Parallel Session 1

Forests, conservation of biodiversity, landscape protection and public services.

Spatial and temporal response of insect communities to fire disturbance in Mediterranean forests

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MEDITERRANEAN FOREST FIRE

- A number of threats affect the integrity of forest ecosystems and landscapes in the Mediterranean Basin, such as: fragmentation, human exploitation, pest outbreaks, invasion from exotic species, overgrazing and fire (Lafortezza et al. 2008)
- Forest fires can have severe effects on ecological communities by causing direct mortality of animals and plants during the event or by modifying habitat characteristics and species turnover in the post-fire period (Whelan 1995)

THE EFFECTS ON INSECT COMMUNITY

- Insects are good example of animals that can be directly affected by the heat and the smoke during fire and indirectly affected by the changes in forest structure and composition caused by fire (Rainio and Nimelä, 2004)
- The effects of fire on insect community have been studied in grasslands and in forest habitats
- Lack of studies in the Mediterranean landscape.

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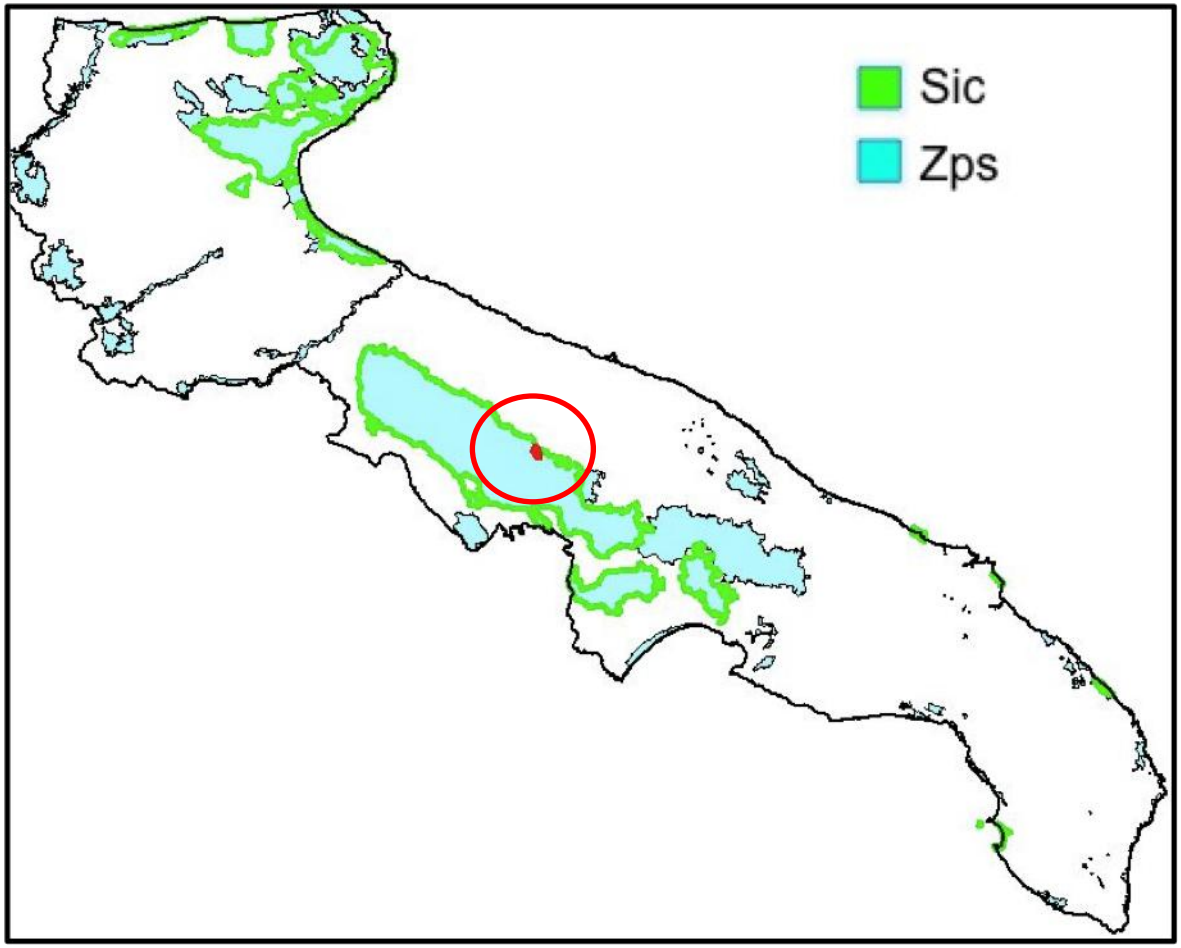
GOAL AND RESEARCH QUESTION

- To understand the dynamics of insects community in response to fire disturbance
- Research question:

  *Does **distance from ignition point** explain patterns of **spatial and temporal variation** in insect communities*?

STUDY AREA



Altitude from 250 m to 410 m

Area > 600 ha

Area of study within the "Alta Murgia" National Park

STUDY AREA

Altitude from 250 m to 410 m

Area > 600 ha

Quercus pubescens (Willd.)
Quercus coccifera (L.)

STUDY AREA

Altitude from 250 m to 410 m

Area > 600 ha

Quercus pubescens (Willd.)
Quercus coccifera (L.)

Pistacia lentiscus (L.)
Pistacia terebinthus (L.)
Rosa canina (L.)
Crataegus monogyna (Jacq.)
Phillyrea spp
Rhamnus alaternus (L.)
Erica arborea (L.)
Rubus ulmifolius (Schott.)
Smilax aspera (L.)

STUDY AREA

Summer 2008

Area 260 ha (40%)

Fire event: **crown fire** of **great intensity** and **high energy release**

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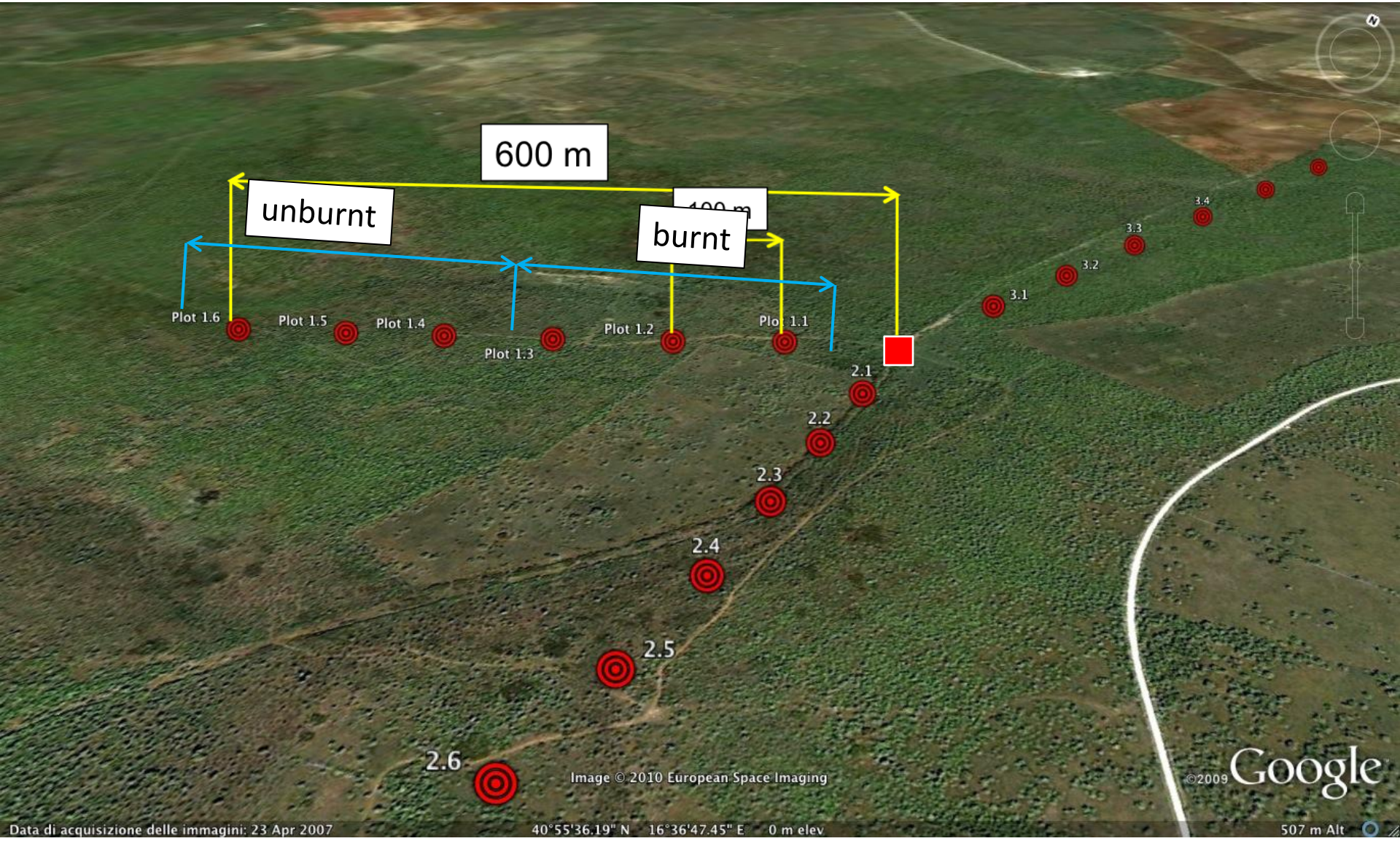
Fire caused: **reduction of the canopy tree cover** and **large open areas** covered by herbs and seedlings

OVERVIEW METHODS



OVERVIEW METHODS

Pit-fall traps:

- **vinegar** to **attract , kill and preserve** insects
- covered by a sloped stone

OVERVIEW METHODS

Sampling:

- **every week**
- plastic container with **ethyl alcohol**
- identification to the **family level**

RESULTS

- total of **2556 specimens**
- **8 orders** and **26 families**
- **abundance increased**

during the two years from 1077 (2009) to 1479 (2010) individuals

+37.3 %

Order	Family	2009	2010	Total
Lepidoptera	*Noctuidae*	667	204	871
	Nimphalidae	9	5	14
	Total	676	209	885
Coleoptera	*Carabidae*	79	98	177
	Staphylinidae	59	236	295
	Curculionidae	3	6	9
	Coccinellidae	1	—	1
	Crhysomelidae	4	10	14
	Anobidae	2	—	2
	Silphidae	—	4	4
	Scarabaeidae	—	3	3
	Tenebrionidae	—	92	92
	Total	148	449	597
Diptera	*Muscidae*	76	86	162
	Tabanidae	28	47	75
	Gasterophilidae	33	361	394
	Cecidomyiidae	39	180	219
	Bibionidae	3	3	6
	Syrphidae	2	—	2
	Tipulidae	—	36	36
	Total	181	713	894
Orthoptera	*Tettigonidae*	6	13	19
	Gryllidae	2	9	11
	Total	8	22	30
Hymenoptera	*Vespidae*	54	1	55
	Formicidae	5	81	86
	Ichneumonidae	2	1	3
	Total	61	83	144
Dermaptera	*Forficulidae*	—	3	3
Hemiptera	*Pyrrochoridae*	2	—	2
Blattodea	*Blattidae*	1	—	1
TOTAL		**1077**	**1479**	**2556**

ANOVA

- **SPATIAL VARIATON**: grouping sampled data based on distance classes (burnt: 0-300 m and unburnt: 300-600 m)

- **TEMPORAL VARIATON**: grouping sampled data based on survey years (2009 and 2010)



SPATIAL VARIATION

- **not significant differences** between the overall abundance of individuals in distance classes (0-300m and 300-600m)
- **significant difference** in the two locations for *Coleoptera* in both years
- **not significant differences** for *Lepidoptera*

Observation	Factor		N.	Mean	Std. Dev.	Std. Error	ANOVA F	ANOVA Sig.
Insect community	2009	0-300	9	55.11	28.733	9.578	0.439	0.517
		300-600	9	63.67	26.010	8.670		
	2010	0-300	9	63.33	25.971	8.657	3.183	0.093
		300-600	9	92.89	42.369	14.123		
Coleotteri	2009	0-300	9	4.33	3.202	1.067	5.493	**0.032**
		300-600	9	12.11	9.427	3.142		
	2010	0-300	9	16.78	14.167	4.722	5.294	**0.035**
		300-600	9	33.11	15.902	5.301		
Lepidotteri	2009	0-300	9	41.11	25.157	8.386	0.382	0.545
		300-600	9	34.00	23.659	7.886		
	2010	0-300	9	12.33	4.637	1.546	0.314	0.583
		300-600	9	10.89	6.194	2.065		

TEMPORAL VARIATION

- **not significant differences** between the overall abundance of individuals in 2009 and 2010, both in distance classes (0-300m; 300-600m)

- **significant difference** for *Lepidoptera* and *Coleoptera*

- however the two orders showed a **contrasting pattern** in terms **of mean abundance**

Observation	Factor		N.	Mean	Std. Dev.	Std. Error	ANOVA F	ANOVA Sig.
Insect community	0-300	2009	9	55.11	28.733	9.578	0.406	0.533
		2010	9	63.33	25.971	8.657		
	300-600	2009	9	63.67	26.01	8.67	3.109	0.097
		2010	9	92.89	42.369	14.123		
Coleotteri	0-300	2009	9	4.33	3.202	1.067	6.607	**0.021**
		2010	9	16.78	14.167	4.722		
	300-600	2009	9	12.11	9.427	3.142	11.615	**0.004**
		2010	9	33.11	15.902	5.301		
Lepidotteri	0-300	2009	9	41.11	25.157	8.386	11.39	**0.004**
		2010	9	12.33	4.637	1.546		
	300-600	2009	9	34	23.659	7.886	8.037	**0.012**
		2010	9	10.89	6.194	2.065		

LINEAR REGRESSION

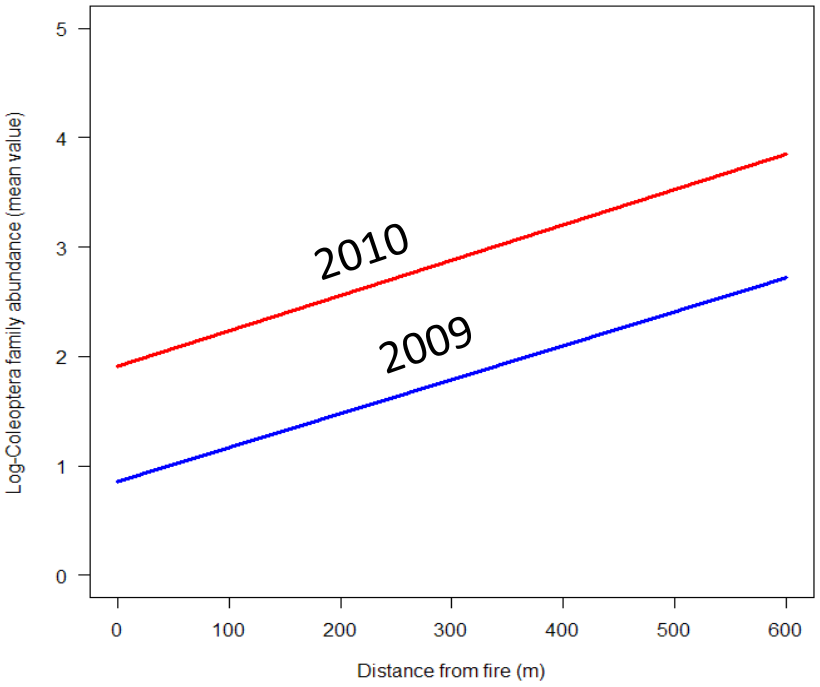
• Considering the overall insect community, the resulting models suggest **a positive relationship** between abundance (log-transformed) and distance to fire (m)

Order	Year	Model	R^2
Insect community	2009	4.04 + 0.001 * dist	0.24
	2010	3.85 + 0.001 * dist	0.52
Lepidoptera	2009	4.02 - 0,001340 * dist	0.33
	2010	2.71 - 0,0008546 * dist	0.24
Coleoptera	2009	0.85 + 0.003107 * dist	0.77
	2010	1.91 + 0.003235 * dist	0.74

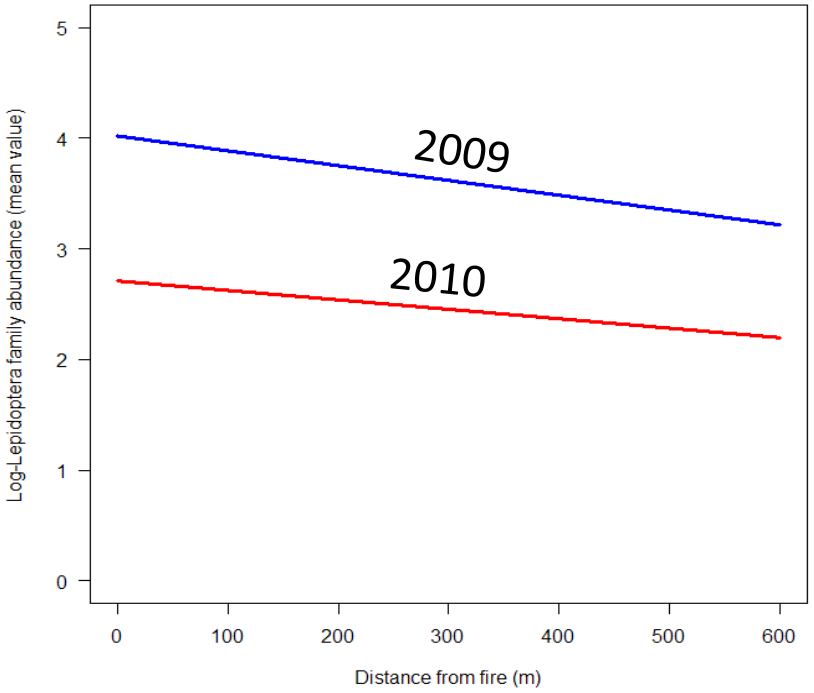
LINEAR REGRESSION

- *Coleoptera* abundance **raised during the survey period** and was **positively correlated** (2009: R^2=0.77; 2010: R^2=0.74) with distance from fire ignition.
- *Lepidoptera* abundance decreased during the survey period and was negatively correlated with fire distance (2009: R^2=0.33; 2010: R^2=0.24).

Coleoptera



Lepidoptera



CONCLUSION

• Fire disturbance influences the short-term response of insect abundance with positive or negative effects depending on the ecological traits and habits of *taxa*. Understanding these effects become crucial in highly-modified ecosystems, such as the Mediterranean forests.

• Terrestrial *Coleoptera* were negatively affected by fire especially if we consider the original habitat changes as a consequence of disturbance.

• Fire disturbance is a key factor driving species turnover and natural forest succession in Mediterranean forest ecosystems and landscapes.

• This factor should be considered into forest management plans and practices in order to preserve the integrity of forest ecosystems, thus creating heterogeneous mosaics of different successional stages.

THE EFFECTS ON INSECT COMMUNITY

- Potts et al. (2003) analyzed changes in bee community structure following fire and observed that the abundance of bee declines steadily in the post-fire period.
- Huntzinger (2003) explored the effects of fire management practices on butterfly diversity. In fire-adapted forests, maintenance of landscape heterogeneity seems to support butterfly diversity.
- Campbell et al. (2007) studied the effects of fire on floral visiting insects in oak forests and observed a relationship between insect abundance (or richness) and fire disturbance that reduced overstory trees density and increased the amount of herbaceous plant cover.
- Nunes et al. (2006) characterized ground beetle community in two different Mediterranean ecosystems under prescribed fire treatments and found a decreasing tendency in species abundance and richness in burned plots in Pine stand habitat. In addition, both species abundance and richness were higher in the second year after fire than in the first

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The mean number of tree stems per plant was around 4-5 shoots of small diameter and height.