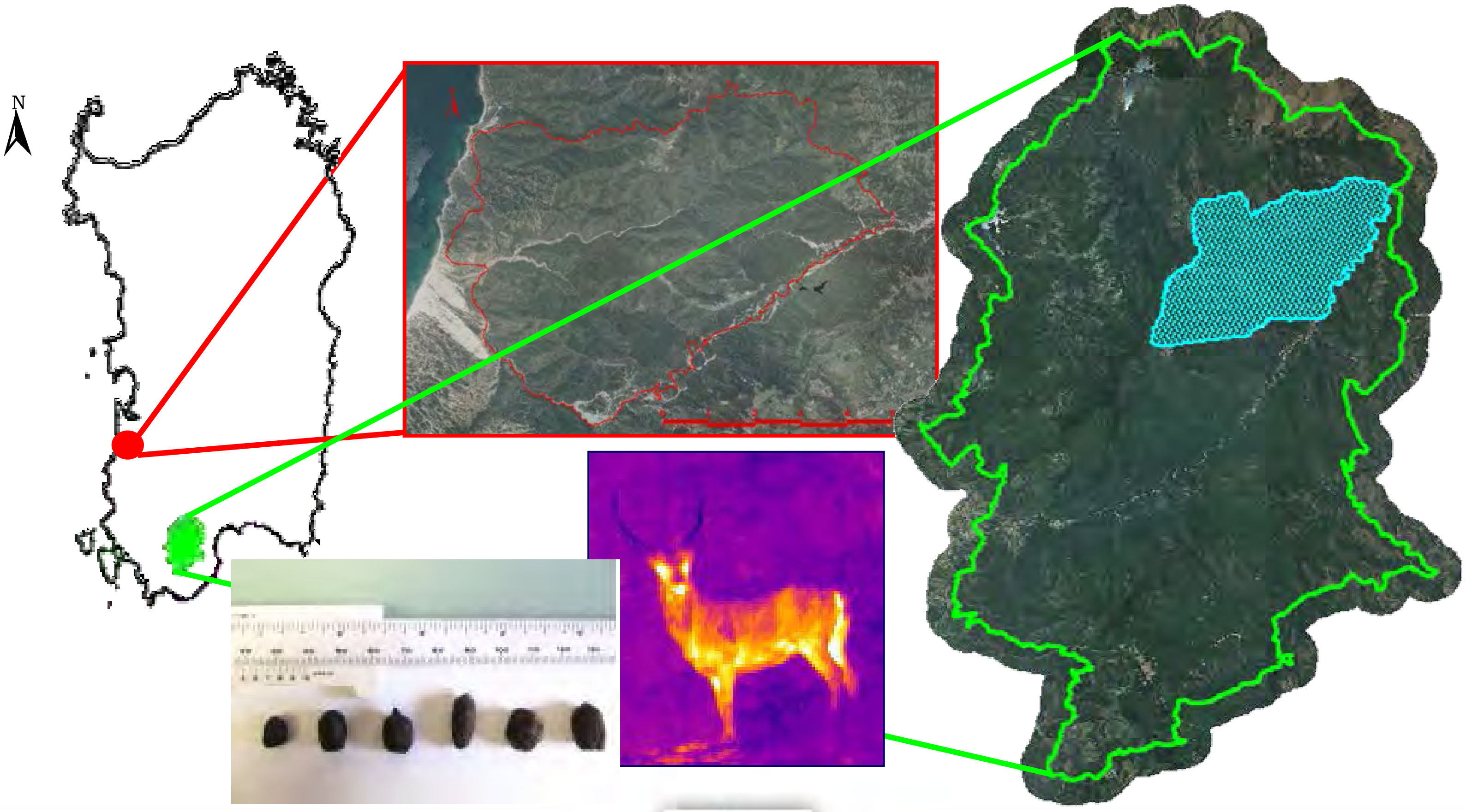
# Assessment of Red deer populations across Sardinia



# Why using Line Transect Sampling? (1)

- **Reliable population estimates => appropriate strategies for (i) effective conservation & (ii) correct management of overabundant ones.**

- **Elusive species, living in dense habitat & inhomogeneous distributed => standard sampling methods are inefficient**

- **Line transect sampling (LTS) is suited because (i) takes into account variables influencing the detectability (ii) estimates the probability of detection to adjust counts collected.**

- **LTS for elusive species can be applied on counts of signs or counts of animals at night, using thermal imagery.**

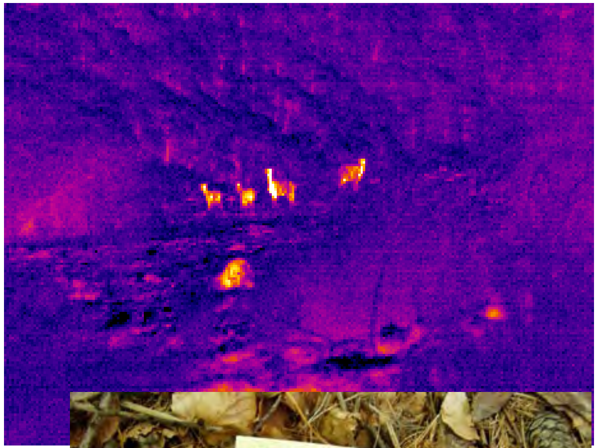
- **LTS is widely used for direct and indirect surveys of many wild species and the reliability of results given has been proved in several papers (Focardi et al, 2005; Acevedo et al, 2008; Franzetti et al, 2011; Chauvenet et al, 2017)**

# Why using Line Transect Sampling? (2)

- **Estimation of detection probability => to adjust counts**
- **Robust to heterogeneity in detectability**

**(survey effort, group size, number of group detected)**

- **Surveying dense habitats**
- **Surveying large areas**
- **Free software & statistical assistance**



**Thermal imaging**

- Improves detection probability
- Reduces flushing probability

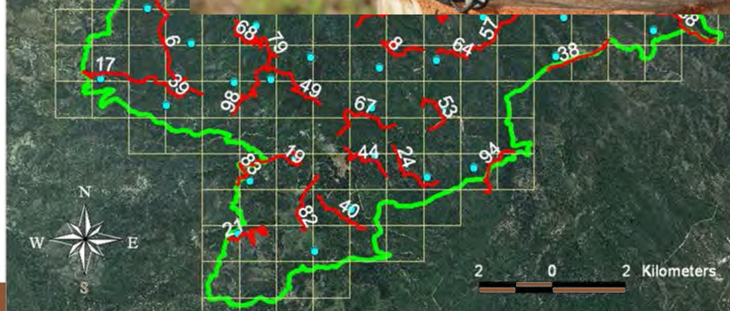

**Pellet count**

- flushing probability set to 0
- Instruments costs set near 0

# Methods / thermal imaging (1)

OASI DI COSTA VERDE (75 km$^2$)

# imaging (2)

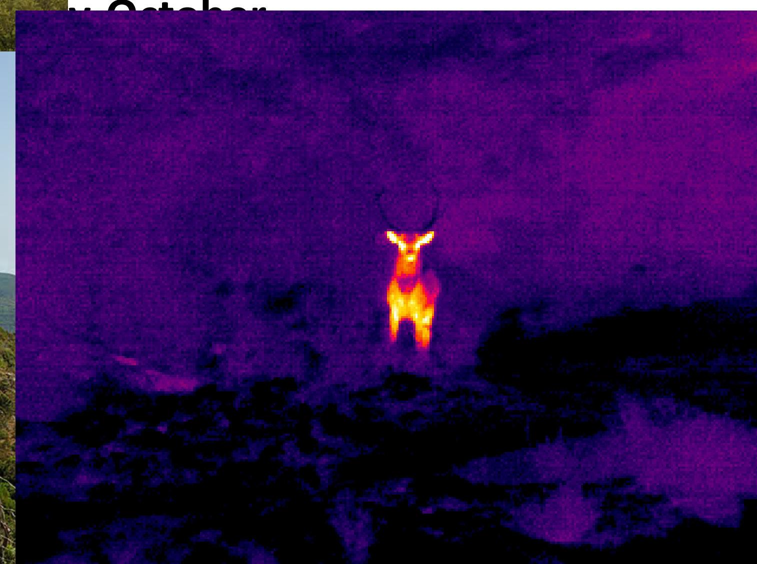




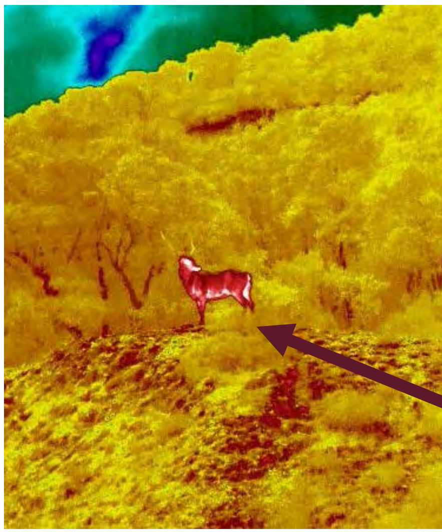
ARCOSU (300 km$^2$)

nd fallow deer are also present

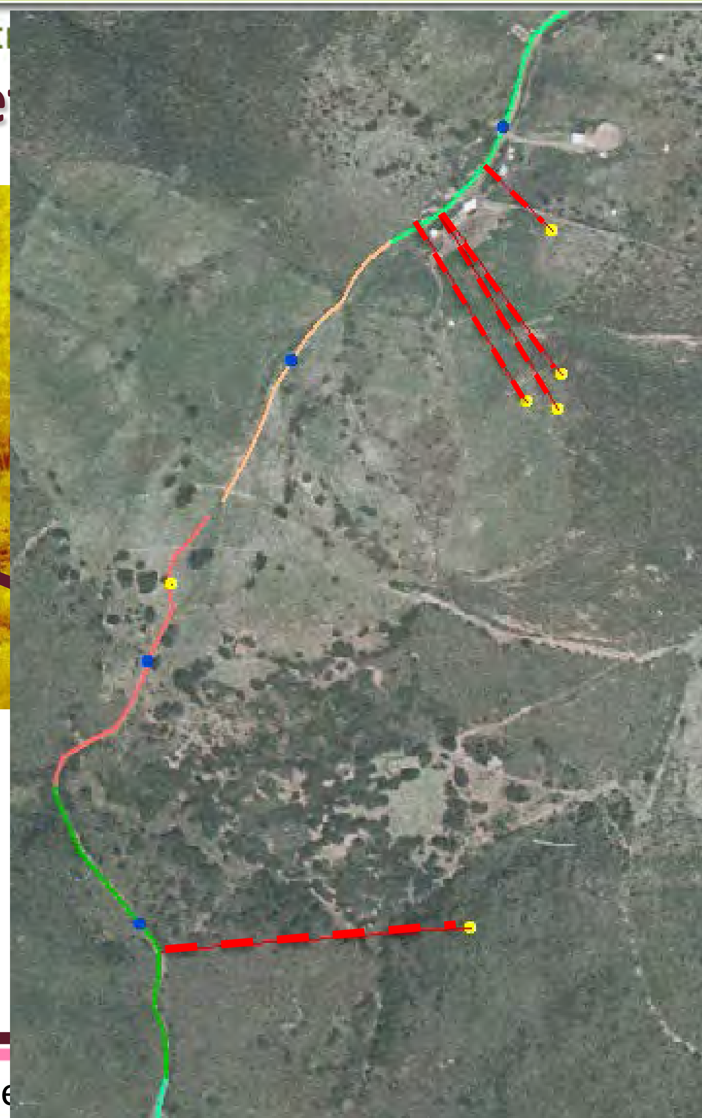
3 survey replicates)



# Me… (3)



(deer location: 39,558N;8,562 E plotted via GIS)



## Perpendicular distances

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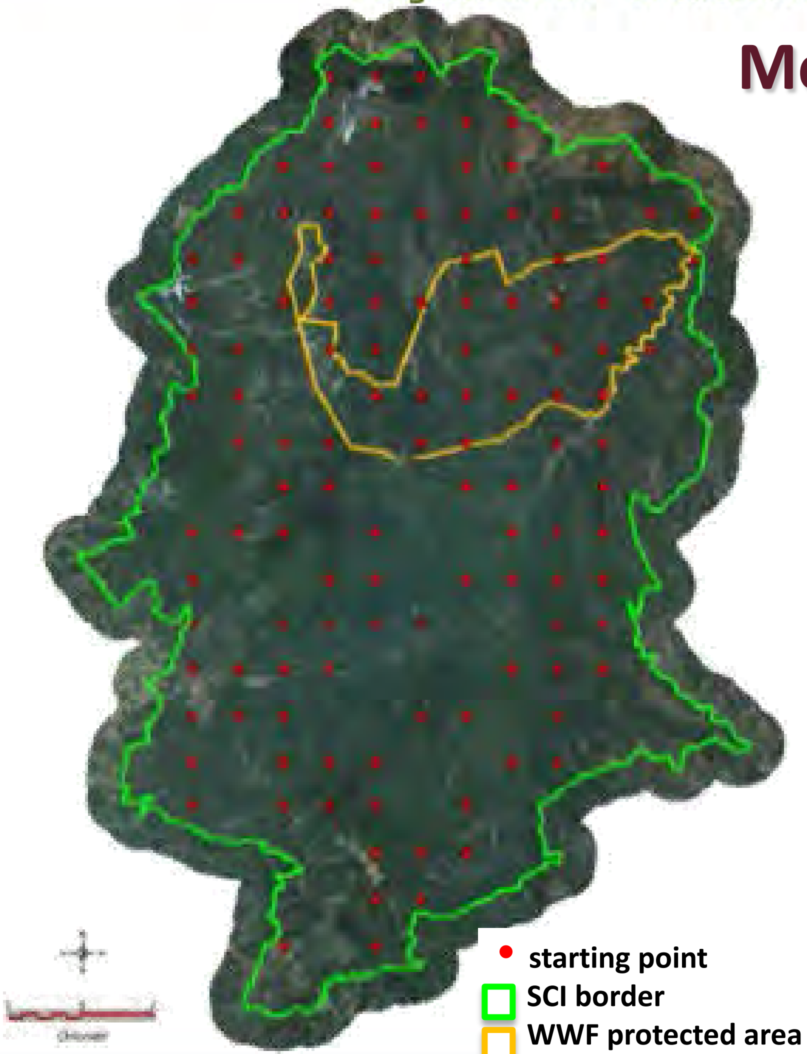
(observer location: 39,557N;8,570E)

# Methods / pellet counts (1)




**SCI MONTE ARCOSU (300 km$^2$)**

**2012-2014 (4 survey replicates: Autumn-Spring)**

**TOT effort: 32-33 km**

**Trnsects lenght: 0.2-0.3 km**

**Survey lenght: 23-30 days**

**2 teams of 2 operators each**

**Transect covered following the maximum slope, from down to top, unrolling a ribbon to define the transect line**

**perpendicular distances from transect line were measured with a graduated stick (2 m)**

**20-46 pellet groups/km**

# Methods / pellet counts (2)

## RECOGNITION OF PELLETS

**70 pellet groups of red deer**

**67 pellet groups of fallow deer**

- **differences between species were analyzed**
- **operators were subjected to recognition tests**

# Methods / pellet counts (3)

## DECAY RATE ESTIMATION (Retrospective Method)

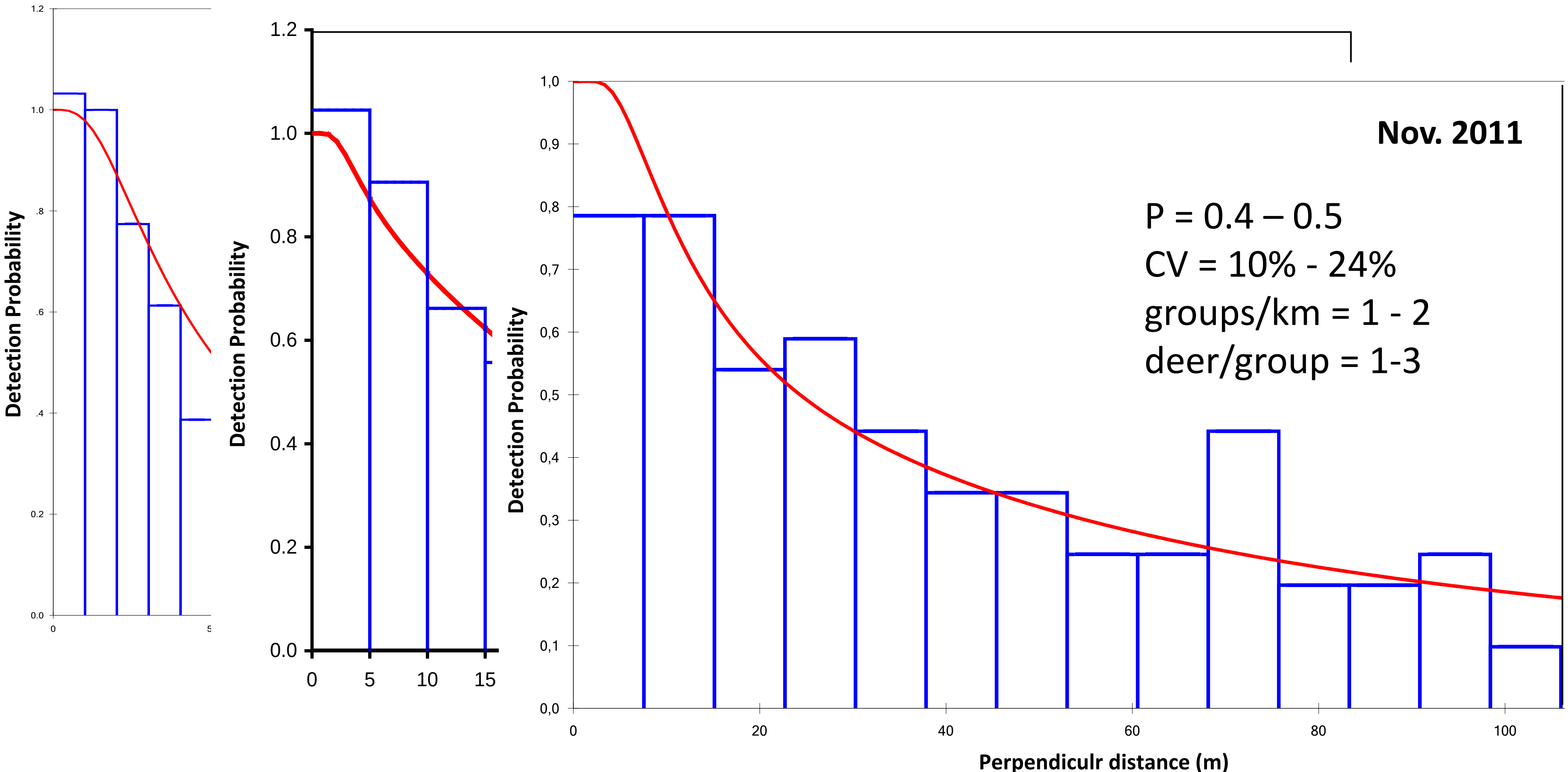


Autumn decay rate: 122± 9 SE days
Spring decay rate: 71± 2 SE days

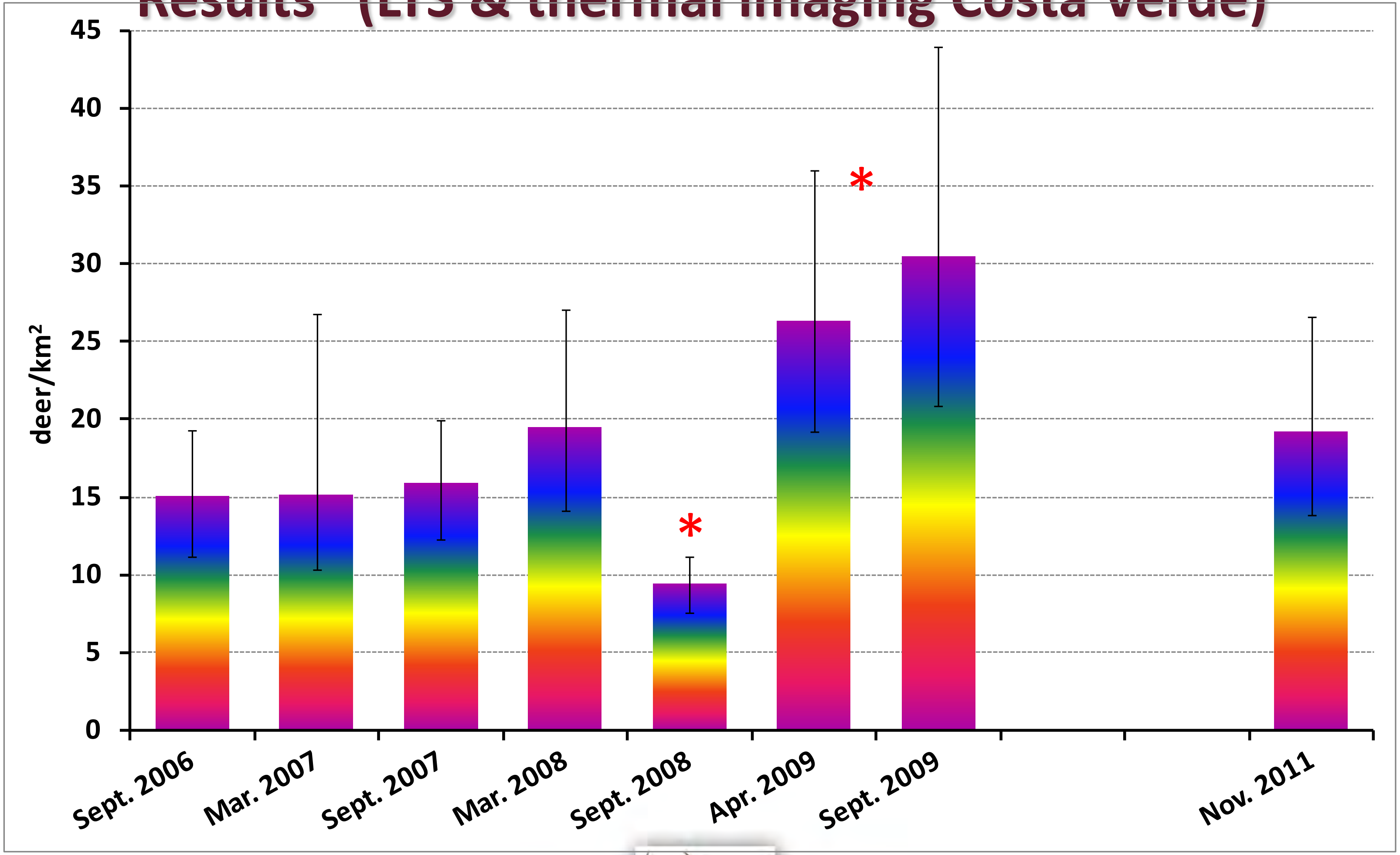
- 1 pellet group/site
- 25 site distributed proportionally to the extent of different habitat types
- presence and final disappearance of pellet groups are recorded monthly, during the 3-6 month before the planned survey
- during each visit new pellet are laid
- decay probability estimated as a function of time, using a logistic regression.

**DEFECATION RATE** 23,4± 6.5 SE pellet group/deer/day
(Mitchell & McCowan 1984; Mitchell et al.1983)

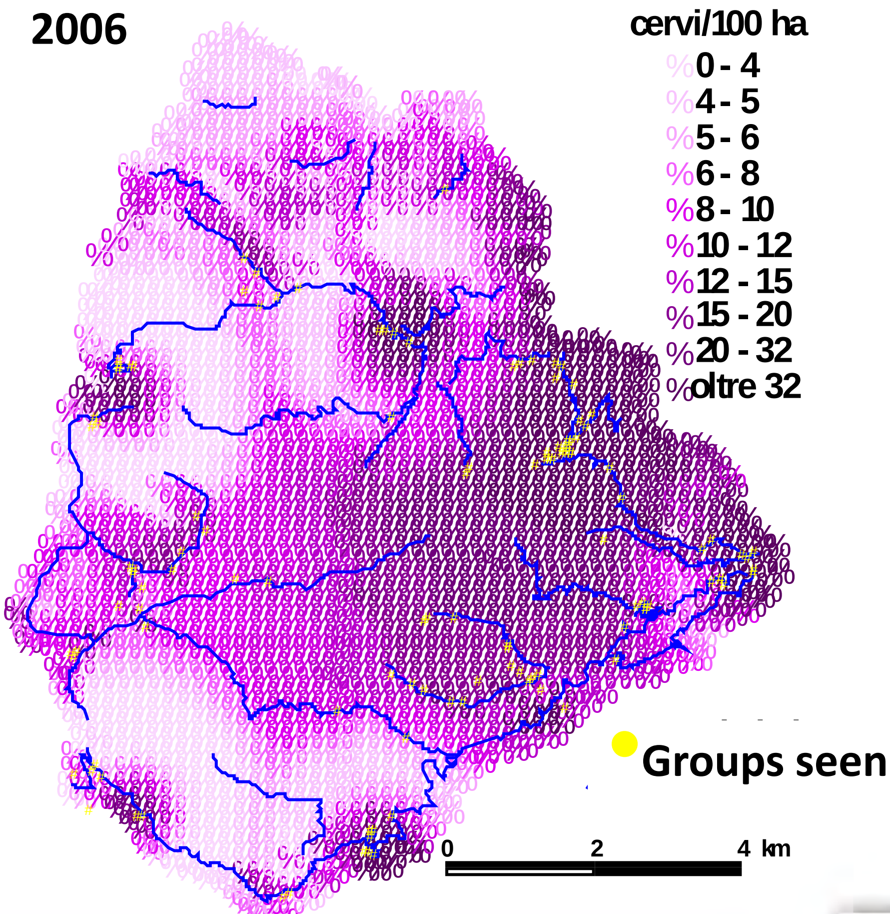
# Results (thermal imaging Costa Verde)

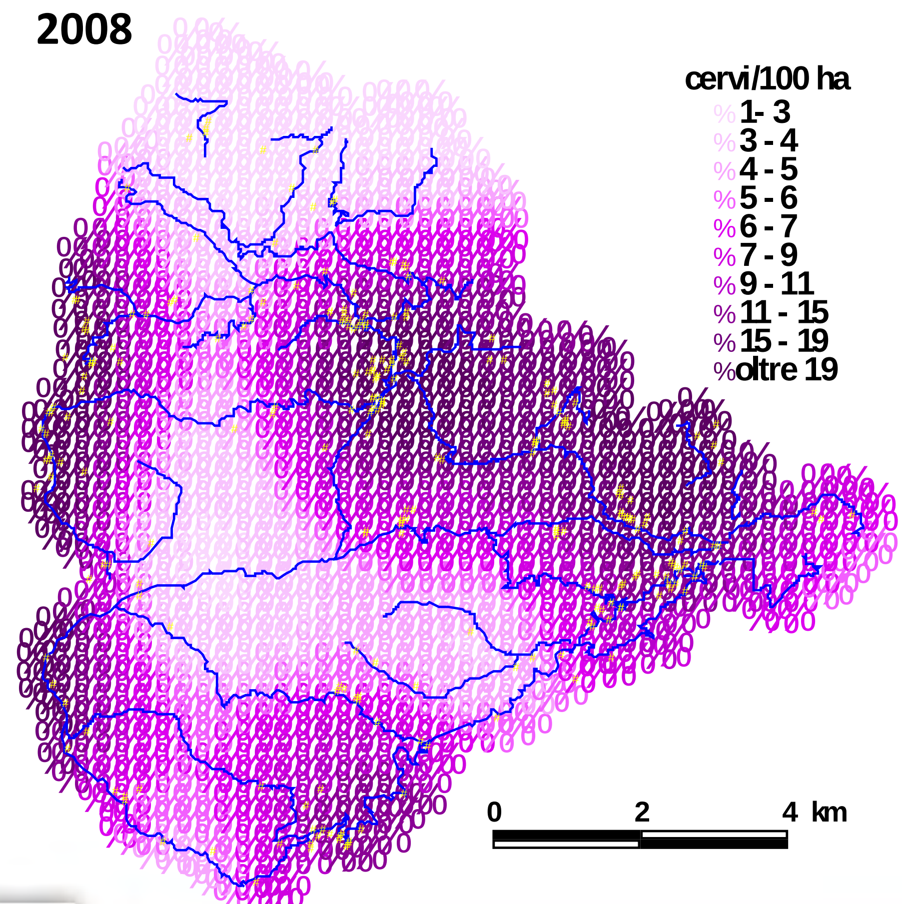


# Results (LTS & thermal imaging Costa Verde)



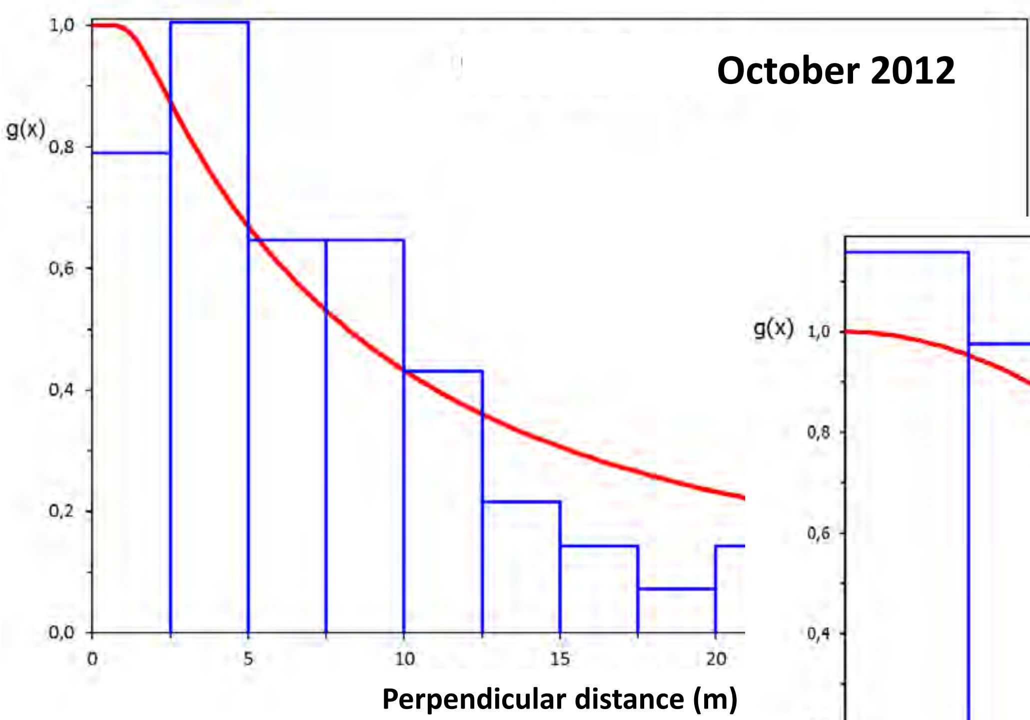
# Results (LTS & thermal imaging Costa Verde)

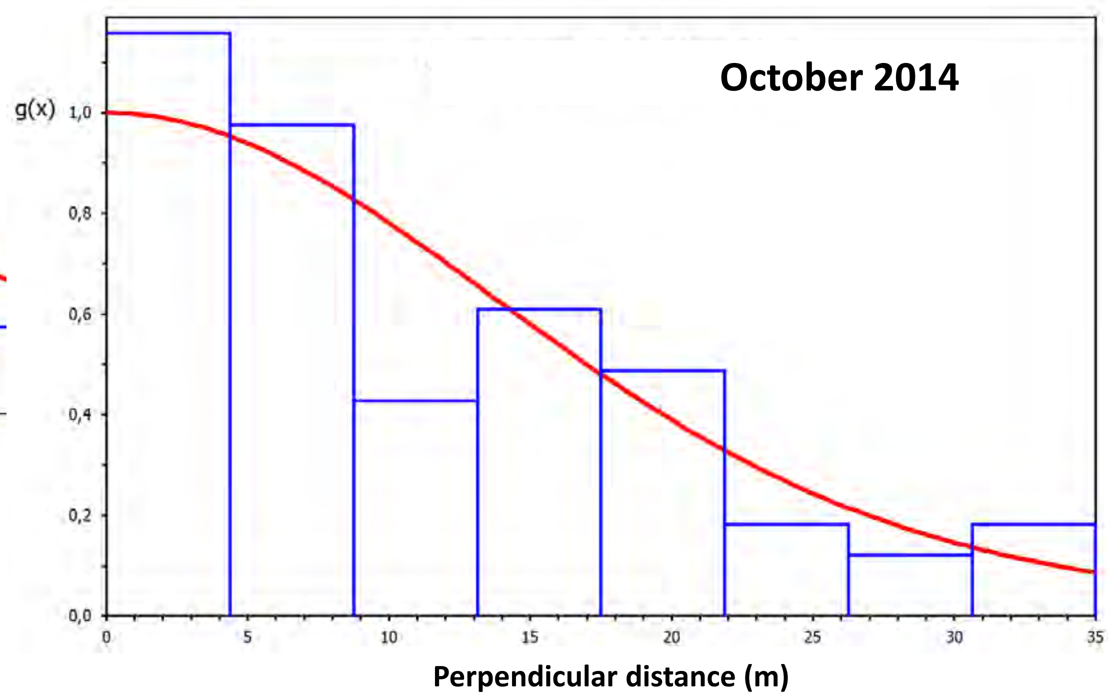


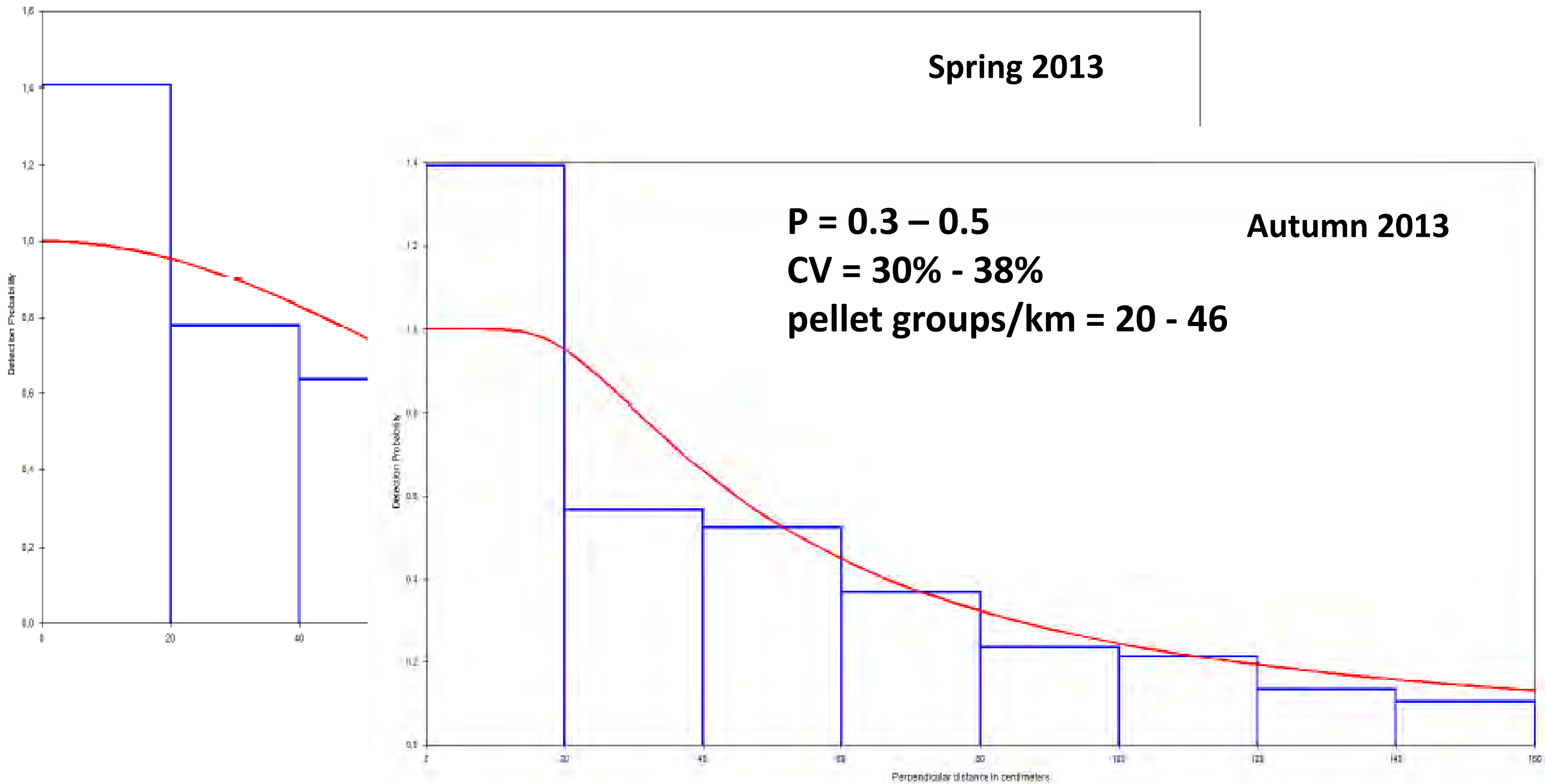
# Results (LTS & thermal imaging Monte Arcosu)

P = 0.4 – 0.5
CV = 19% - 21%
groups/km = 0.3 - 0.5
deer/group = 1.5

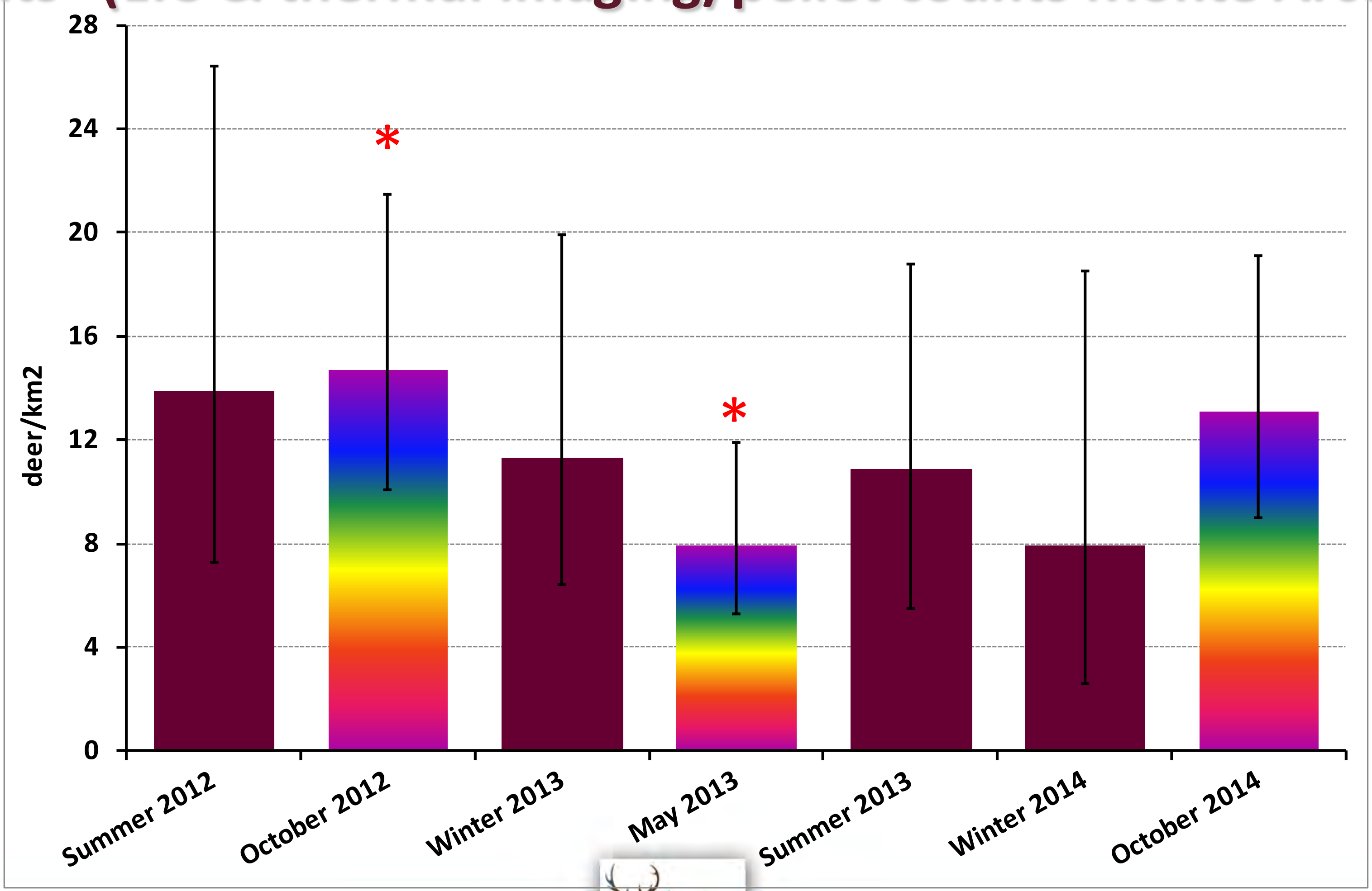


# Results (LTS & Pellet counts Monte Arcosu)



# Results (LTS & thermal imaging/pellet counts Monte Arcosu)



# Discussion

- **LTS provides estimates characterized by a good average precision**
  - ✓ **despite species elusiveness and low visibility characterizing the study areas**
  - ✓ **provided that trained observers are involved**
- **the opportunity of obtaining maps of density gradients may support a more rational management of the impacts of the species on the habitat**
- **Direct LTS provides slightly better precision than Indirect one**
- **precision of the density in indirect surveys is indeed influenced by the estimation of the decay and the defecation rates (more sources of variation than with direct survey).**
- **LTS & thermal imaging takes pictures of the population (in specific areas and times)**
- **LTS & pellet counts gives a population estimation averaged among several month, referring to a certain period prior to the survey**
- **Sampling costs are mainly due to the work of trained personnel (new thermal imagery ~3-5,000€; pellet counts require huge amount of work dedicated to the estimation of decay & defecation rates)**

# Special thanks to

## D.R.E.A.M. Italia
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