

Agropastoralism and fires in the Mediterranean

Giuseppe Pulina, M. d'Angelo and Giuseppe Enne

Nucleo Ricerca Desertificazione, Università di Sassari, Via De Nicola, I-07100 Sassari, Italy

Tel: 39 079 229304; Fax: 39 079 229302; E-mail: nrd@ssmain.uniss.it

ABSTRACT

Within the MEDALUS (Mediterranean Desertification and Land Use) research programme funded by the EU, the relationships between agropastoralism and fires were studied in areas subjected to grazing. The investigation was carried out in northern Sardinia (Italy), the Italian region most affected by summer wildfires, where agropastoralism is the main economic activity. Socioeconomic data (live-stock and population) were acquired and related to fire occurrence and extension in the period 1980–1990. The results highlighted a positive correlation between sheep number and burned surfaces, thus confirming that the use of fire as an agronomic practice to clear pastures for sheep breeding is still deeply rooted.

Key words: agropastoralism, fires, land degradation, livestock, Sardinia.

INTRODUCTION

Due to the peculiarity of natural resources and their climatic variability, Mediterranean drylands are subjected to a continuous degradation. Throughout the millennia the Mediterranean Basin has been overexploited mainly because of a rapid human population growth and associated land use pressures which, in many cases, has caused the disappearance of fragile ecosystems (UNEP 1994).

Fire is one of the main factors leading to land degradation in the Mediterranean (see also Yassaglou and Kosmas, this volume); among its many causes, agropastoralism is traditionally considered one of the most important (Margaris 1992). More recently, land development and speculation in tourist areas and “business” has promoted fire prevention.

Sheep and goat breeding is the most widespread economic activity in Mediterranean rural areas, where it is essential to the livelihood of local communities. In particular, the number of sheep farms is increasing, mainly due to the growing demands of the national and international cheese markets (Roquefort in France, Feta in Greece, Pecorino Romano in Italy) (Kalantzopoulos 1993). In the Mediterranean region this has probably caused the increase in burned areas during the last decades; indeed, the grazing behaviour of sheep, who prefer grass to shrubs, leads farmers to use ploughing or fire to clear pastures. The latter is usually the most preferred practice as it is economical and because steep slopes and stony soils prevent any other cultivation practice (Molina 1996). This situation is particularly true for Sardinia, a Mediterranean island, which is the Italian region most affected by fires and with the highest sheep and goat stocking rates. During the period 1985–95, 38,884 fires occurred for a total surface of 483,760 ha, about 20% of the island total area (RAS 1996). In that period, the regional average stocking rate was about 1.73 (3.3 considering specific stocking rate) sheep ha⁻¹ and milk production was about 137 l ha⁻¹.

The aim of this paper is to review the role of fire in agropastoralism practices in the Mediterranean Basin. In particular, we investigate the possible relationship among livestock number and their dynamics, number of fires, affected surfaces, tourism and unemployment rates in Sardinia.

MATERIAL AND METHODS

Description of the study area

The investigation was carried out in Northern Sardinia (Italy) over a representative area of about 752,100 ha (Figure 1). The climate is characterised by hot and dry summers and mild winters. Elevation ranges from sea level to 1359 m a.s.l. (Monte Limbara).

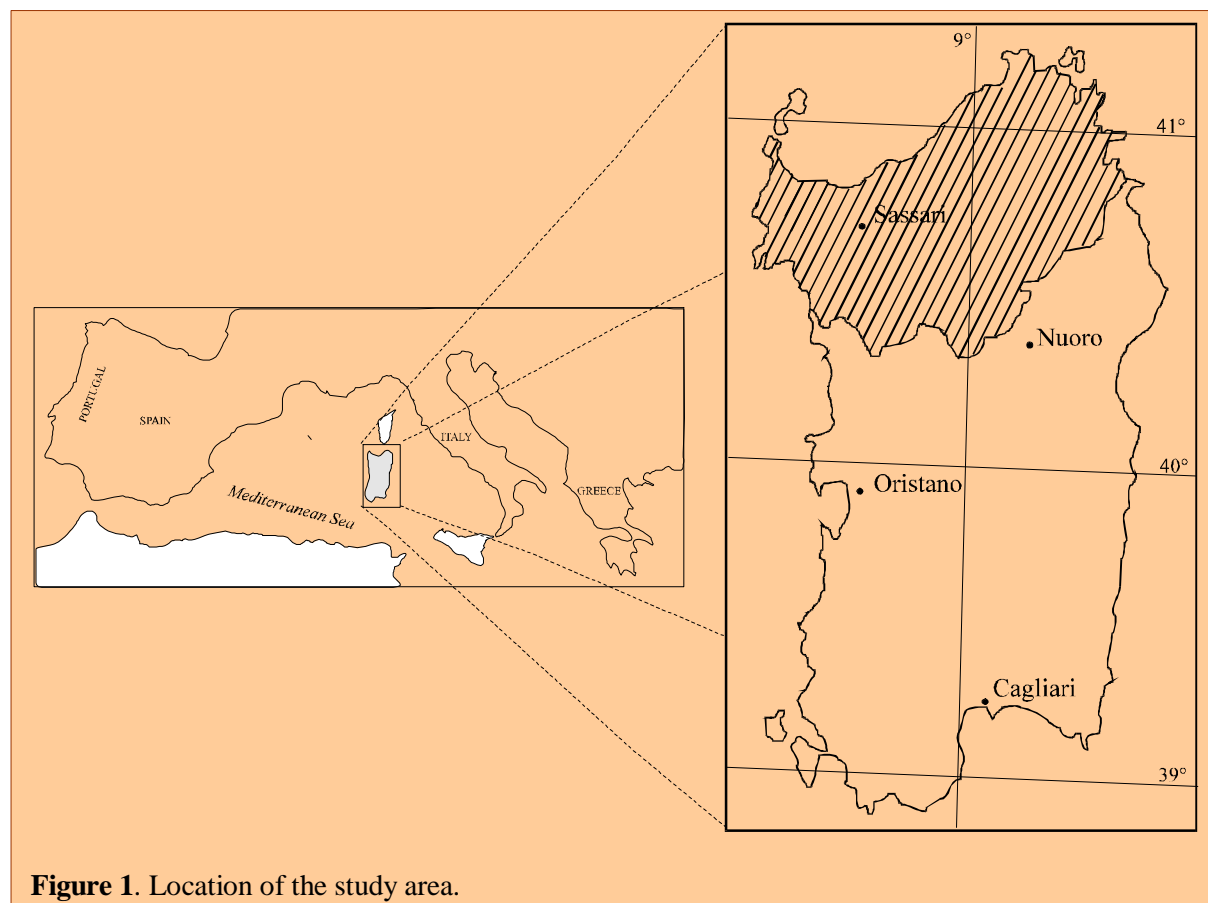


Figure 1. Location of the study area.

With reference to geolithological and morphological aspects, the landscape is quite heterogeneous; almost all Sardinian landscapes are represented, although landscapes on intrusive rocks of the Paleozoic are the most widespread. Land degradation and soil erosion are quite widespread due to past overexploitation.

With reference to land use patterns, the total agricultural area amounts to 637,408 ha, 46% of which is represented by grasslands and permanent pastures, 21% (133,931 ha) by cultivated areas and 3.6% (22,962 ha) by permanent crops. Woodlands, mainly represented by Mediterranean maquis in its different physiognomic-structural types, cover about 22% (141,276 ha) of the total agricultural area. Here agropastoralism, mainly based on sheep breeding, represents one of the most important economic activities (1.05 million head according to the General Agricultural Census in 1991).

Data acquisition and analysis

The investigation considered 84 municipalities during the period 1980–1990, the data set referring to this period being complete and quite homogenous.

For each municipality the following data were acquired:

- Fires: number of fires (NF) and extent of affected surfaces (pastures, woodland) for each year (source: Regional Forestry Administration).
- Livestock: sheep number (SN) and cattle number in 1980 and in 1990 (source: Italian General Agricultural Censuses).
- Population: economically active population and unemployed population in 1980 and 1990 (source: Italian General Population Censuses).

The following data were calculated for each municipality:

- Number of fire outbreaks per km² (NO); total burned area (S); percentage of burned area in relation to the municipality area (% S).
- Change in the number of sheep (Δ SN); change in the number of sheep and cattle (Δ LSU) expressed in Livestock Unit (LSU= 450 kg BW corresponding to 1 cattle, 10 sheep); sheep stocking rate (SR).
- Unemployment rate (UR).

All municipalities were classified according to their tourist activity, ranging from high to low and absent.

Statistical analyses concerned:

- Pearson correlation analysis among the variables.
- Regression analysis between Δ SN and burned areas (S).
- ANOVA, using the GLM procedure, to highlight the influence of tourist class on the number of outbreaks per km⁻² and burned surfaces as percentage of total municipality area (%S).

RESULTS AND DISCUSSION

The correlation analysis (Table 1) showed a positive correlation (0.592) between sheep number (SN) and total surface swept by fire (S). The same trend could be observed when considering sheep number change (Δ SN) and surfaces affected by fire, even though the correlation was lower (0.35). The number of fires (NF) was positively correlated with sheep number (0.467) rather than with sheep number change (0.133).

Table 1. Correlation coefficients for the relationship between fire and other factors.

	NF	NO	S	SN	Δ SN	Δ LSU	SR
NO	<i>0.508</i>						
S	<i>0.700</i>	0.157					
SN	<i>0.467</i>	-0.047	<i>0.592</i>				
Δ SN	0.133	-0.080	<i>0.350</i>	<i>0.787</i>			
Δ LSU	0.040	-0.014	<i>0.290</i>	<i>0.556</i>	<i>0.852</i>		
SR	-0.036	0.208	0.002	<i>0.304</i>	<i>0.336</i>	<i>0.367</i>	
UR	-0.015	<i>0.223</i>	-0.122	-0.147	-0.009	0.072	0.169

Legenda: NF = Number of fires. NO = Number of fires per km².
 S = Total burned surface. SN = Sheep number.
 Δ SN = Sheep number change. Δ LSU = Livestock units change.
 SR = Sheep stocking rate. UR = Unemployment rate.

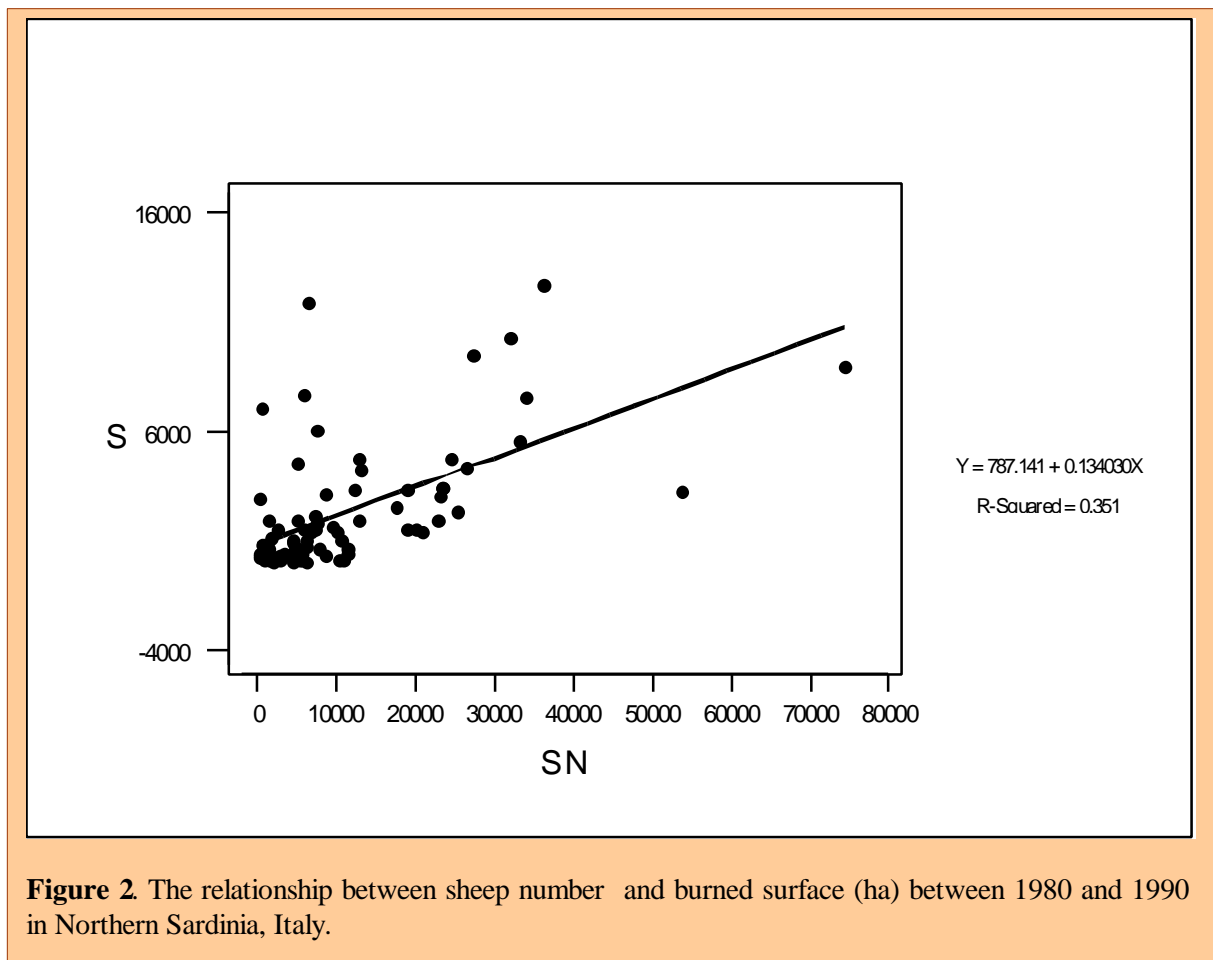
Correlation coefficients with P<0.05 are in italics.

Correlation between stocking rate (SR) and burned surface (S) being very low, it can be inferred that the use of fire was mainly related to the clearance of the existing pastures and to the creation of new ones independent of stocking rate. Stocking rate (SR) is mainly linked with soil productivity: on irrigated soil, SR can be 20 sheep ha⁻¹ with no need to use fire as an agronomic practice; on the contrary, in areas having a SR of 1 sheep ha⁻¹ fire can be intensely used.

The correlations mentioned above confirm the close relationship between number of fires or extension of burned areas and sheep number rather than stocking rate.

In addition the number of outbreaks (NO) showed a low correlation with burned surfaces, thus confirming the high incidence of catastrophic events, while the positive correlation with UR (0.223) highlights the socioeconomic component in fire phenomenon.

The regression between sheep number and burned surface (Figure 2) showed that to each sheep head corresponds 0.13 ha of burned area, explaining 35.1% of total variance.



The regression between sheep number change and burned surfaces (Figure 3) showed the presence of two almost independent components: the first one related to sheep number change (regression line) and the second one to all the other factors influencing the phenomenon (broken line), partially excluding SN as a consequence of

the high correlation between the two variables ($r=0.787$). The first component explains about 12% of the total variability of the phenomenon.

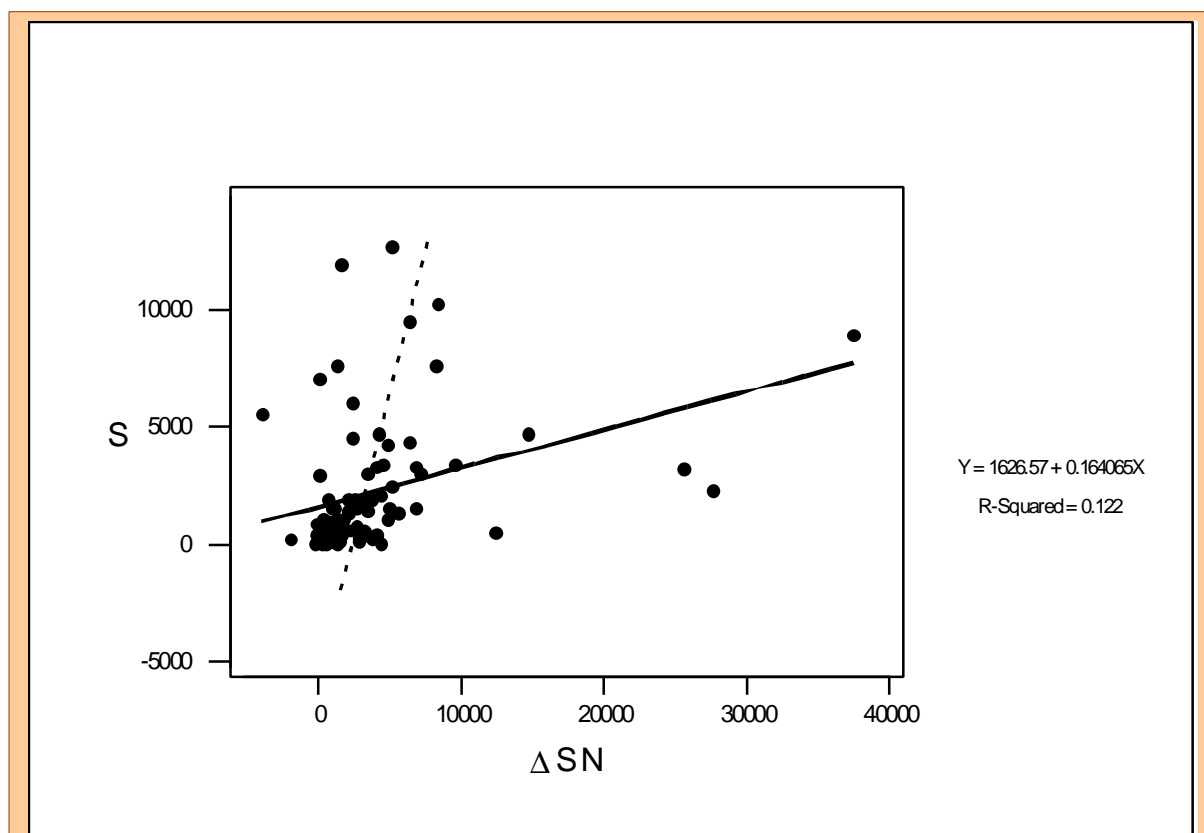


Figure 3. Regression for the sheep number change and burned surface (ha) in the decade 1980–1990 in Northern Sardinia, Italy (the 2nd component is shown by the broken line).

The analysis of variance (Table 2) showed an increase in the percentage of burned surface in areas characterised by low tourist relevance: this confirms that in rural areas fire is used as an agronomic practice. In municipalities with high tourist relevance the total burned area was reduced by half.

Table 2. Adjusted means (\pm SE) of outbreaks and burned surfaces of municipalities classified by tourist relevance.

Tourist relevance	Number of outbreaks per km ² (NO)		% burned of the municipality area (%S)	
	m	SE	m	SE
High (n=19)	0.685	0.100	13.65 a	3.52
Low (n=15)	0.797	0.181	28.51 b	6.70
Absent (n=50)	0.998	0.100	31.81 b	3.90
<i>P</i> of <i>F</i> and DSR of GLM	0.180	0.658	0.031	0.251

CONCLUSION AND PERSPECTIVES

The study carried out in Northern Sardinia on the relationship between fires and agropastoralism allowed a better understanding of a complex phenomenon such as fire in Mediterranean rural areas. In particular the investigation confirmed that:

- Agropastoralism plays a major role among the causes of fires. The use of fire as an agronomic practice for shrub clearance is still a deeply rooted tradition among rural populations.
- The positive correlation between sheep number and burned surfaces can be considered as an indirect effect of agropastoral activities on land degradation phenomena.
- Fires are often linked to socio-economic aspects, such as tourism and probably unemployment rate.

This work is a methodological contribution towards the understanding of fire phenomenon. Within the EU -MEDALUS project, a more comprehensive investigation involving the whole island will be carried out; other socioeconomic indicators will be considered and a more accurate methodology for burned areas inventorying will be tested.

ACKNOWLEDGEMENTS

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