

Effects of Forest Fires (1984-92) on the Cinereous Vulture *Aegypius* *monachus* reproduction in Sierra Pelada (Huelva, SW Spain)

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SUMMARY

In the period 1984-92, the Cinereous Vulture colony of Sierra Pelada suffered devastation from four forest fires, which affected 27 % of the annual mean of pairs that were building their nests, caused by the destruction of the nest platform (n=5), death of the young bird (n=2) or both causes (n=9).

The time needed to recolonise the damaged areas can be very short (two years) when the nests are situated on native trees (*Quercus*) growing in large clumps, or more than eight years in the dominant habitat in the colony, with a high density of exotic trees, and nests placed on wild *Quercus* or isolated cultivated pines in small clumps.

In the only breeding nucleus which was partially damaged, fires did not interrupt the important process of colonisation, because the number of platforms (400.00 %, n=16) increased in areas where there have not been any fires. The shortage of *Quercus*, due too poor management, has become more noticeable after fires, and the above-mentioned process of colonisation has been only possible because of the acquisition of a new strategy by this vulture population, consisting of building nests on isolated cultivated pine trees, locations less prone to forest fires.

INTRODUCTION

Fire has been one of the main factors affecting Mediterranean vegetation and should be used for its conservation and regeneration. (González Bernáldez, 1990). However, over the last decades, harmful human activity has turned forest fires into one of the main causes for the regression of indigenous ecosystems in the

Mediterranean basin. Where Spain is concerned, most fires are intentional or due to negligence (Vélez, 1990). What is more, their terrible consequences are heightened by the incorrect forestry policy of densely cultivating non-indigenous eucalyptus and pine trees.

Information on the effects of fires on birds of prey is very scarce. Moreover, in Spain, data of this type refer to few species. (*Aquila chrysaetos*, Arroyo *et al.*, 1990; *Circus aeruginosus*, González López, 1991; *Neophron percnopterus*, Perea *et al.*, 1991).

Concerning the Cinereous Vulture, Bernis (1966) quoted the case of a pair which recently took half burned branches to an unaltered platform on a cork tree. In one colony from the Mountains of Toledo, Morillo and Lalanda (1972) found a high proportion of nests on rocks, due to the fact that the largest trees are found there as it is an area free from fires. Hiraldo (1977) commented on the destruction of five trees with nests in the Sierra Pelada colony due to fire in the clump where the nests were situated. The fire was started in order to reafforest the area with non-indigenous trees. Aragües & Lucientes (1980) blamed a small fire for the disappearance of a former breeding colony (of little importance?). Finally, fires today represent one of the main problems for conservation in the Sierra de Gata colony; a fire which took place in 1991 destroyed 26 nests in this colony, 14 of which were occupied (A. Gentil, pers. comm.).

In this paper we analyse the effects fires have had from 1984-92, on the Cinereous Vulture's reproduction in Sierra Pelada. This is the fourth most populated colony in Spain (González, 1990), and one in which the dreadful consequences of this type of damage are clear.

AREA AND METHOD OF STUDY

Sierra Pelada is located NW of the province of Huelva (SW Spain). The mean altitudes are above 400 m.; the maximum altitude is 736 m. The area for the study was described by Hiraldo (1977).

The original nesting habitat is tall, dense scrub with slopes characterised by the presence of dense, Mediterranean undergrowth with oak trees (mainly *Q. suber* and *Q. rotundifolia*) which are used as bases for nests.

At present, most of the area is occupied by dense forestry cultivation of *Eucalyptus spp.* and non-indigenous pine trees (*Pinus pinea* and *P. pinaster*). Nearly all these clumps or thickets are small, and occupy only narrow stretches on hillsides, between reafforestation areas. The large areas of dense thicket occupy the whole or most of the basin of a ravine. In both types the shortage of *Quercus* is apparent. Considering the whole breeding colony the boundary of pasturelands is just as narrow.

Method

Yearly censuses were carried out between March and August, and generally every nest was checked monthly. Data from visits at other times of the year were also used (pairs breeding or building new nests early). After every fire all the breeding platforms in the area were inspected, in order to determine the physical state of the nest and chick, if applicable. Even if all the platforms had been destroyed these areas were studied yearly to analyse their evolution.

“d” has been used for “normal deviation”, for statistical purposes, as described by Sokal & Rohlf (1968).

RESULTS AND DISCUSSION.

Direct effects of fires on the colony.

The fires which took place from 1984-92 were intentional (3 cases) and due to negligence (1 case). None of them affected the amount of food available for the Cinereous Vulture, as most of the damaged area was forestry cultivation.

There were three remaining damaged areas out of the colony's eight breeding nuclei (Fig. 1). Sixteen nesting pairs (27% of the yearly average of the colony from 1984-92) were affected by destruction of breeding platforms (n=5), death of the chick (n=2) or both (n=9).

The worst fire was in 1992. The high mortality of chicks which resulted made that year's breeding success for the colony (64.93%, n=77 nesting pairs), significantly less than that of 1989 (84.05%, n=69) and 1990 (85.71%, n=70) (d=2.63 and d=2.91, $p<0.01$). From the period 1984 to 92, these two years were the occasions when human intervention was most seriously felt.

Fires affect more pairs than those nesting as there are fewer nesting pairs than destroyed platforms. The figure for platforms destroyed by fire and then occupied one year along with the two nearest platforms, (three in this study), can give an idea of the number of non-nesting pairs affected.

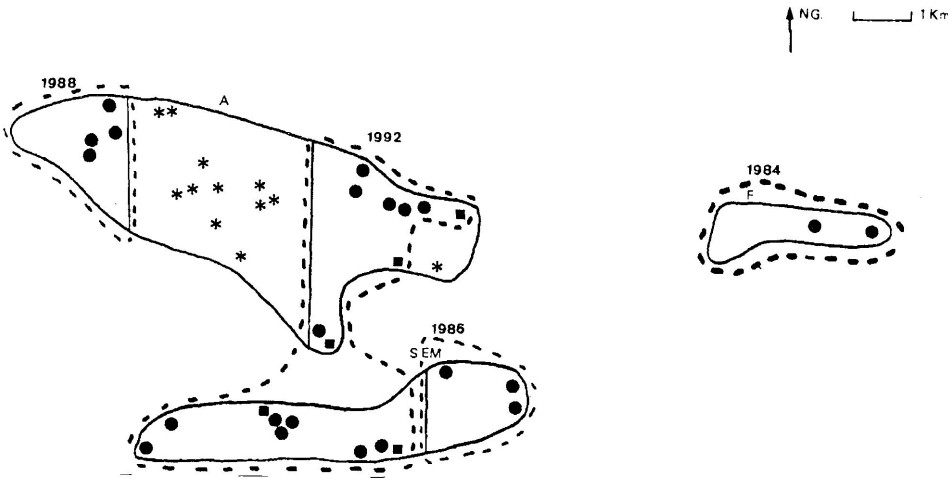
Gusty winds, which coincided with the 1992 fire, caused the fire to have less effect on the platforms occupied that year, (25% were unaltered, n=3), than on the chicks; all of which either suffocated to death, if situated on untouched platforms, or burnt to death if not rescued.

Recolonization of damaged areas.

We have observed that nesting areas affected by fires tend to be recolonized by the Cinereous Vulture (Fig. 2), mainly by building new breeding platforms (n=11), and to a lesser extent by occupying the few platforms not destroyed (n=4). Only in one of the five damaged areas was the recolonization process not begun.

Figure 1. Direct effects of fires on the breeding nuclei: "Aserrador" (A), "Fresneda" (F) and "Solana El Mustio" (SEM).

Vertical continuous lines, geographical sectors considered in "A" and "SEM"; discontinuous lines, breeding areas affected by the fires occurred in the indicated years. Marks used. Platforms in non-damaged areas: *. Platforms in burnt areas: Destroyed: circles. Unaltered: squares.



The time needed for recolonization depends on the habitat affected (Table 1). In the case of nesting on native dispersed trees found in large clumps (sector w of breeding nucleus "Aserrador"), total recolonization is established the second year, when cork trees and holm oaks resprout and are large enough for the vultures' nests. In this area three platforms were not rebuilt (Fig. 2). Less than 25 metres distant from one of them another new platform appeared, the pair which owned it perhaps being the same as that of the destroyed platform. The other two platforms, which were closer together, were occupied alternately before the fire, so perhaps they belonged to the same pair. The fact that they were not rebuilt could be due to the use of cork trees as massive roosting sites by the non-reproductive species *Gyps fulvus*. This species is abundant in the area, especially during the period of building new platforms, due to the close proximity of a feeding site for Cinereous Vulture. This hypothesis could be based on the case of a nest built on a smaller cork tree without a platform some 100 metres away. This nest finally collapsed and the egg was lost. (1994).

In the case of the colony's main habitat (remaining four damaged areas), with nests placed on *Quercus* dispersed over small clumps, surrounded by reafforestation of non-indigenous trees and or with nests on isolated pines, the time needed for recolonization could be more than eight years, although in the second year recolonization can reach around 40%. This longer time for affected *Quercus* could be due to the fact that they are subject to fiercer burning, as they are found

in small clumps, resulting in a greater mortality and perhaps total or partial inhibition of the resprouting process; whilst with pines, it can be explained by their inflammable nature and the fact that they cannot resprout.

In the Sierra de Gata colony Cinereous Vultures built nests on non-affected trees in a damaged area as well as on dry burnt pine trees. (A. Gentil, com. pers.)

Evolution of partially damaged breeding nuclei.

The only breeding nucleus which has been partially damaged was "Aserrador", and has been the target for a process of recolonization by Cinereous Vultures from 1985 to 1994 (Table 2). Forest fires did not interrupt this process, although they did slow it down.

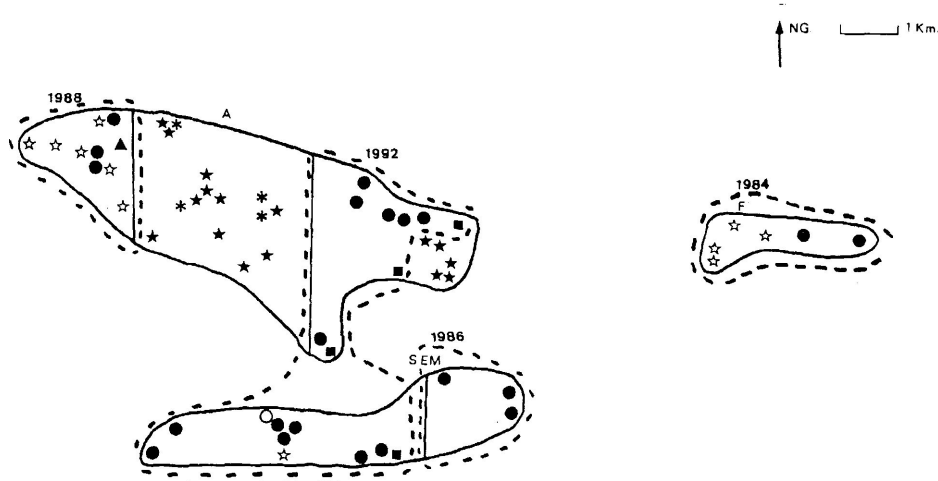
The colonization process has been possible because of the considerable increase in platforms (400.00%, n=16) located in areas which suffered no fire (Fig. 2).

The serious shortage of cork trees and holm oaks which hold the colony, a consequence of poor forestry and conservation management, has been temporarily accentuated in this colony by two fires. The shortage of nesting bases in areas which were not burnt, particularly *Quercus*, has led the affected vulture population to develop a new strategy, which consists of nesting on cultivated non-indigenous

Table 1. Time of recolonization. Nesting couples: year of the fire/year 1994. Type of habitat: large "manchas" (M) or small ones (m) among forest cultivations).

FIRE YEAR	AFFECTED AREA	PAIRS NESTING	RECOLONIZATION YEAR	HABITAT TYPE	TYPE & NO. OF NESTING PLACES (NON AFFECTED) / YEAR 1994
1984	F	2/2	1993	m	<i>P. pinea</i> 2 (0) / 3 <i>Q. suber</i> / 1
1986	SEM(Esector)	1/0	Non colonized	m	<i>Q. suber</i> 2 (0) / 3 <i>P. pinea</i> 1 (0) / 0
1988	A(Wsector)	2/3	1990	M	<i>Q. suber</i> 3 (0) / 3 <i>Q. rotn.</i> 1 (0) / 1
1992	A(Esector)	7/3	Partial reco- lonization (42'85%)	m	<i>Q. suber</i> 4 (2) / 2 <i>P. pinea</i> 3 (1) / 1 <i>Q. rotn.</i> 2 (0) / 0
1992	SEM(Wsector)	5/2	Partial reco- lonization (40'00%)	m	<i>Q. suber</i> 7 (1) / 2 <i>Q. rotn.</i> 1 (1) / 1 <i>P. pinea</i> 1 (0) / 0

Figure 2. Evolution of the damaged nuclei (year of the fire/1994). Interpretations of lines, abbreviations and numbers like those in Fig. 1. Marks used. Platforms in affected areas.- Nonreconstructed: full circles; reconstructed: triangles; non-destroyed and reused: squares; neither destroyed nor reused: empty circles; constructed after the fire: empty stars; platforms in non-affected areas. Existing until 1988: *; constructed after the fires in 1988 or in 1992: full stars.



pine trees, this proves to be the least favourable tree site in the event of fire. In these areas 81.25% of the sites chosen after fires are isolated pines.

The possibility exists that there were formerly a small amount of nests on pine trees in the colony. Hiraldo (1977) found two of these, and there were two in the period of 1985 to 1990. As can be seen in Table 2, nests on pine trees in this nucleus, appear after the first fire in the cycle under study. After the most devastating fire in 1992 the number of these sites grew notably, and in 1994 they were the most predominant.

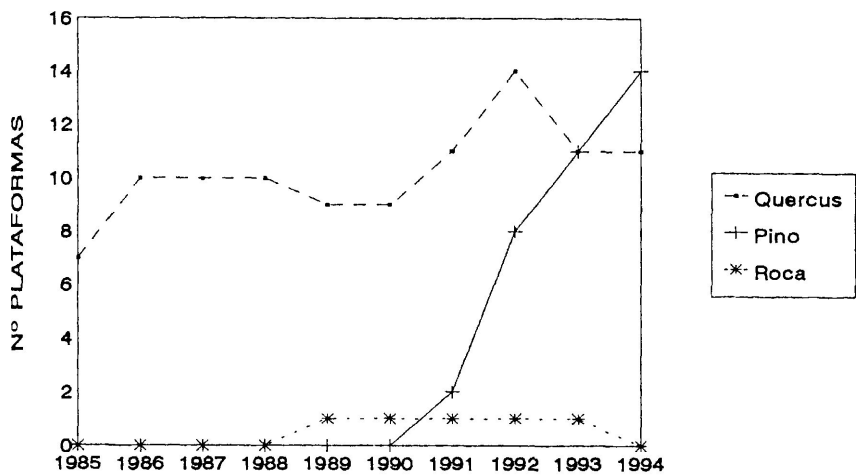
The quality of recolonization has been, up till now, different in the two damaged sectors, due to their different nesting habitats. Sector W with large clumps, was recolonized in two years by means of the settling of breeding pairs on *Quercus* located in the damaged areas. Also in sector E, which has small clumps, the same number of nesting pairs as that of the year of the fire was reached in the second year, although the sector has been expanded to make this possible (Fig. 2), so 57.14 % of pairs in this sector bred on isolated pine trees found in areas which had no fire.

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Table 2 Nesting pairs in the nucleus "Aserrador" (1985-94) and types of existing placings. The years in which fires took place appear in bold type.

	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
Breeding pairs	4	3	6	5	9	9	11	18	15	15
Quercus	7	10	10	10	9	9	11	14	11	11
Pinus	0	0	0	0	0	0	2	8	11	14
Rock	0	0	0	0	1	1	1	1	1	0



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