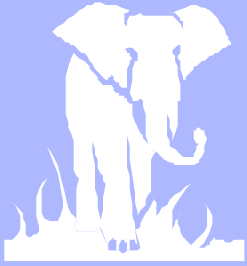


Kevin Duffy
Institute of Systems Science

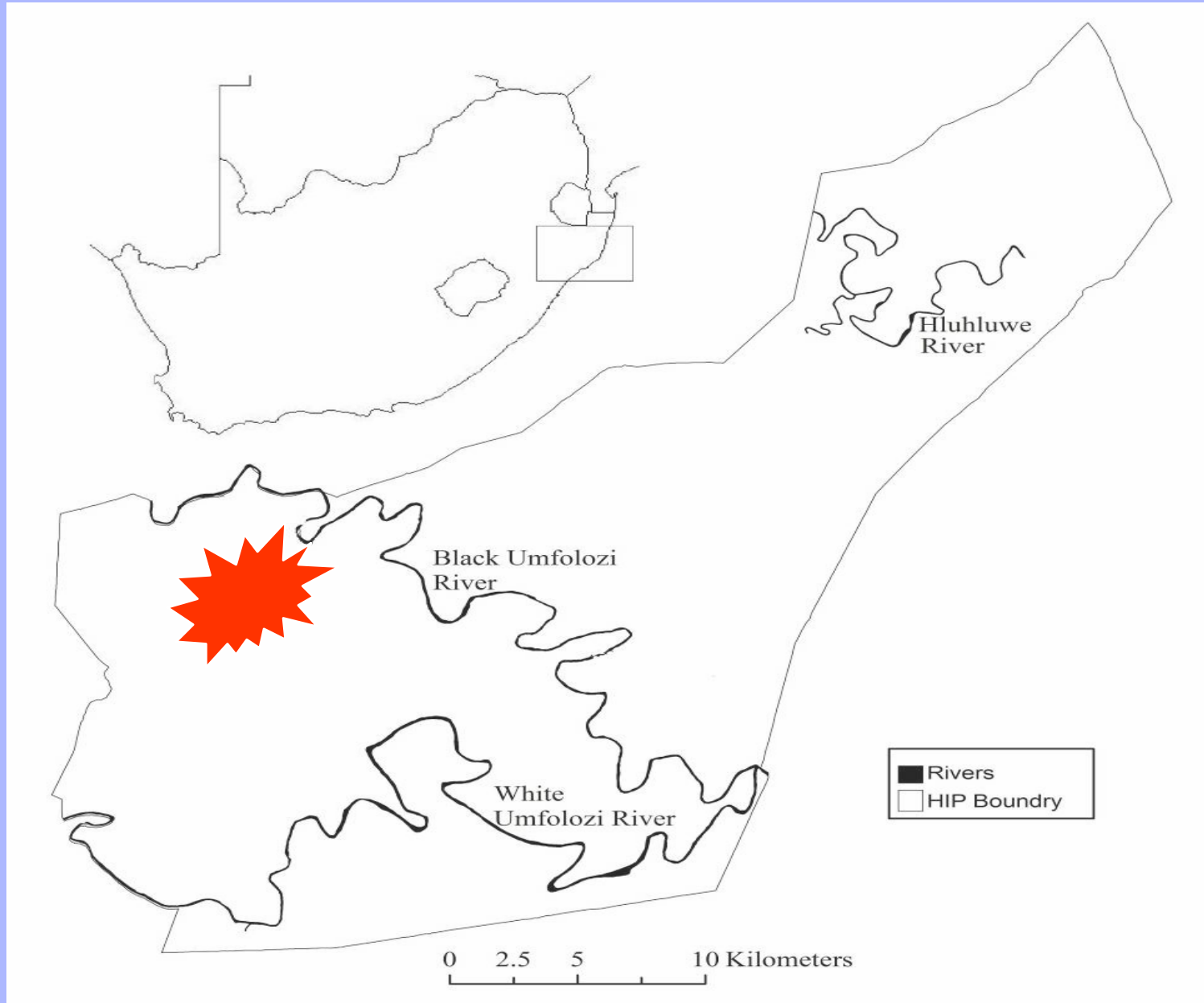


Bruce Page
School of Biological and Conservation
Sciences





Study area: HiP



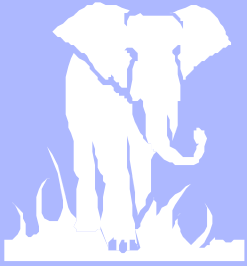


Elephant

All six of the reserve's elephant breeding herds were fitted with G.P.S./cell-phone collars and data collected over three years

Using the Fixed Kernel Density Estimator algorithm we calculated

- a) 50 percent kernels
- b) 95 percent kernels



Impala

GPS collars were fitted to

- 4 females in breeding herds
- 3 males in bachelor herds

all located in areas of

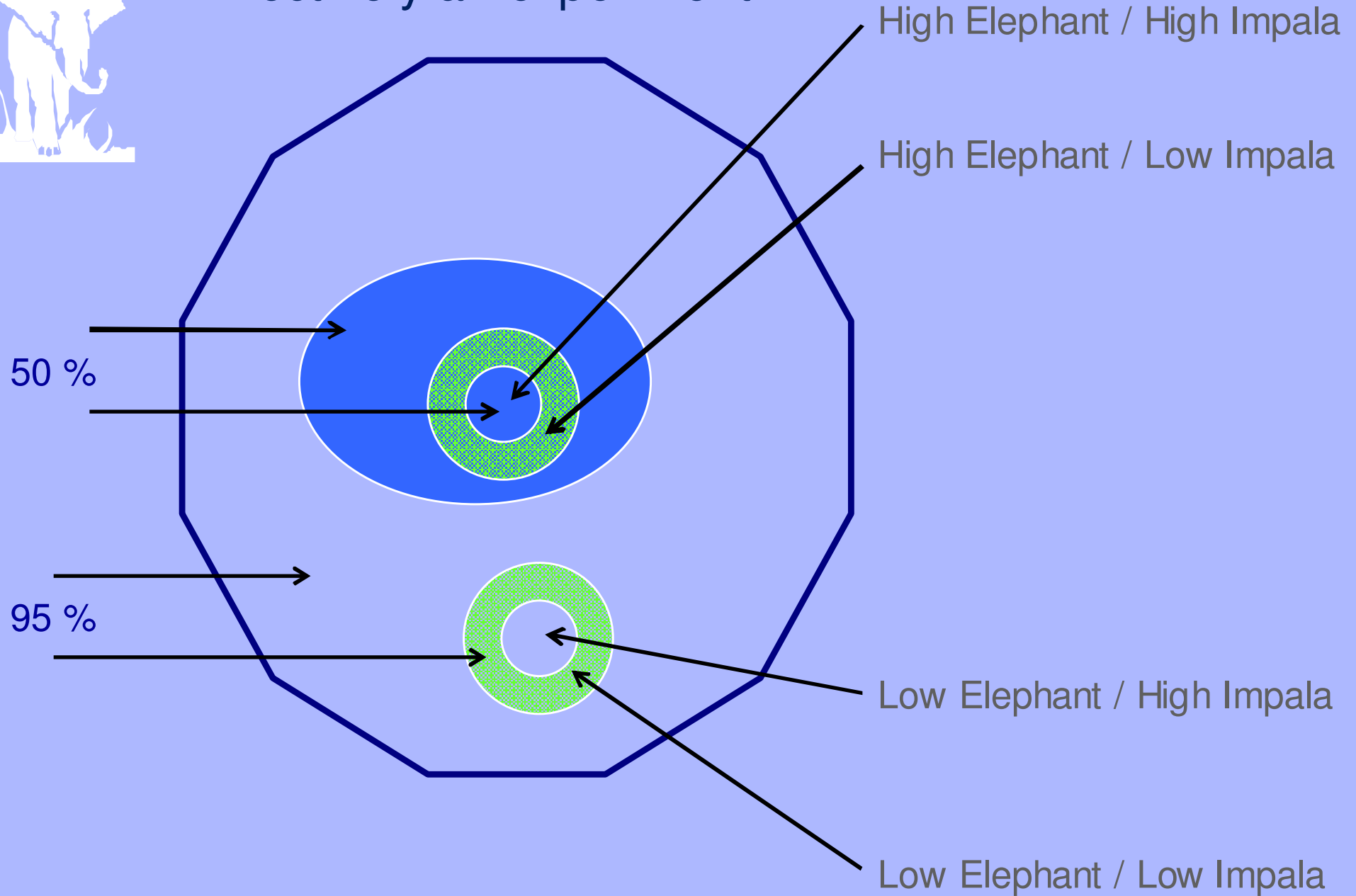
- high impala ecological density and
- areas of either high elephant density or low elephant density – but not both.

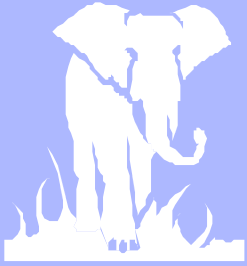
Calculated again:

- a)50 percent kernels
- b)95 percent kernels



Effectively an experiment:



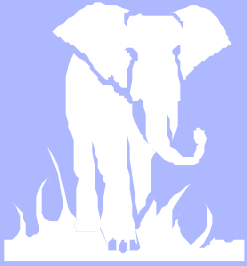


In each of the 4 treatments, 100 randomly located 1m x 1m quadrats were sampled for establishing recruits (< 0.5 m height).



The mean density per hectare and standard error of woody tree species < 0.5 m in each of the zones.

		High Impala	Low Impala
		Density (recruits per ha)	Density (recruits per ha)
		Standard Error ±	Standard Error ±
Open Woodland	High Elephant	2 600 ±645	6 100 ±764
	Low Elephant	7 300 ±501	8 775 ±589



Impala impact appear to act synergistically
with elephant impact

How does this affect system dynamics?



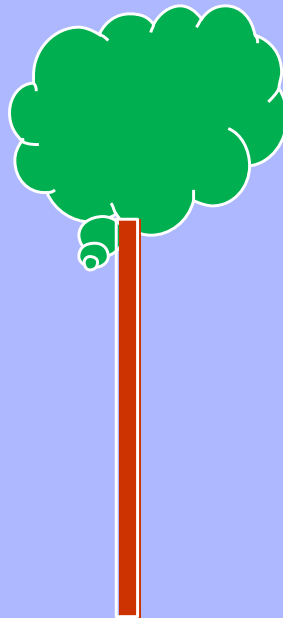
Spatial Model: 25 ha = 250 000 square meters
(impala core area)

A generalised Acacia
3 height classes :

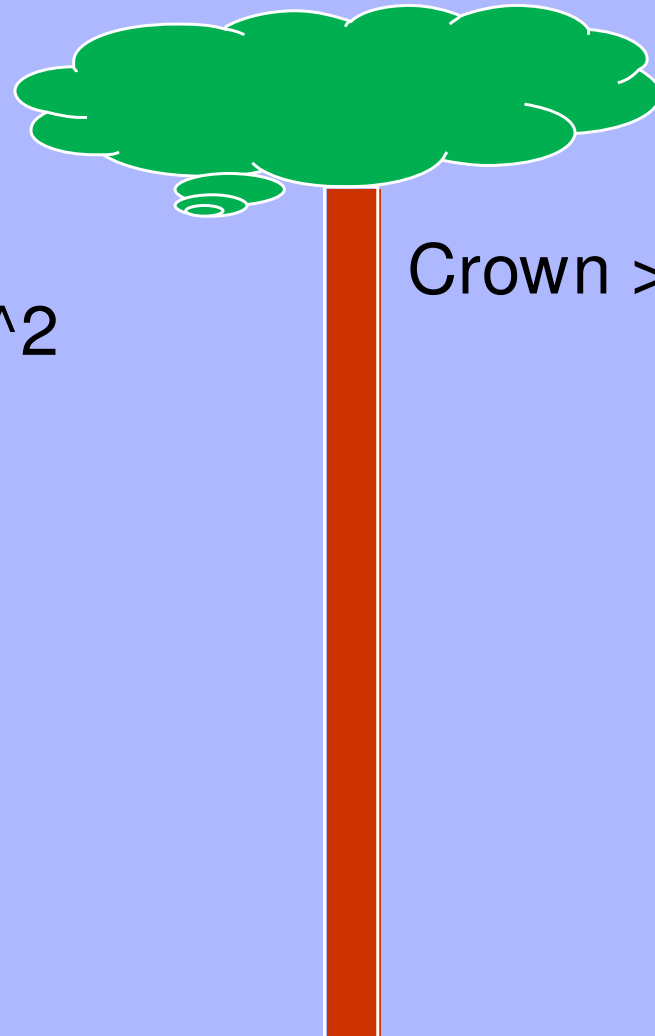
< 0.5m
< 3 years



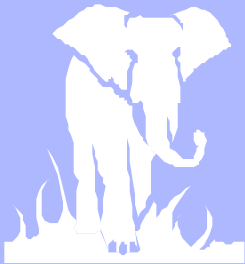
0.5 – 10m
3 – 20 years
Crown > 9m²



> 10m
> 20 years



Crown > 50m²



Seeds are produced by the largest size class (Pellew, 1983)

Recruitment: logistic-like density-dependence $(1 - n^3/K)$, where n^3 is the mature size class and $K=200$ trees/ha.

At carrying capacity each tree produces a recruit, 1 per adults (this is generally known to be ~ 2 per adults).

An added probability of recruitment from outside the model area is fixed at 0.1

Thus, for a vacant patch the probability of recruitment is 0.1 - 1 depending on the density of mature trees.

Pellew, R. A. P. 1983. The impacts of elephant, giraffe and fire upon the *Acacia-Tortilis* woodlands of the Serengeti. *African Journal of Ecology* **21:41-74**.



Recruits and small trees ($< 10\text{m}$): mortality from general browsing and other causes is set at 0.25 (estimated for HiP from Balfour (2005)).

Mature trees die at age 60 years.

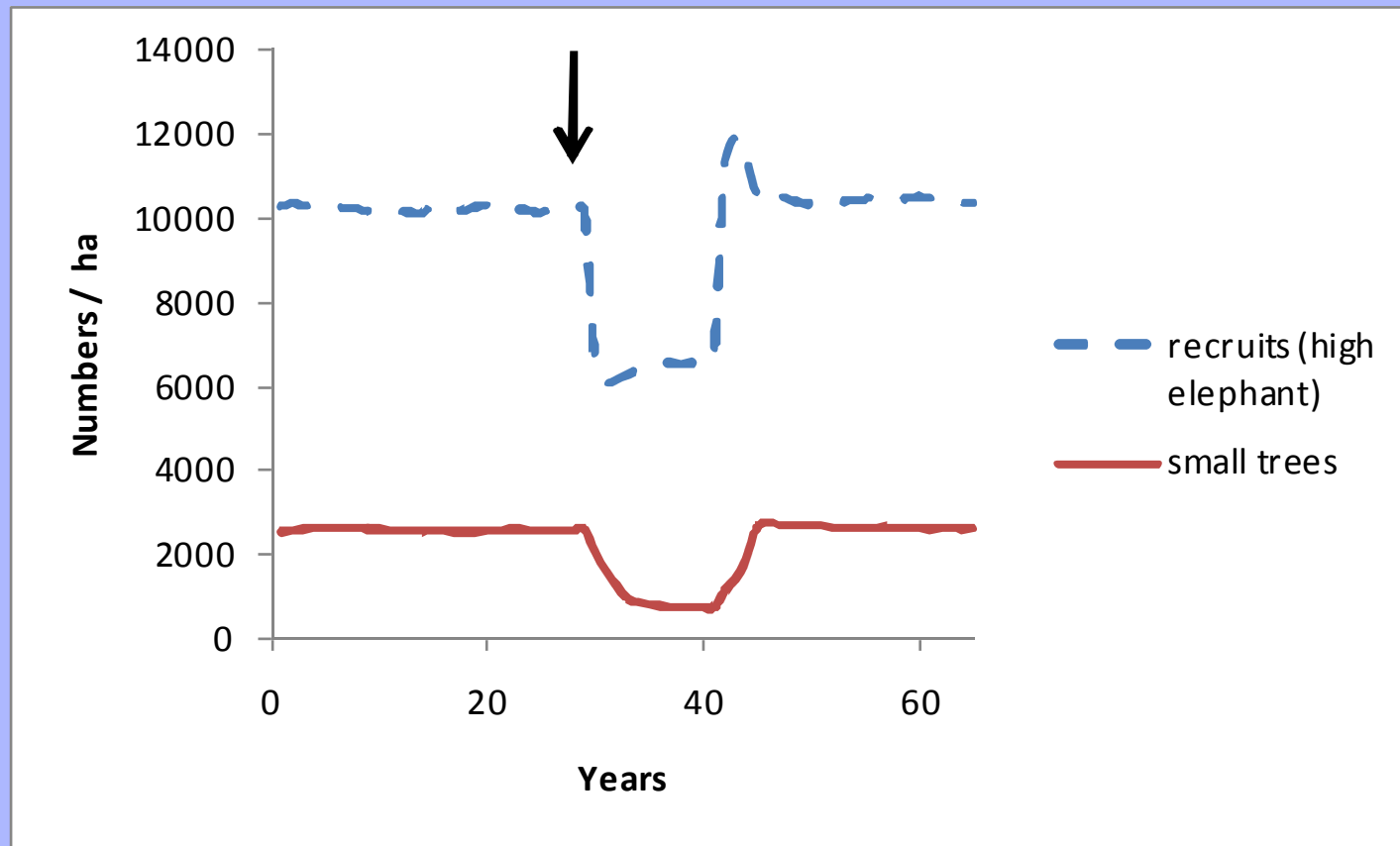
Recruits are browsed by impala when present by an extra probability of 0.25 (our data)

Small trees are browsed by elephant when present by an extra probability of 0.1 (Pellew, 1983)

Balfour, D. A. P. 2005. Acacia demography, fire and elephants in a South African savanna . *PhD Thesis*, University of Cape Town.

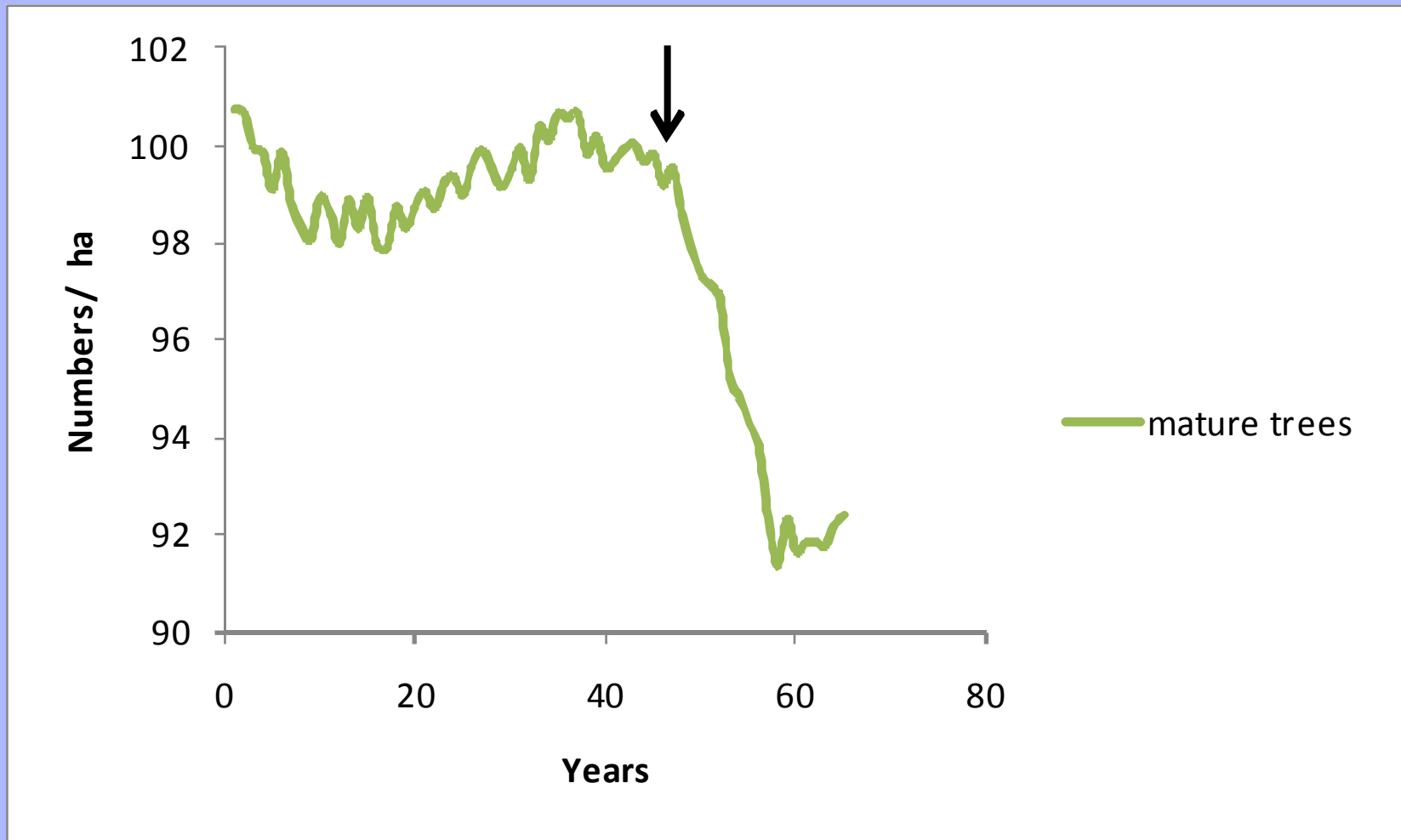


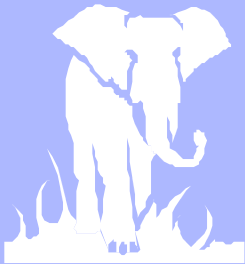
Model results: Impala in / out of core area



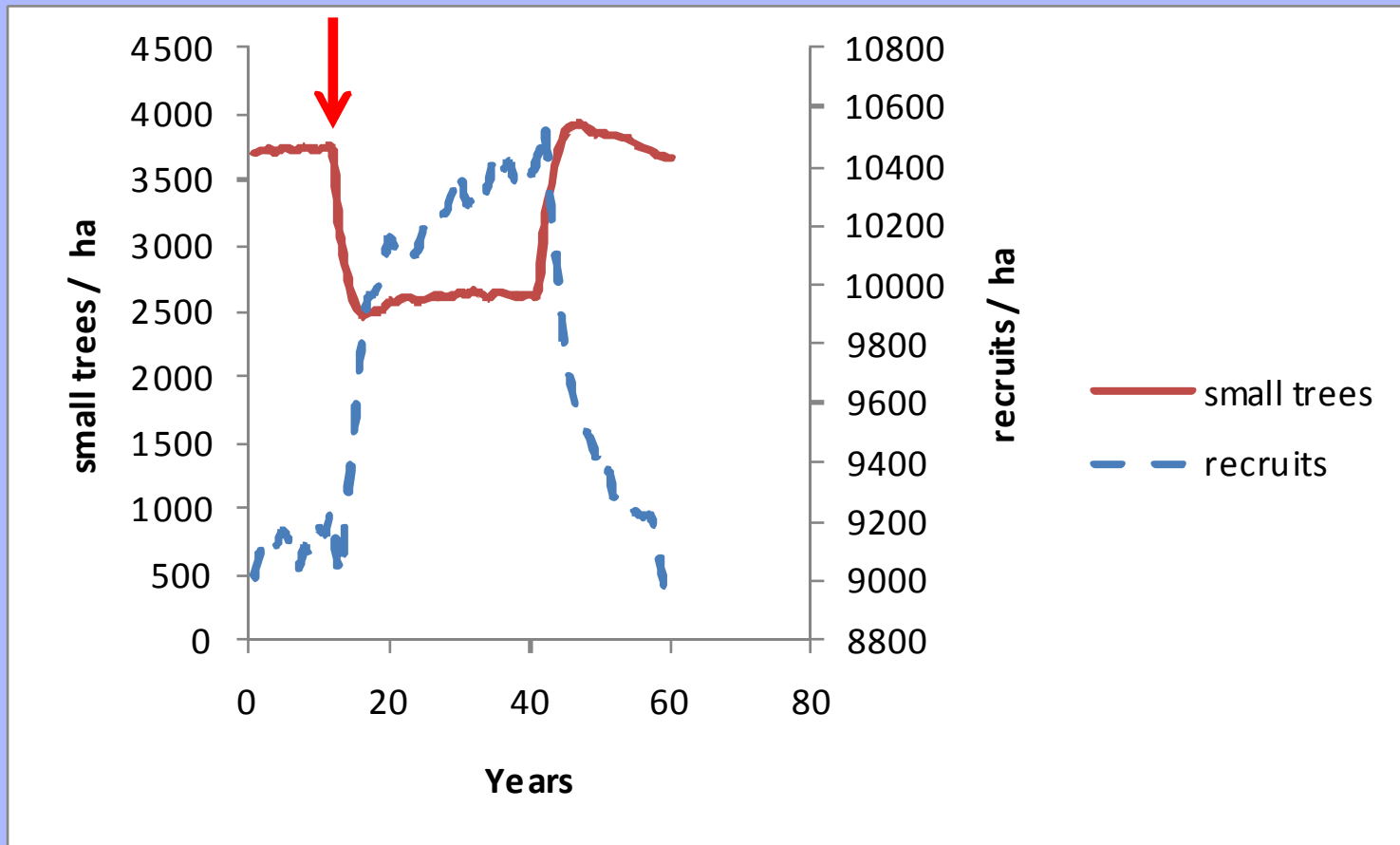


Model results:



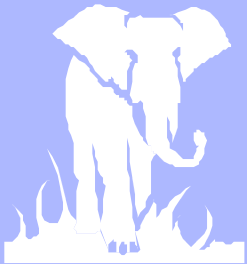


Model results: effect on recruits for elephant high impact without impala

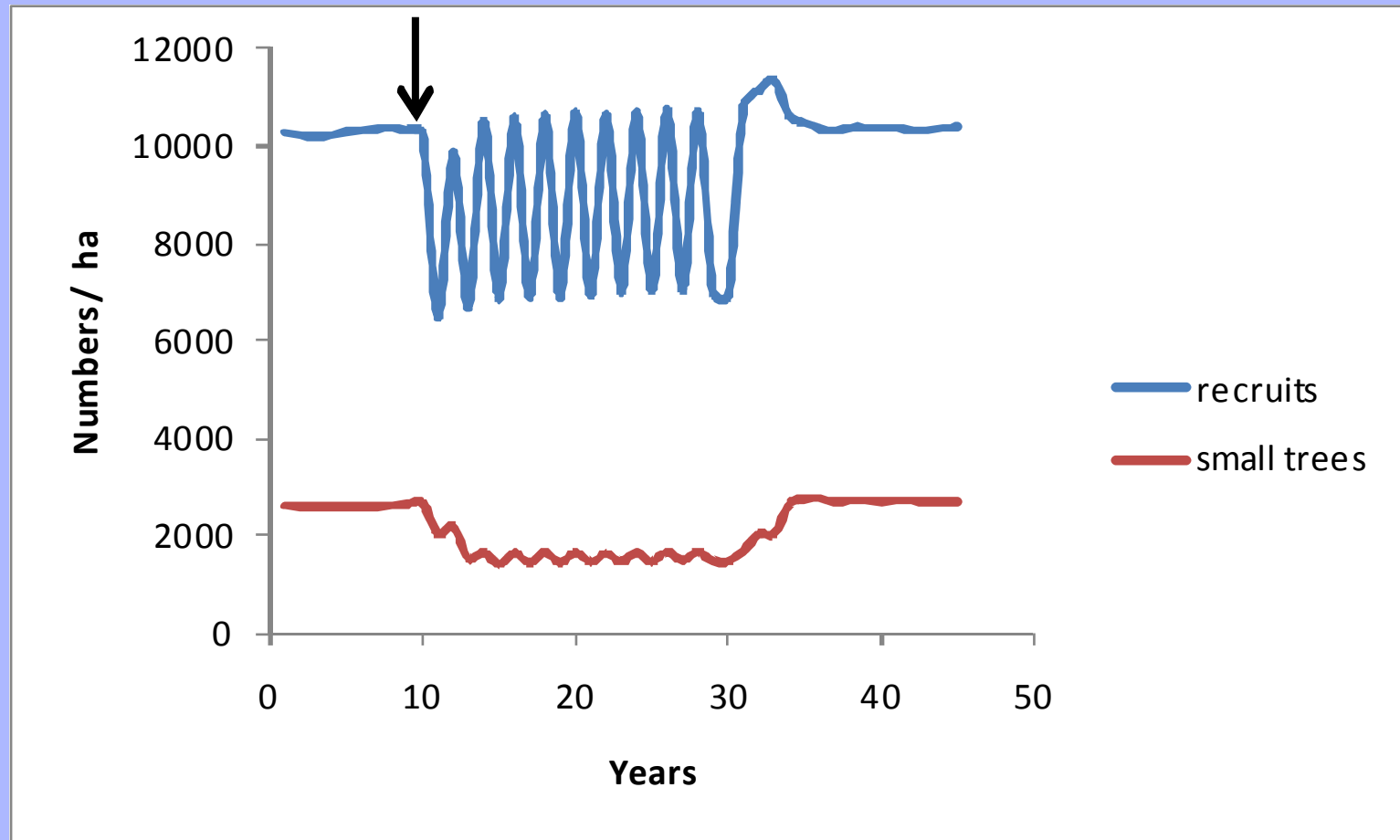




What is the effect of the duration of
core persistence?



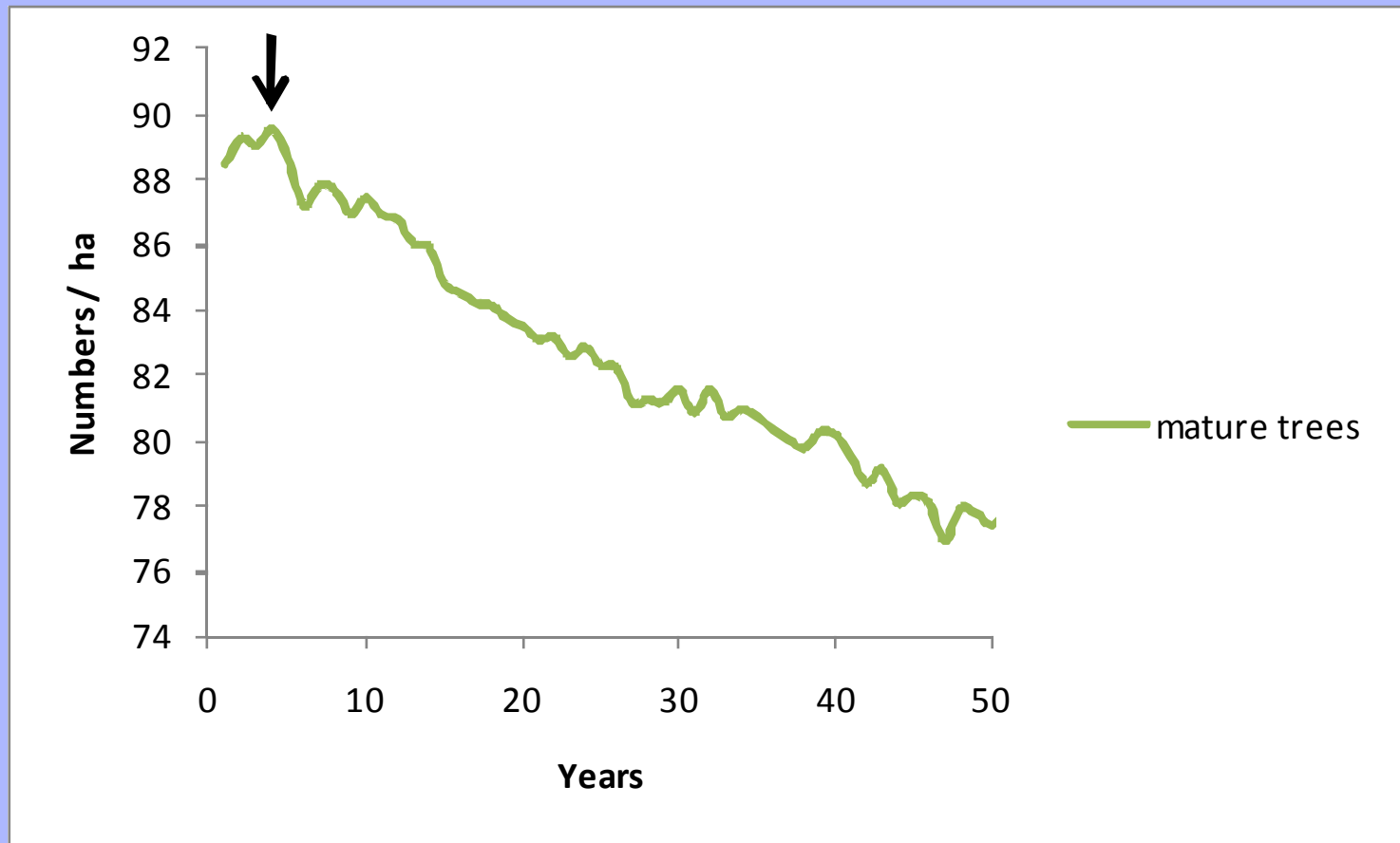
Model results: impala switching annually





Model results:

from alternating impala in and out





Conclusions:

1. Impala can affect local tree recruitment rapidly.

2. Irrespective of the duration of core area persistence, there is an impact.

3. Thus impala are one of the drivers of spatio-temporal patterning.

4. Elephants influence recruits positively (reducing shading) and negatively (feeding).



Acknowledgments

Christopher O'kane

Tarik Bodasing

Dane Paijmans





THANKS

