

# Exploring the potential of vegetation corridors in forest fire hazard reduction at the landscape level: examples from Portugal

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# Outline

- Land cover and fire behavior
- Edges and fire behavior
- The case of holm oak (*Q. rotundifolia*) in Portugal
  - Evidences of fire resistance
  - Test of hypothesis
    - Holm oak woodlands are fire resistant
  - Potential for holm oak fire prevention corridor and network establishment
    - Actual distribution and configuration of holm oak remnants

# Land cover and fire behavior

- Fire behaves differently in different land cover classes
  - Flammability
    - Fuel load, size, structure (horizontal and vertical), moisture, etc.
    - Fuel models
  - Basic knowledge for preventive silviculture measures
  - Basic knowledge for fire fighting strategies

# Edges and fire behavior

- Fire edges, associated with LULC edges
- Edges as barriers for fire spread
  - Discontinuity in fuel attributes
  - Other factors associated with distribution of vegetation types (water, topography)
- Effects at the landscape level: reduction in total and mean burned area

# The case of holm oak woodlands

- Persistence of holm oak (*Quercus rotundifolia*) woodlands in areas of frequent fires
- Resistance?
  - Evidence
    - Observed fire extinction in woodlands edges
    - Spatial relations between burned areas and unburned holm oak woodlands

*Wildfires in the  
França parish,  
Bragança  
1975 - 2005*

Source: Parque Natural de  
Montesinho

Year	Number	Area (ha)	Area (%)
1975	2	1447.1	25.3
1976	4	27.0	0.5
1977	2	333.6	5.8
1978	10	1637.5	28.6
1979	2	164.6	2.9
1980	3	295.2	5.2
1981	2	156.0	2.7
1982	1	40.3	0.7
1983	3	154.5	2.7
1984	18	522.2	9.1
1985	13	829.0	14.5
1986	9	215.1	3.8
1987	2	141.9	2.5
1988	1	33.5	0.6
1989	16	262.4	4.6
1990	8	133.3	2.3
1991	3	46.1	0.8
1992	0.0	0.0	0.0
1993	0.0	0.0	0.0
1994	8	302.6	5.3
1995	6	111.6	1.9
1996	14	555.0	9.7
1997	3	36.8	0.6
1998	6	203.8	3.6
1999	10	139.4	2.4
2000	8	843.4	14.7
2001	8	176.4	3.1
2002	2	18.2	0.3
2003	0.0	0.0	0.0
2004	2	20.5	0.4
2005	1	10.8	0.2



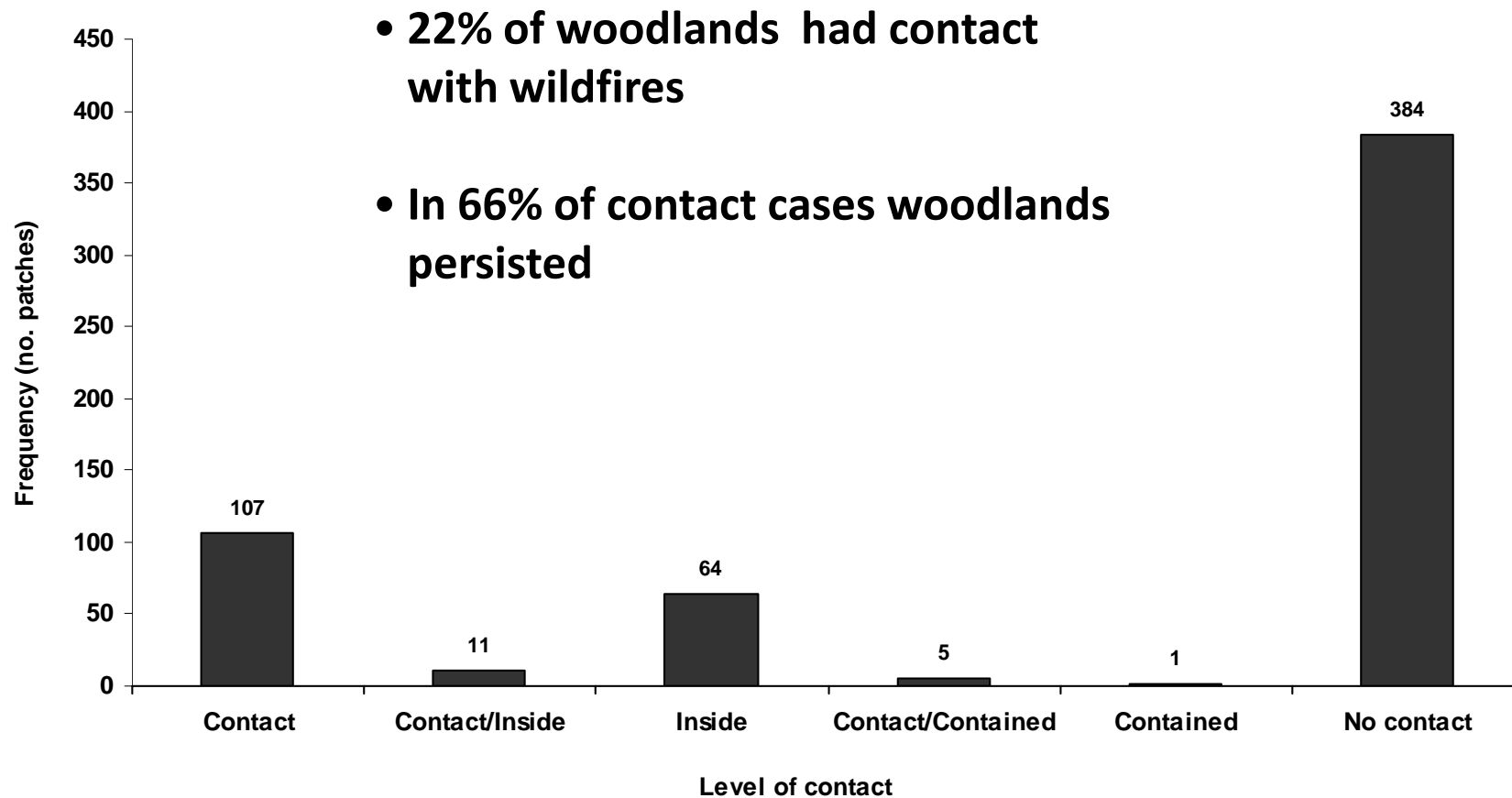


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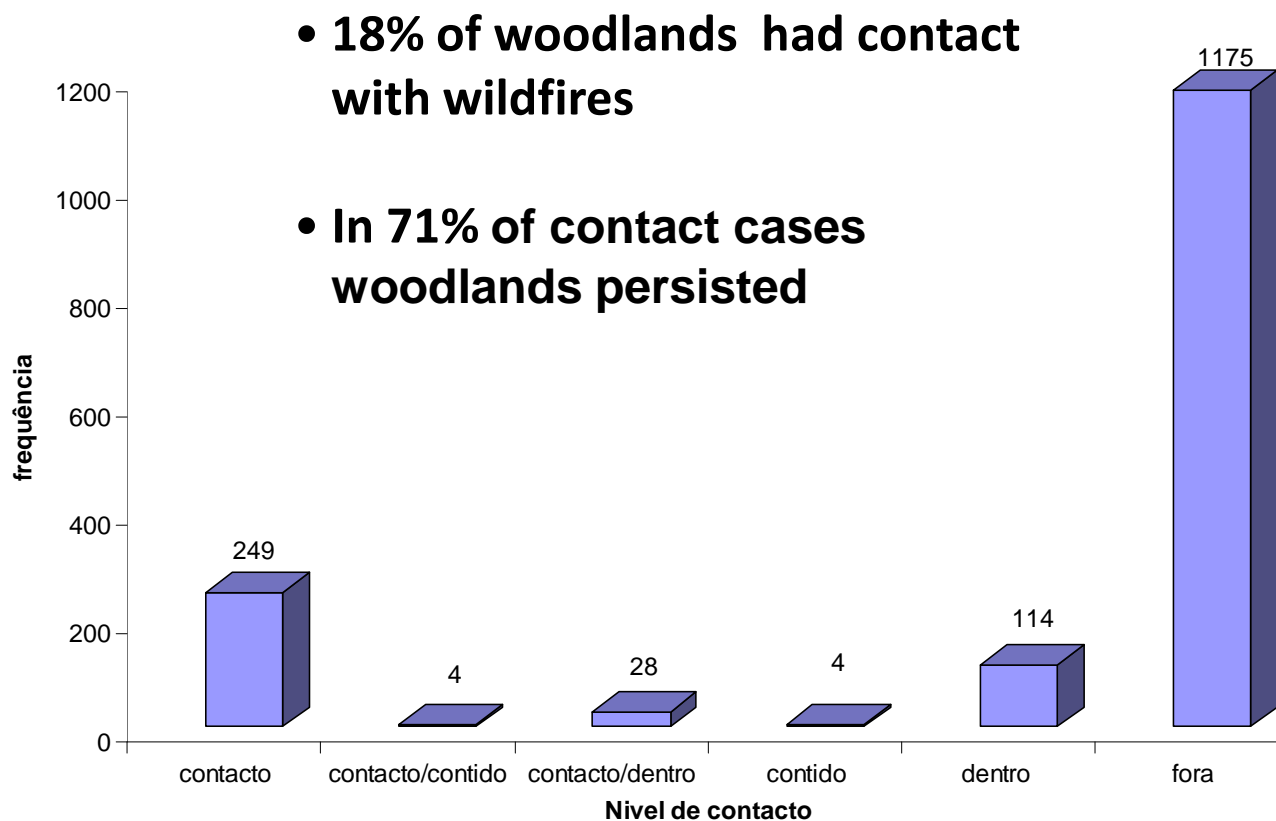




# Types and frequencies of fire-holm oak contacts since 1990 at the PNM

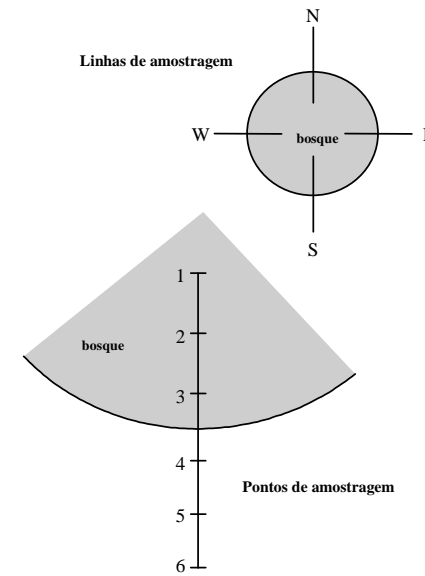
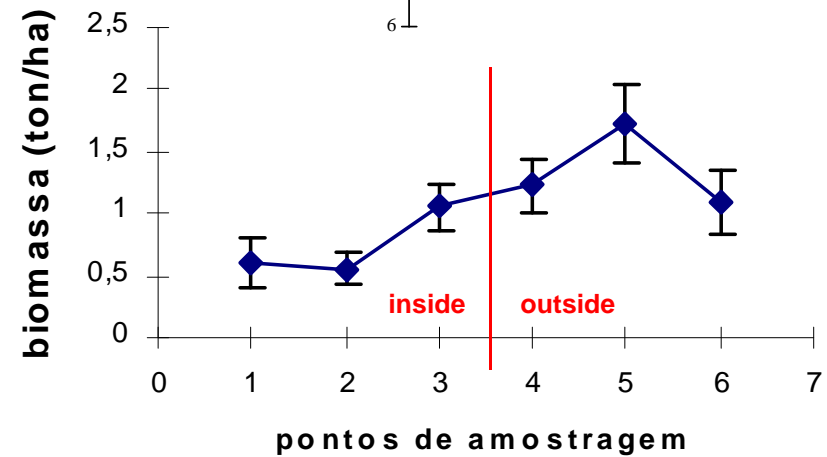
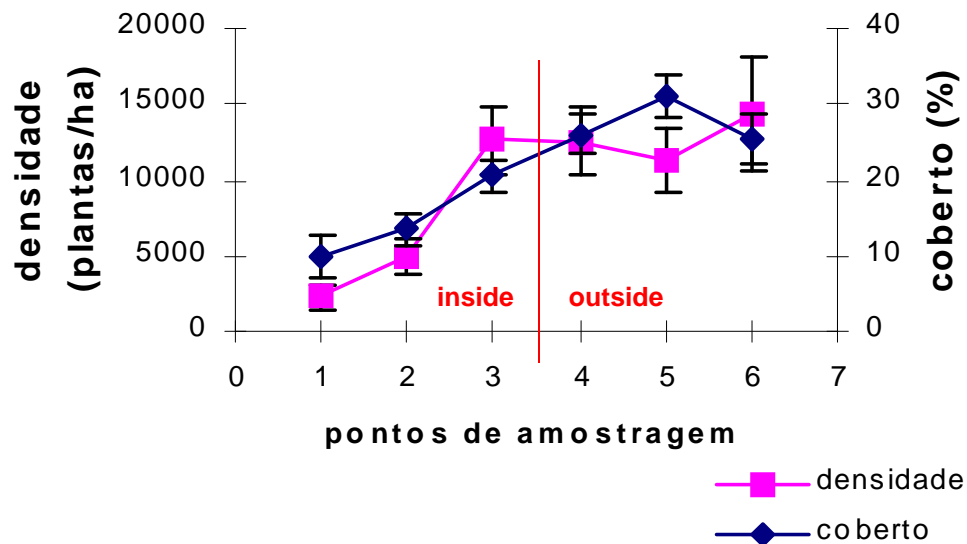


# Types and frequencies of fire-holm oak contacts since 1990 in the District



# Edges of Holm oak woods and fire

- Azevedo, J. & F. Caçador. 2000. Bordaduras de bosques de *Quercus rotundifolia* Lam. no Parque Natural de Montesinho. *Quercetea* 1: 126-137



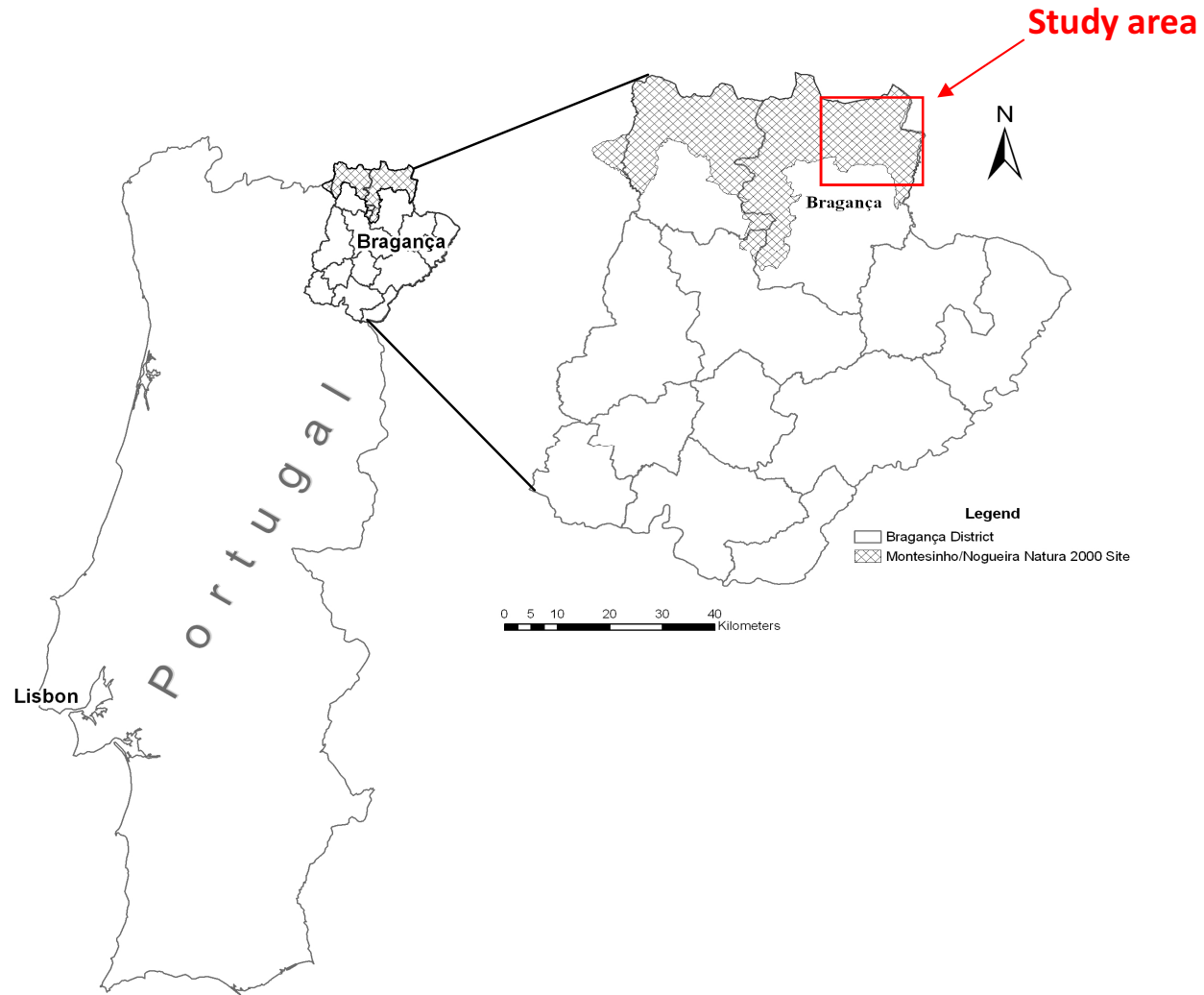
# The case of holm oak woodlands

- Persistence of holm oak (*Quercus rotundifolia*) woodlands in areas of frequent fires
  - Hypothesis: “*Holm oak woodlands are fire resistant due to sudden changes in fire behavior taking place at edges*”
  - Test: Fire behavior modeling and simulation based on vegetation and fuel structure across shrubland-holm oak woodland edges

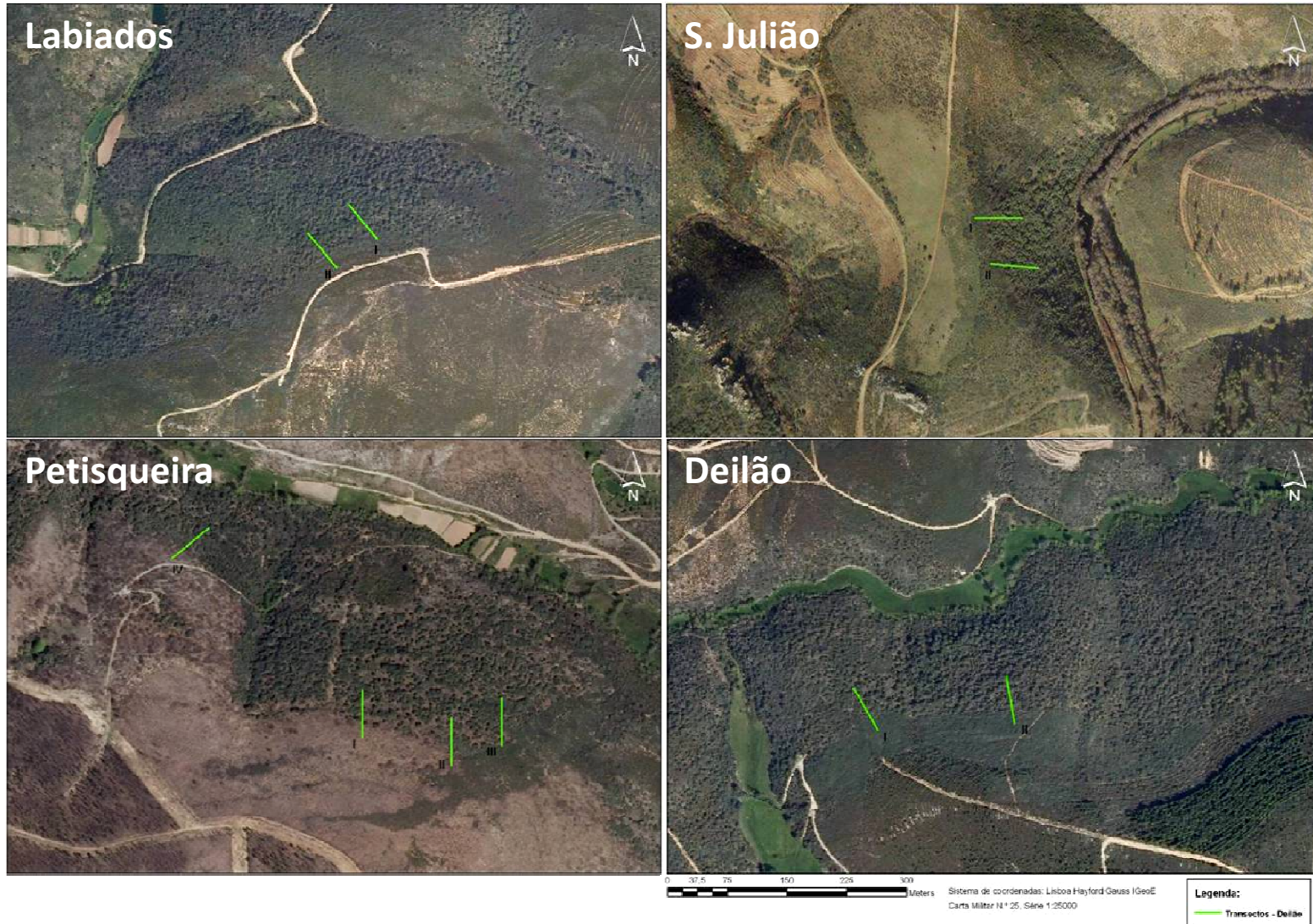
# Methods

- Data collection
  - 12 sampling transects (60m) perpendicular to the holm oak edges with known fire contact
    - 5 locations in the Deilão, S. Julião, Petisqueira, Labiados parishes (Bragança)
- Quantification of vegetation parameters along the sampling lines at distances -20, -10, -5, -1, 0, 1, 5, 10, 20, and 40m
  - Plant composition
  - Plant cover and height: herbs, shrubs and trees
  - Forest litter composition and thickness
- Fuel model construction for each point in the sampling transect
- Fire behavior simulation for each point of the sampling transect with BehavePlus

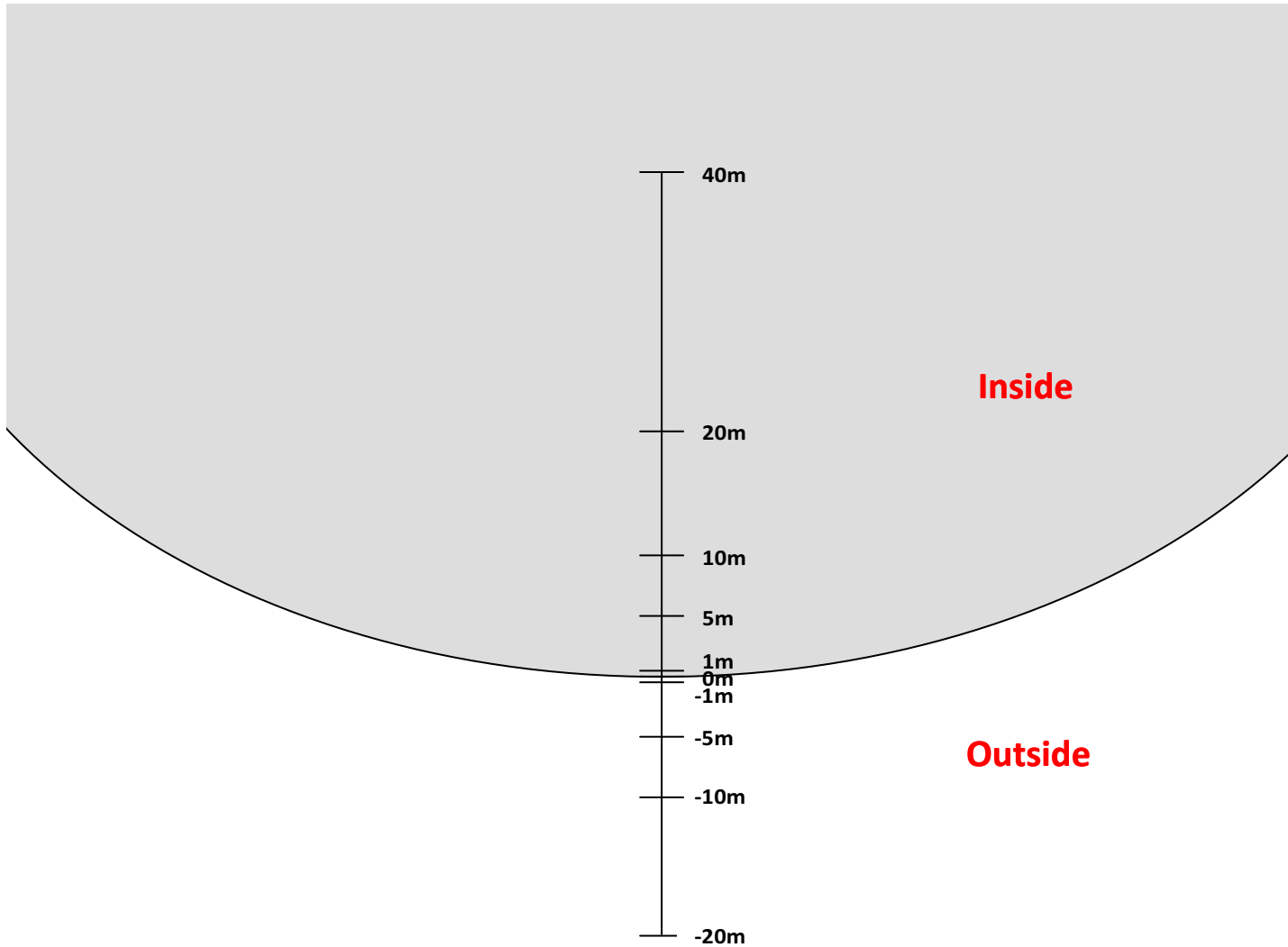
# Study area



# Methods



# Sampling scheme





# BehavePlus Fire Modelling System (USDA Forest Service)

Implements the Rothermel (1972) semi-empirical fire propagation model and associate models (Albini 1976)



United States  
Department of  
Agriculture  
Forest Service  
Randy Meentemeyer  
Research Station  
Forest Sciences Laboratory  
June 2005  
BehavePlus  
fire modeling system  
Version 3.0  
User's Guide  
Patricia L. Andrews  
Colin D. Bevins  
Robert C. Sill



## Inputs

- Fuel model (quantitative description of fuel based on vegetation attributes)
- Wind speed
- Slope
- Fuel moisture by category (dead, alive) and size class

## Basic outputs

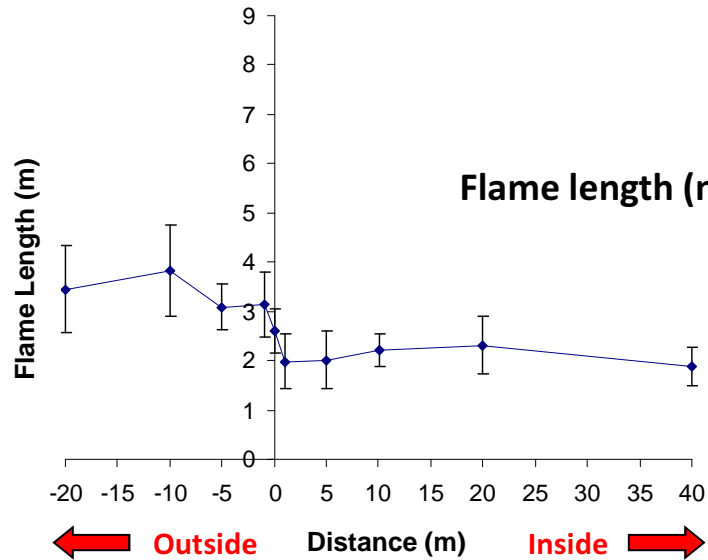
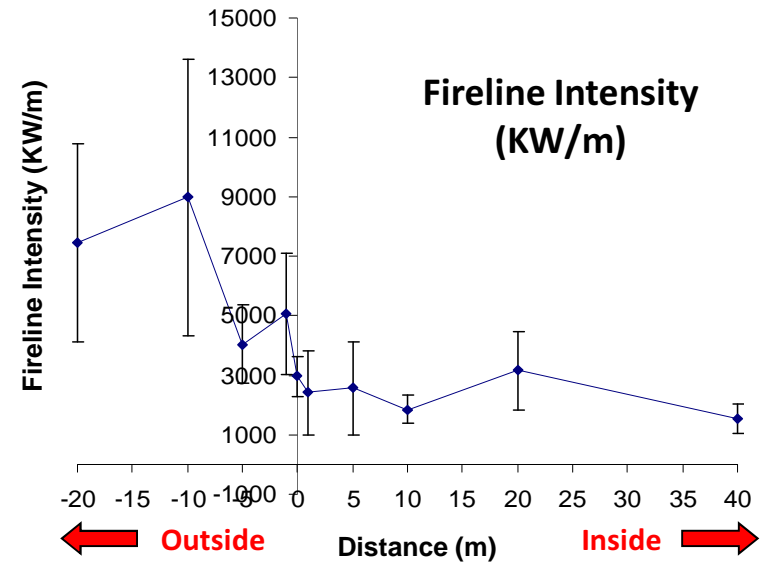
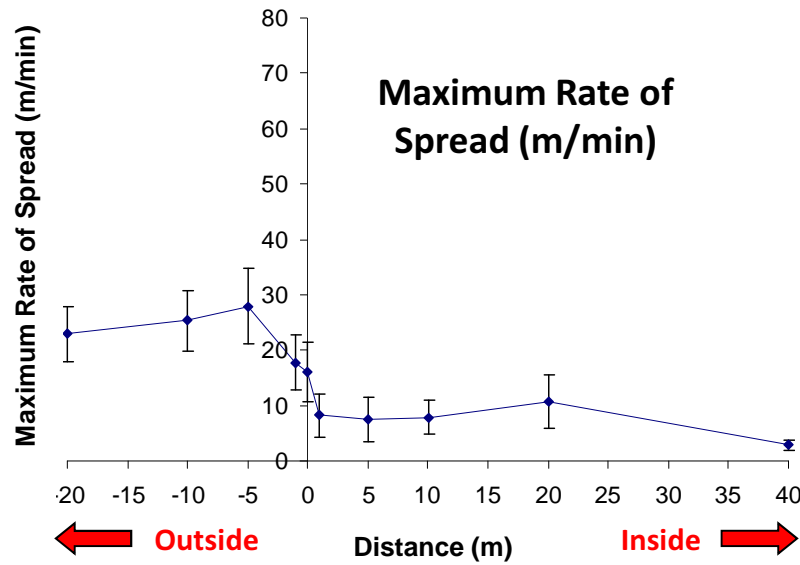
- Calculation of fire behavior attributes for a set of uniform conditions in a particular location:
  - Maximum rate of spread (m/min)
  - Flame length (m)
  - Fire line Intensity (kW/m)



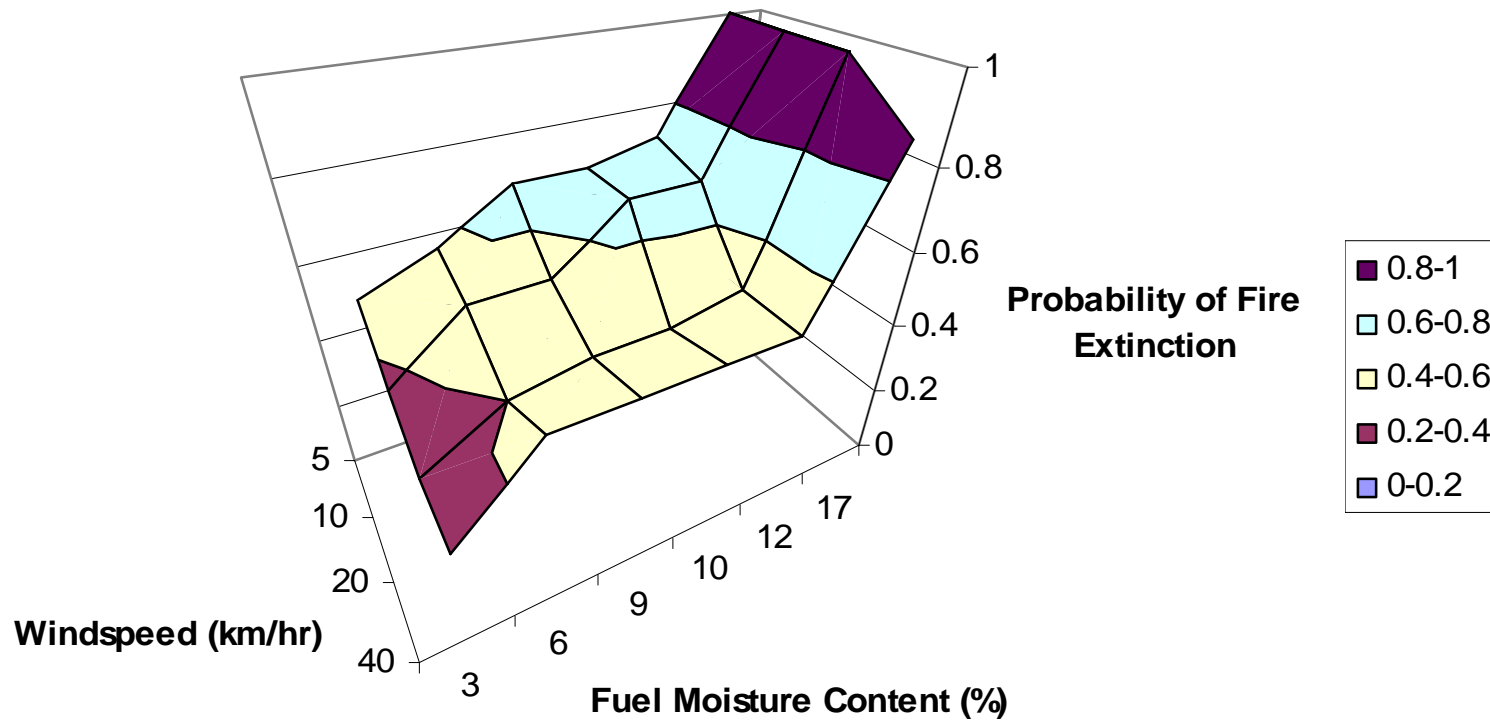




# Global results



# Fire extinction probability



Results based on 25 simulations per wind speed/moisture content combination and fire extinction thresholds for fire in the region

# Conclusion

- There is a sudden reduction in intensity, flame length and rate of spread at woodland edges resulting from structural variation
- Contrast between outside-inside conditions increases with age of adjacent shrublands but fire behavior inside the woodlands seems to be insensitive to outside shrub development
- These variations in fire behavior can contribute to explain fire self-extinction at edges and resistance of these woodlands

# Next step

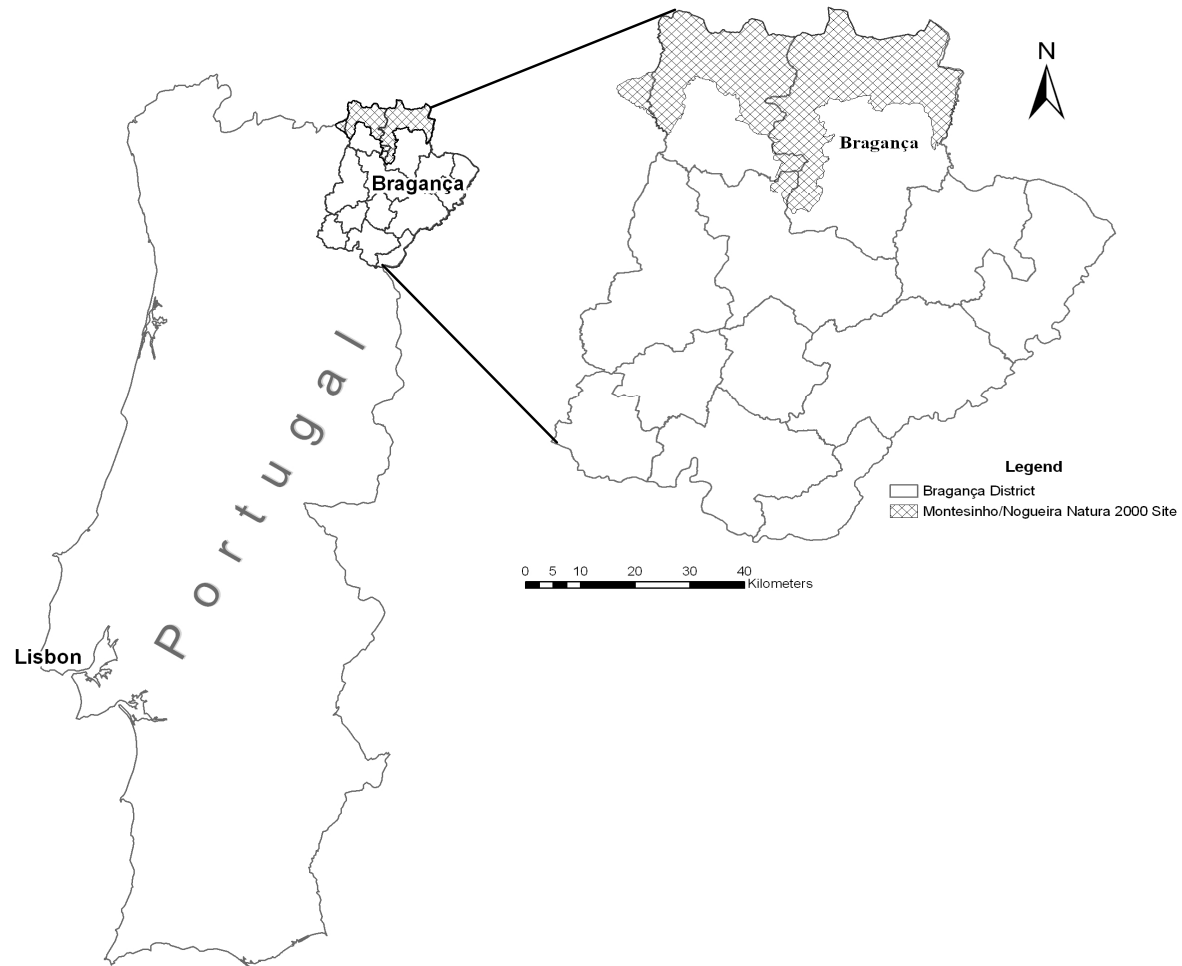
- If this is true, then holm oak woodlands present high potential for fire hazard reduction at the landscape level
- Questions:
  - What is the actual distribution of holm oak woodlands?
  - Where do woodlands seem to be more resistant/resilient to fire? In which conditions?



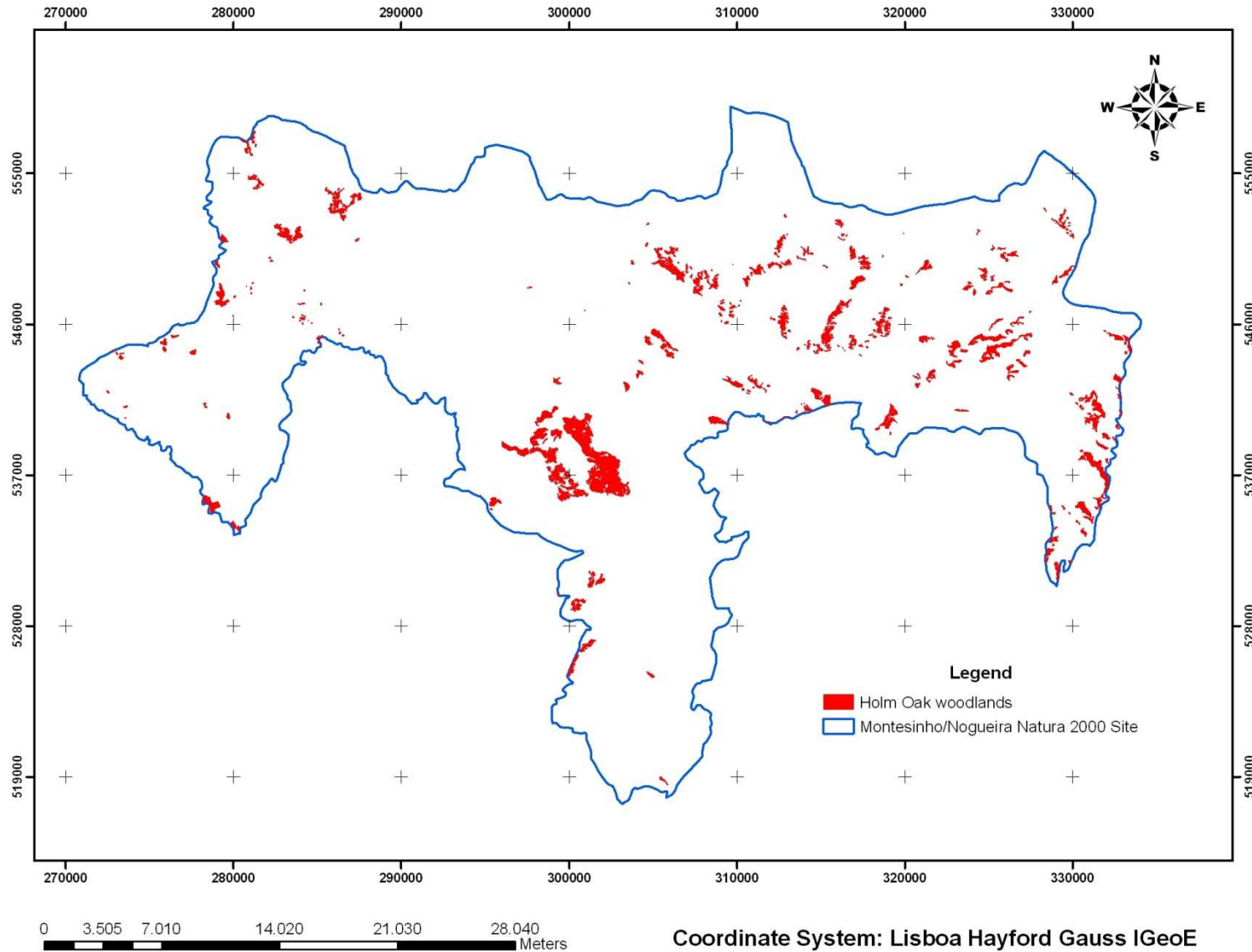
# Procedure

- Photointerpretation of orthophotomaps
- Mapping of holm oak woodlands
  - Natura 2000 Montesinho/Nogueira Site
  - Bragança district
- Description holm oak woodland patches in terms of
  - Size and shape
  - Geology and soils
  - Slope and aspect
  - Position in the slope
  - Proximity to streams

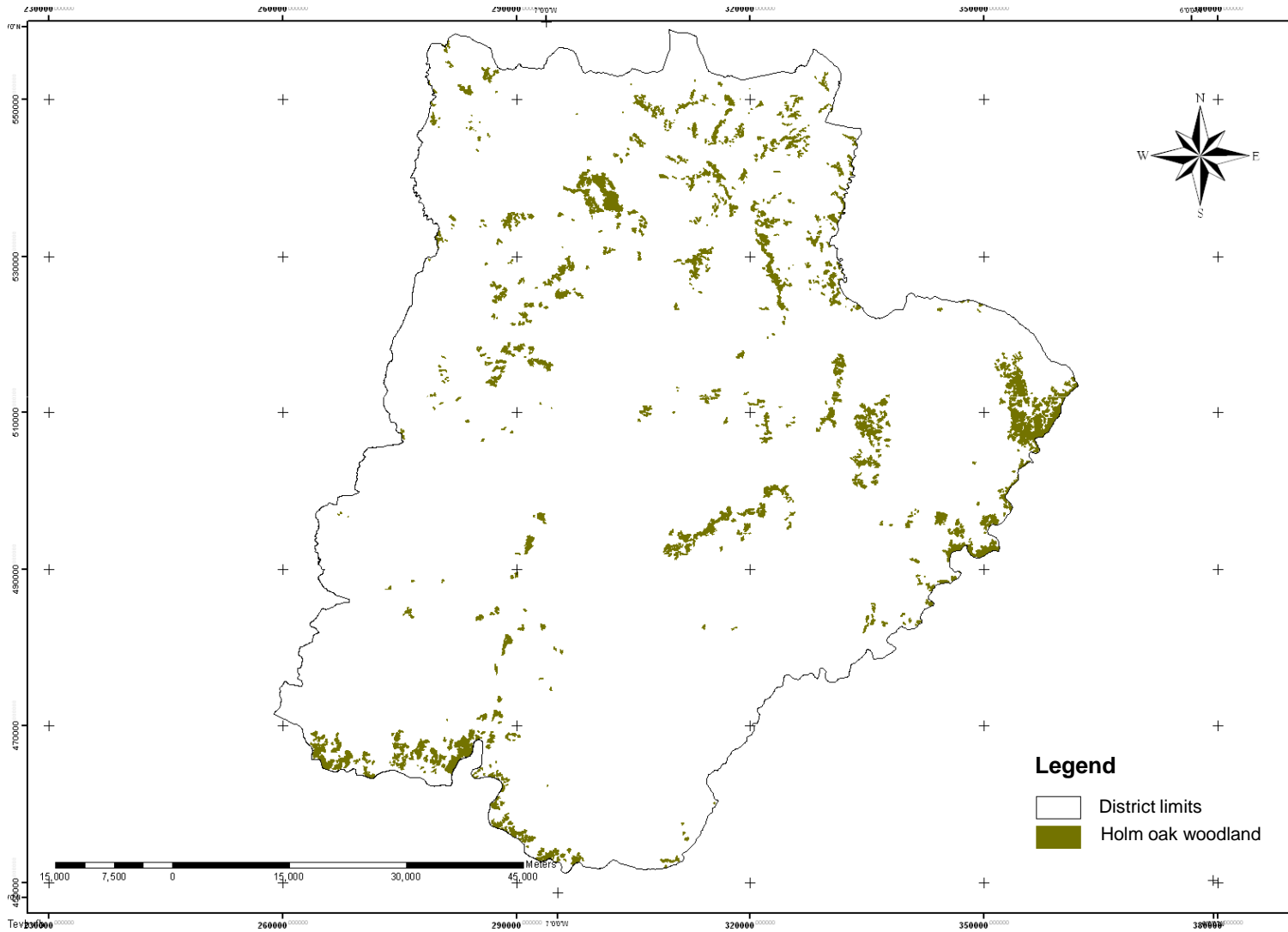
# Study areas



# Montesinho/Nogueira site (PTCON0002)

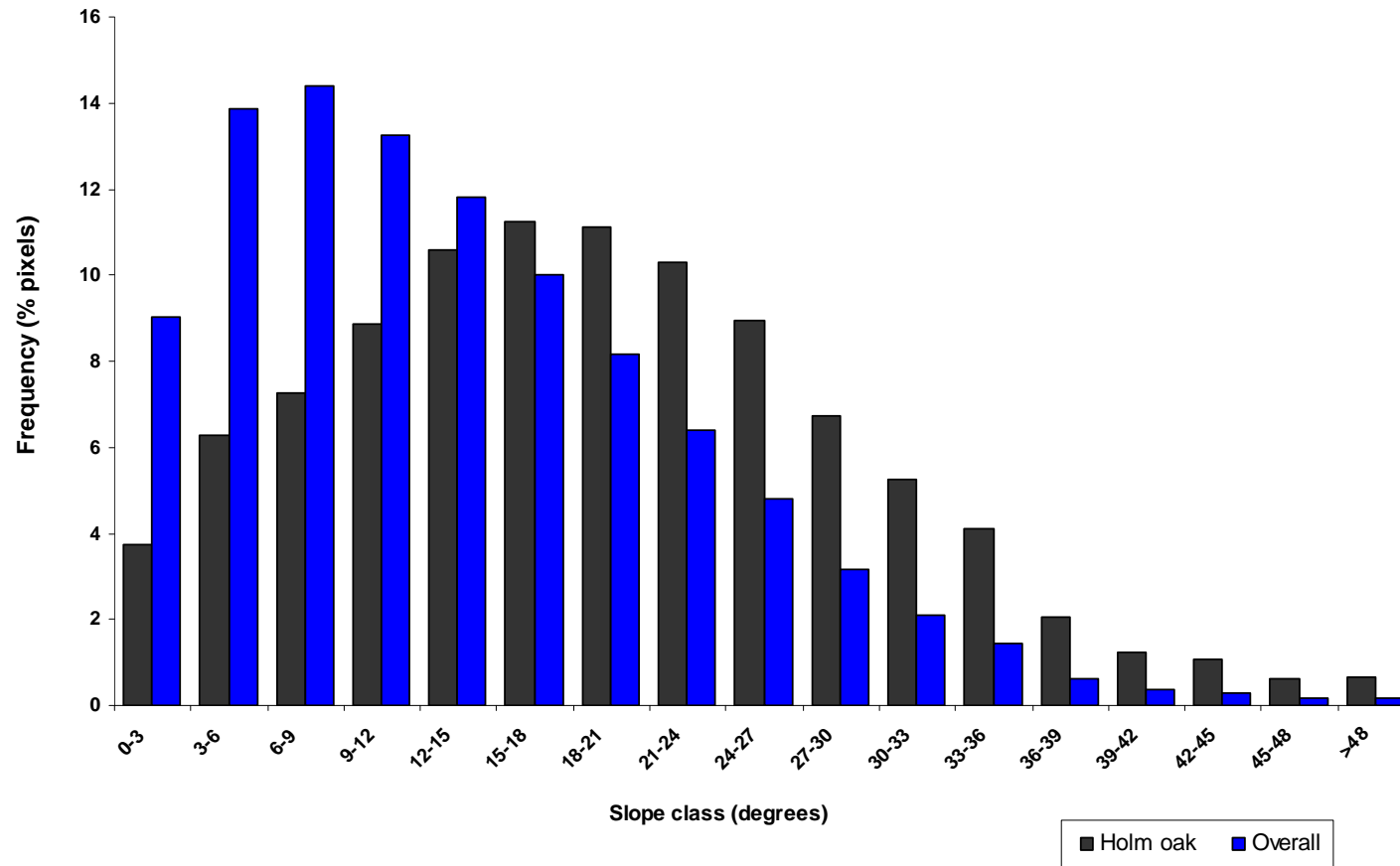


# Bragança District

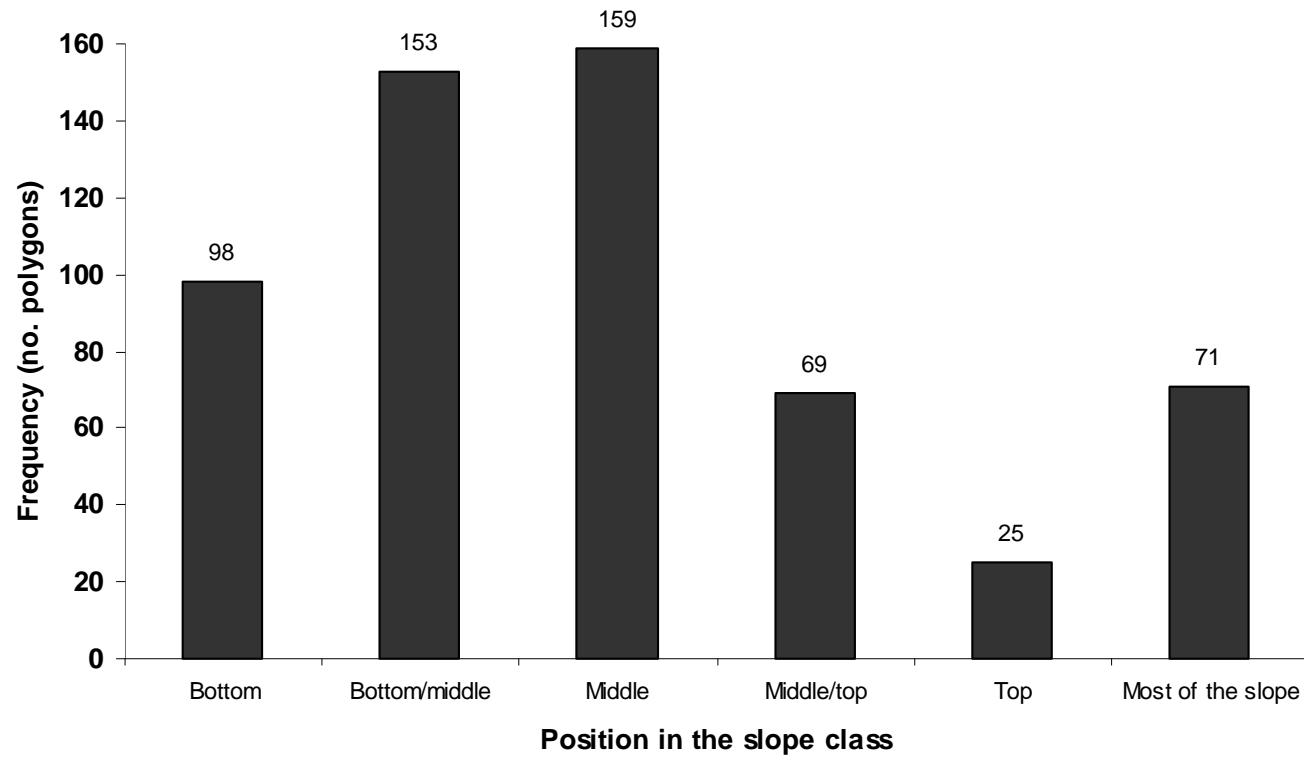


16,789 ha  
(8.8% of forest  
area)

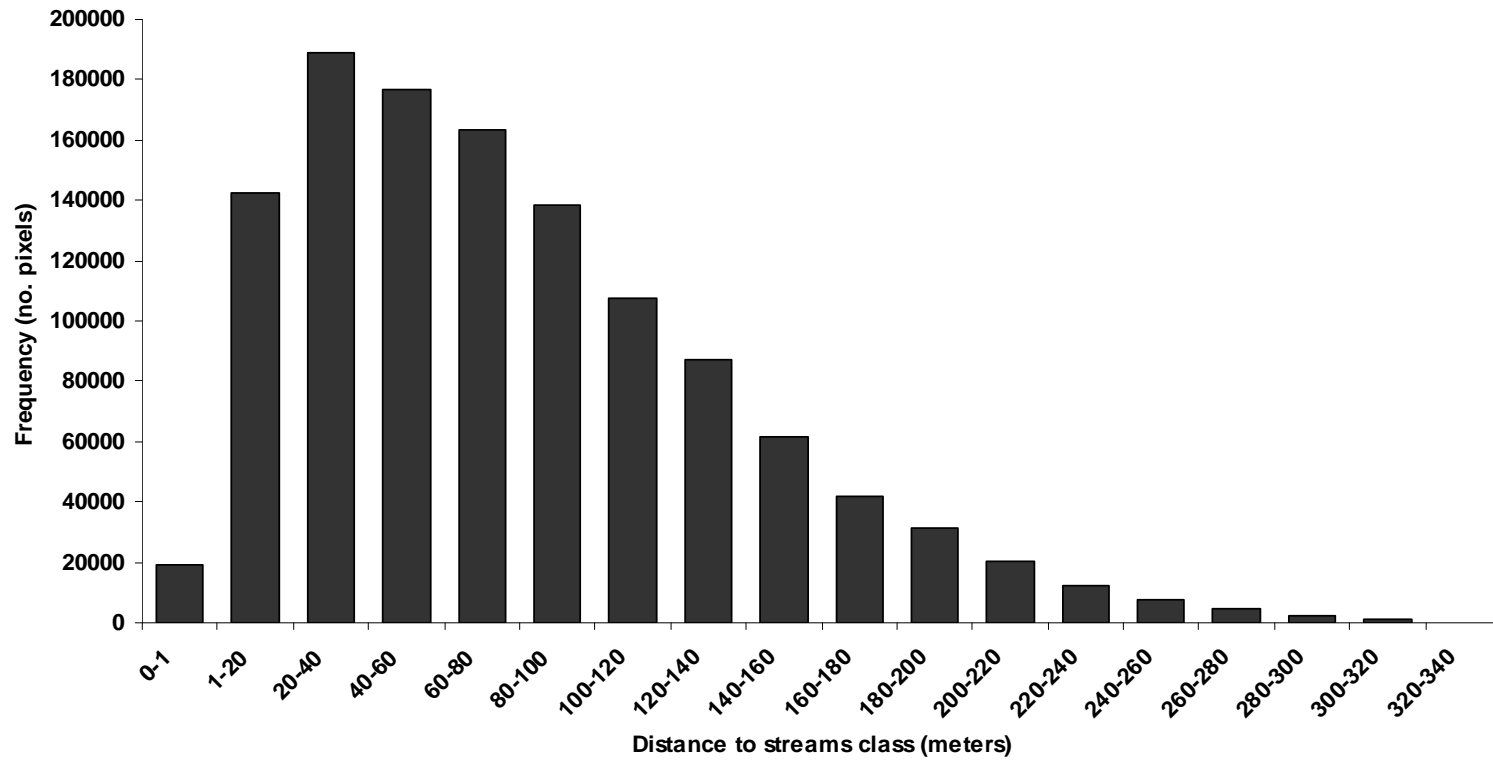
# Holm oak woodlands distribution by slope classes



# Holm oak woodlands distribution by position in the slope



# Holm oak woodlands distribution by distance to streams classes

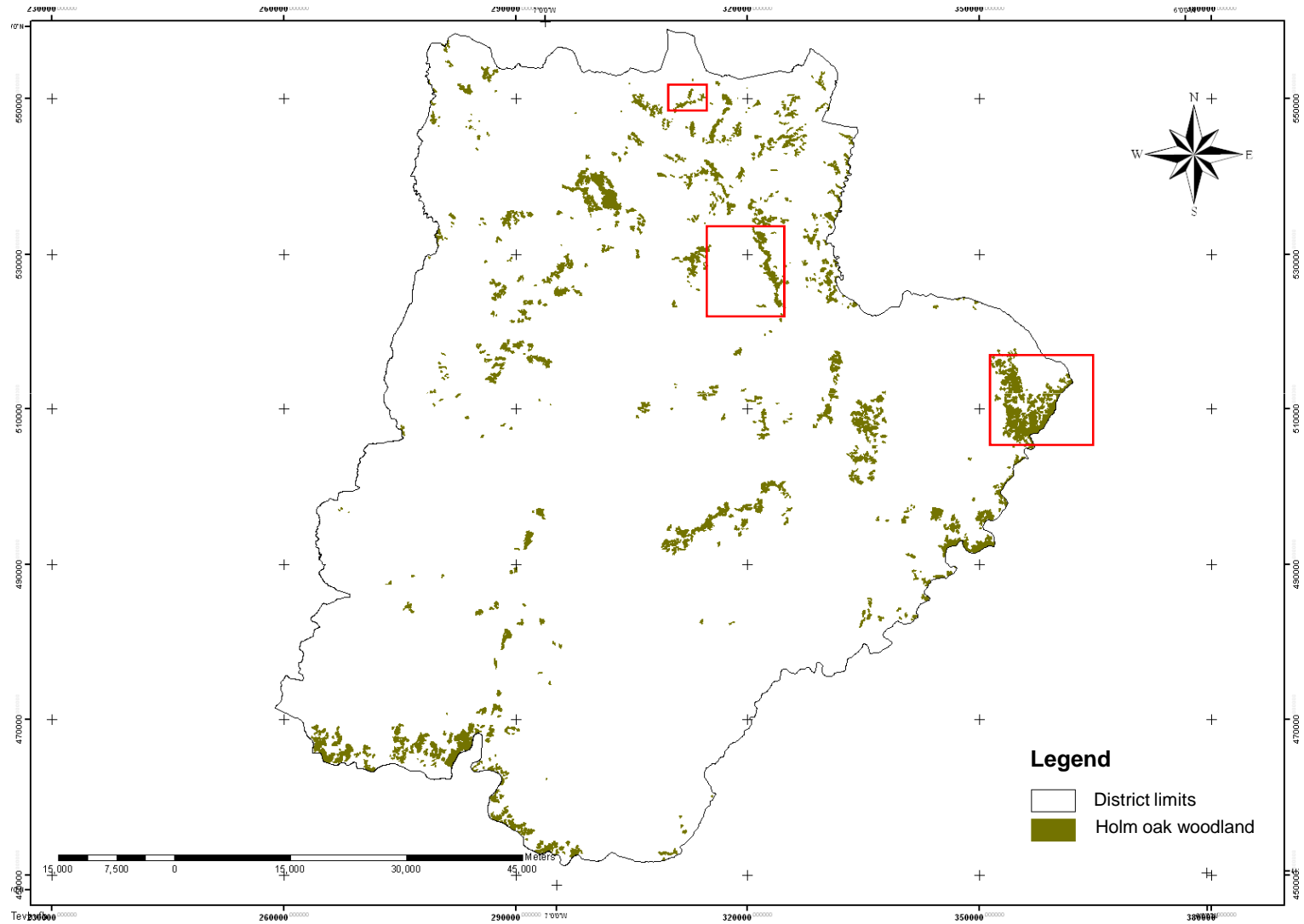


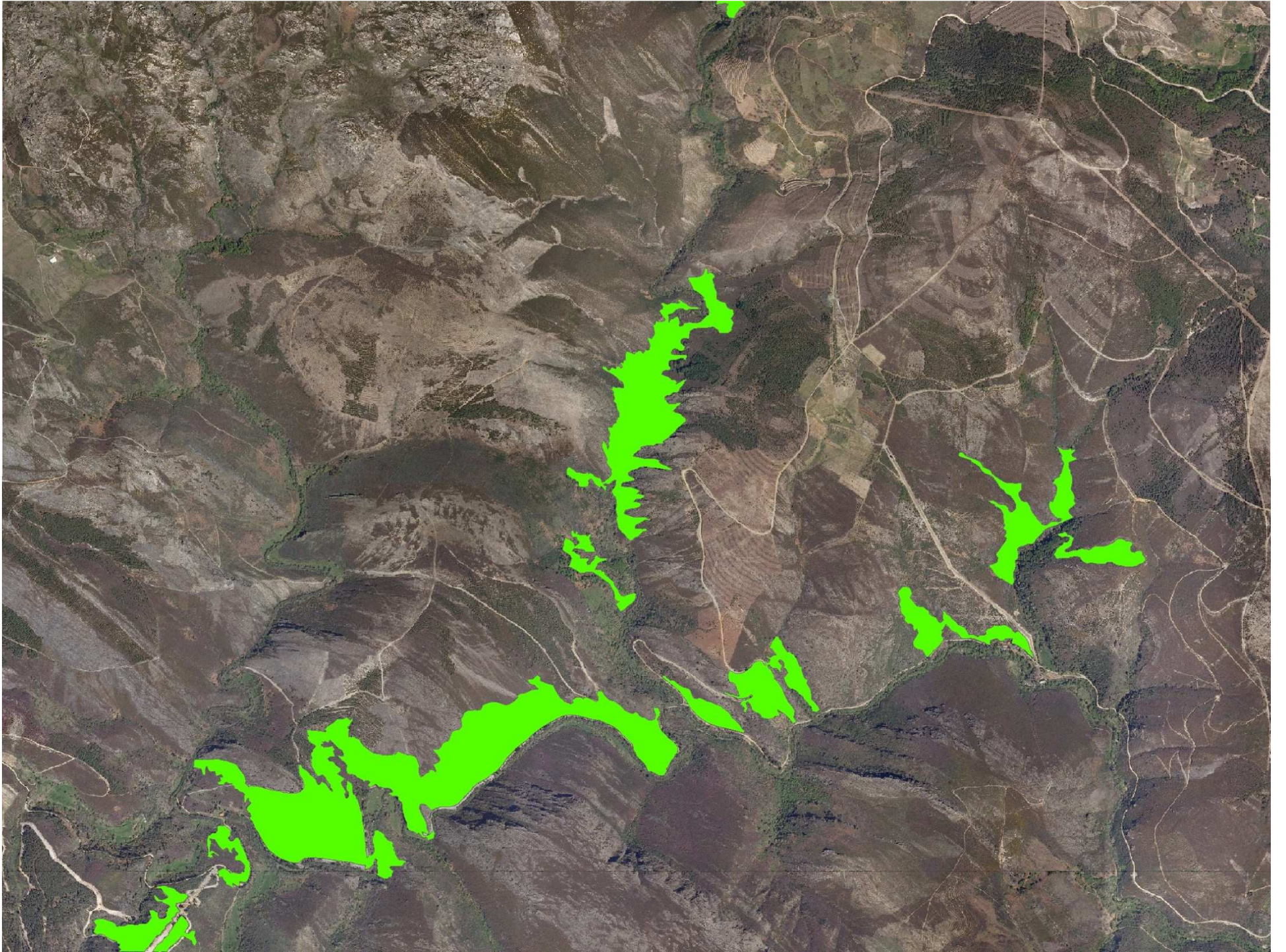
# Potential for holm oak in fire hazard reduction strategies

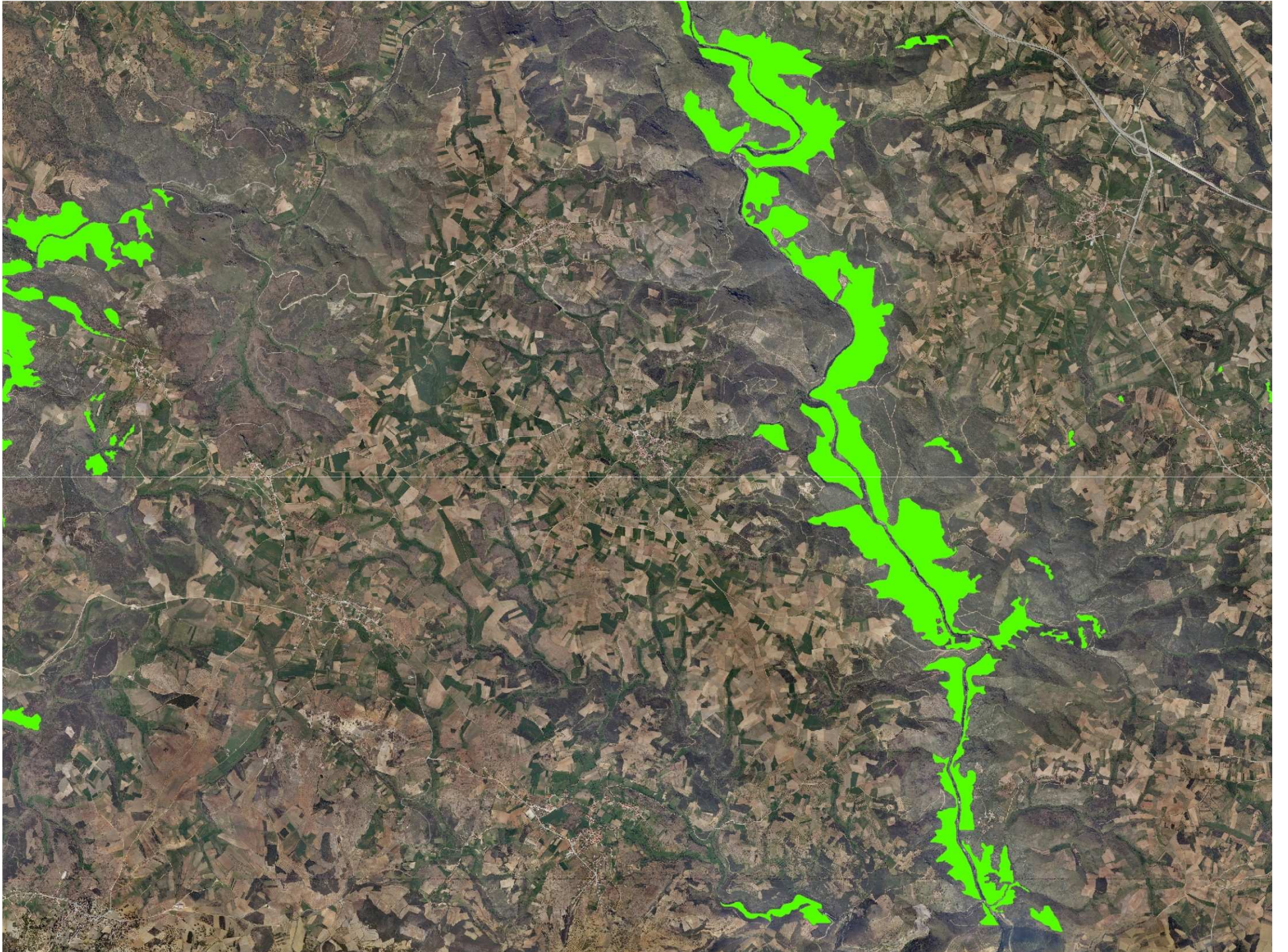
- Overall limited conditions for fire prevention corridor/network establishment in the district
  - Holm oak area
    - Our data: 16,789 ha (8.8% of forest area)
  - Clustered/fragmented distribution
- However, some potential results from
  - Corridors in river valleys
  - Abundant locally in some areas
  - Often associated with the meadows/riparian forest system (to be analyzed in the near future)

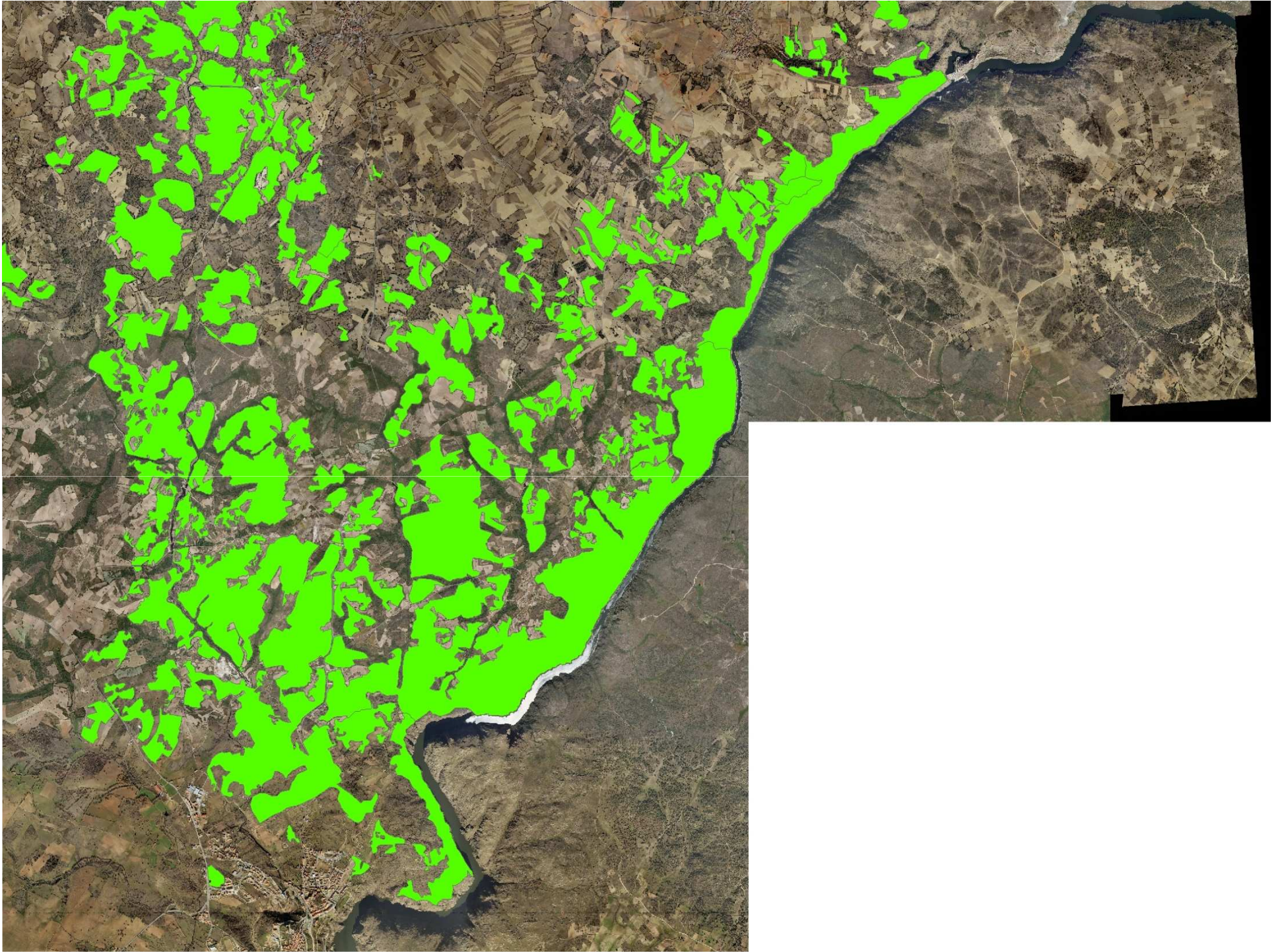


# Bragança District









# Final conclusion

- Holm oak woodlands show a high degree of fire resistance
  - Changes in fire behavior in edges seem to indicate a strong possibility of self extinction
- Current distribution limits the use of holm oak woodlands in fire hazard reduction for the entire district but some potential exists locally and in combination with other landscape elements

# Acknowledgments

Parque Natural de Montesinho

Câmara Municipal de Bragança

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