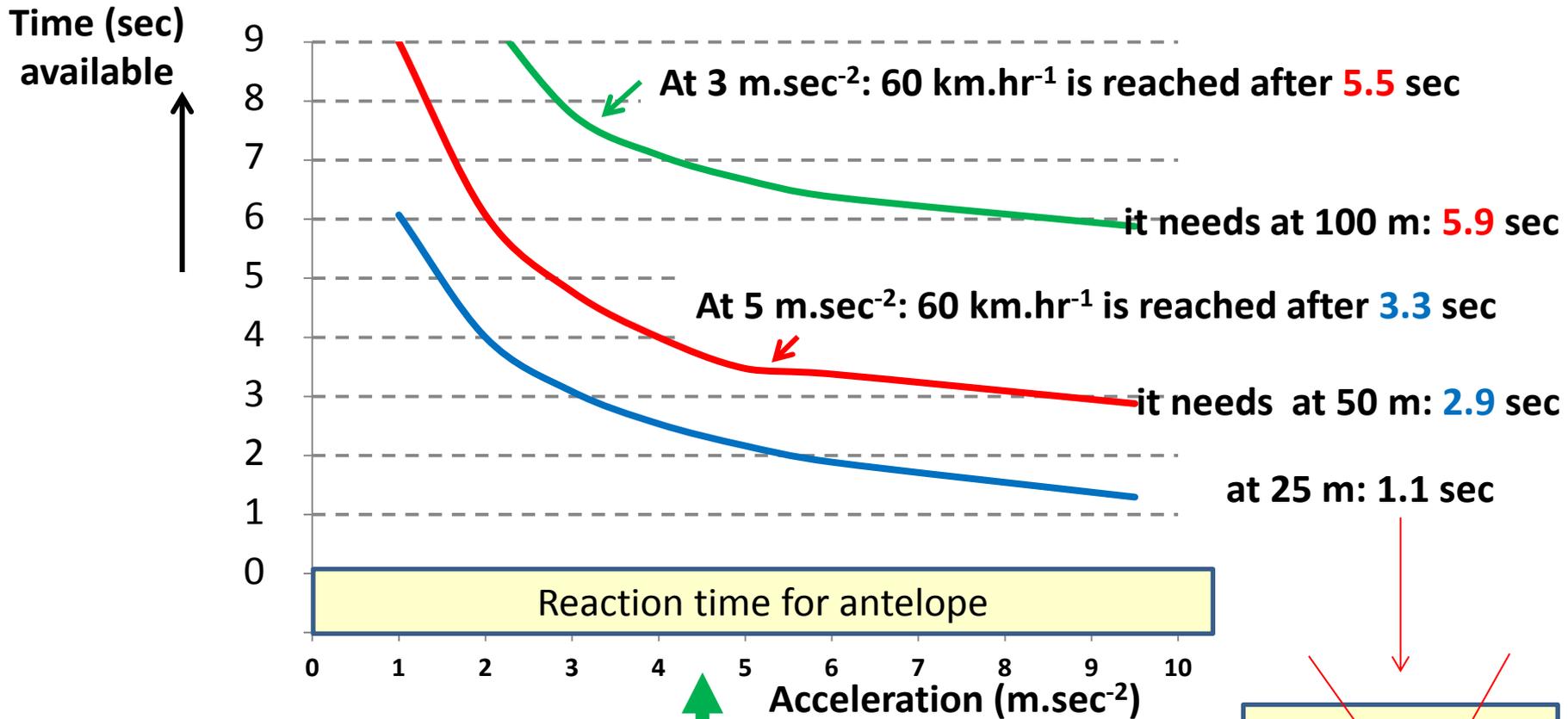
How much time does an antelope have to run away?

Antelopes have a terminal speed of 60 km.hr^{-1} too (like lions)



How much time would an antelope need to escape ?

with both lions and antelopes have the same terminal speed of 60 km.hr⁻¹



Acceleration of 3 m.sec⁻² even at 100 m is not enough (- 0.4 sec)

Acceleration of 5 m.sec⁻² at 50 m is enough (+ 0.4 sec)

antelope

Space shuttle = 29 m.sec⁻¹

From all our work in South Africa I concluded that:

1. Grazing lawns occur everywhere graminoids occur and where grazing takes place,
2. If grazing is excluded for a while the grass gets tall and the lawn disappears,
- 2b. (If populations of grazers are decimated e.g. through diseases I expect the same),
3. Grazing lawns are characterized by high biomass density (g.m^{-3})
4. Intake can be much higher on lawns
5. Quality of this intake is also much better for grazers on a lawn
6. Fires are detrimental to lawn formation [and perhaps maintenance]
7. Under wet conditions lawns do not form well
8. Lawn formation is not caused by differences in soil quality or edaphic processes (but if a lawn exists, trampling may change soil structure) but by grazing.
- 9. If lawns are too small, predators prevent their continued existence – their size must be minimally about 50 x 50 m (but not too large either – grazing must be concentrated to maintain them)**

Not only in Africa



Tiger: thus dangerous

Not only in Africa



**“stressed grass”
maintained by rhino**

Tiger: thus dangerous

Indian rhino: megaherbivore not susceptible to tiger predation





Situation different with deer



Tiger & Leopard

**Lawn: 25 m from
forest edge**

Fear zone: ungrazed



**tussock grasses
ungrazed**

**tussock grasses
grazed & outcompeted**



Conclusion:

predators (lions, tigers) through scale-dependent tri-trophic cascades modify the landscape



Predators matter !



**They help shape the vegetation –
even for cows in Africa**