

Reintroduction of the Griffon Vulture *Gyps fulvus* in the Massif Central, France.

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ABSTRACT

Griffon Vultures disappeared from the Causses in the Southern Massif Central around 1945. In 1981, a reintroduction project began in this area. Ten years later, the new colony includes about a hundred individuals. The different steps of its settlement and increase are described. They concern spatial dispersion and foraging zone as well as reproduction and exchanges between the Causses colony and Pyrenean and Iberian populations.

INTRODUCTION

Griffon Vultures (*Gyps fulvus fulvus*) were eliminated from south central France during the first third of the twentieth century because of direct destruction by gun and poison. They were extinct by 1945 (Berthet 1946).

In 1968 a reintroduction project was started (Fonds d'Intervention pour les Rapaces - Parc National des Cévennes) near the last known breeding site (Heim de Balzac 1922) in an area of still good habitat for vultures; cliffs and limestone plateaux, the Causses, where important sheep rearing persists. This project occurred in three successive stages (Brosselin 1971; Terrasse 1980, 1982, 1983, 1990):

- 1968 to 1981 : Preparation of public opinion, education of hunters, obtaining strychnine prohibition and gathering of about 50 captive Griffon Vultures:

- 1981 to 1986: release of captive vultures (at the end of this first stage the colony was about 50 free-flying individuals strong):

- after 1986: free evolution of this population.

The reintroduction method based on releasing adult pairs in order to fix a breeding group fundamentally differs from those usually used in other raptor reintroduction projects like those of the Bearded Vulture, *Gypaetus barbatus*, (Esteve 1986), White-tailed Sea Eagle, *Haliaeetus albicilla*, (Love 1983) and Peregrine Falcon, *Falco peregrinus*, (Cade 1979), in which only immature birds were preliminarily released. In 1970, attempts to release young Griffon Vultures failed because of high juvenile dispersion in this species.

The nearest wild breeding colonies of Béarn and Catalonia are located at least 300 km from the release site.

This study analyses the progressive adaptation of this colony to its new environment, focussing on the exploitation of food resources and basic demographic parameters.

Figure 1. Situation map of the study area.

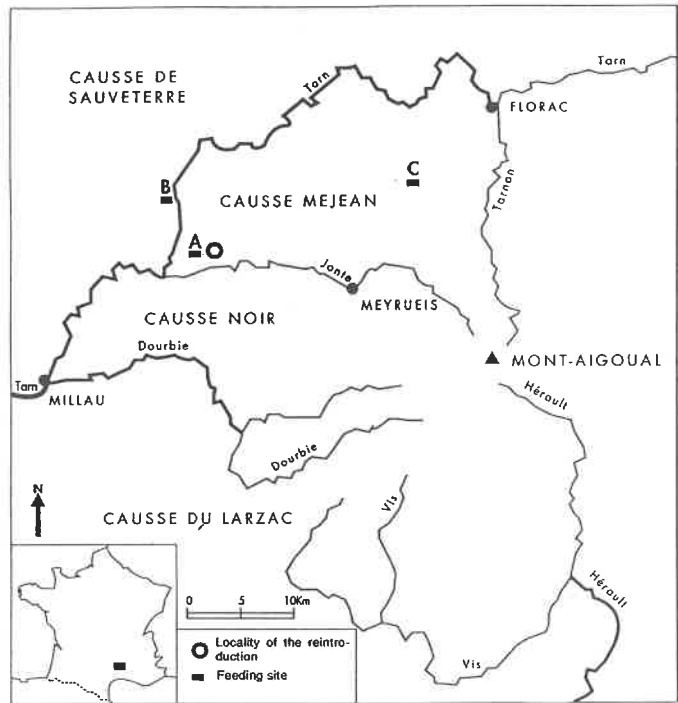
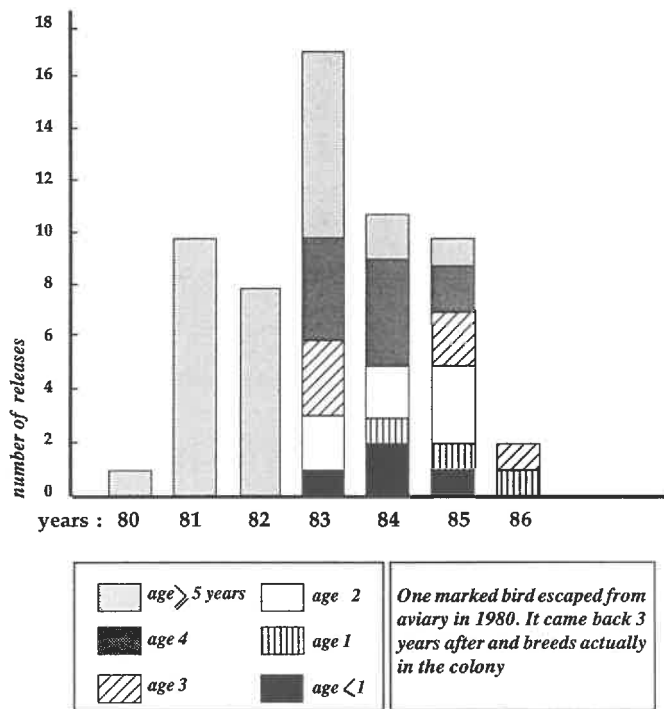


Figure 2. Number of yearly releases (by age classes).



METHOD

Study area

The study area covers all the Grands Causses of South Central France especially in Lozère and Aveyron department (Figure 1) where the Tarn, Jonte and Dourbie rivers flow into deep canyons. The release site is located on the southern rim of the Causse Méjean, where the aviary for captive breeding was built at the top of a cliff overlooking the gorges of the Jonte river.

Vulture group used

From 1970 to 1987, 86 Griffon Vultures had been obtained from different origins:

- 47 came from the wild or from rehabilitation centres (31 from Spain and 16 from France)
- 24 were given or exchanged by zoos,
- 6 were seized from dealers (unknown origin),
- 9 were born in our aviary.

More than one third of these vultures had lived in captivity for a long time (5 to more than 10 years). Moreover, even some of those held in captivity for shorter times were already habituated to man.

Release conditions

To maximize the chances of settling a colony, the first released vultures (in 1981 and 1982) were all paired adults and most of them had bred in an aviary. The first ten adults were released in December at the time of display and mating. Because of unfavourable climatic conditions in winter with few thermal currents, younger individuals which had spent less time in captivity were released only in 1983 (Figure 2).

Monitoring

Since first release all individuals were monitored daily with visual marks or radio transmitters. All released vultures were marked with a metallic ring and one plastic lettered ring or a combination of coloured rings. Because of ring losses and problems with reading letters from distances over 300 m, young vultures are today marked in the nest with DARVIC coloured rings and recapture sessions will occur every year in order to ensure that all adults will be marked. From 1981 to 1983, all released birds wore radio-transmitters (17 gr) fixed to their two central tail feathers. Radio tracking permitted us to retrieve vultures who landed, during their first flights, in anomalous sites like dense bushes on slopes. The maximal theoretical range of the transmitters was about 20 km but the usual recording distance was less than 1 km and the lifespan of the transmitters never exceeded 6 months (4 - 5 months on average). These results, the easy visual monitoring and the increasing trend of released birds to remain around the release site quickly led us to stop radio-tracking after 1983.

The census and observations were essentially made by three persons permanently involved in the project, subsequently helped by several amateur ornithologists. All the following results were derived from marked birds.

Feeding method

Some months before the first releases, feeding site A (Figure 1), close to the aviary, was supplied in order to establish links between corvids and captive vultures as were also sites B and C respectively 5 km and 20 km away from A. These feeding sites were 100 to 400 m² fenced areas to keep off foxes and dogs. They were supplied with carcasses mainly coming from farms and sometimes from two nearby slaughter houses. Since 1985, vultures have begun to feed on carcasses laid out by farmers.

Figure 3. Movements and dispersal of Griffon Vultures from December 1981 to December 1984.

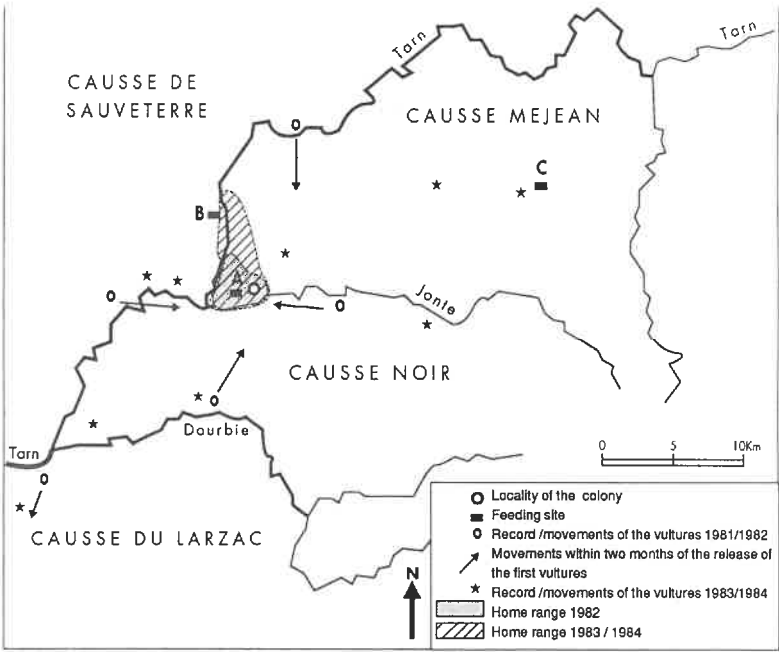
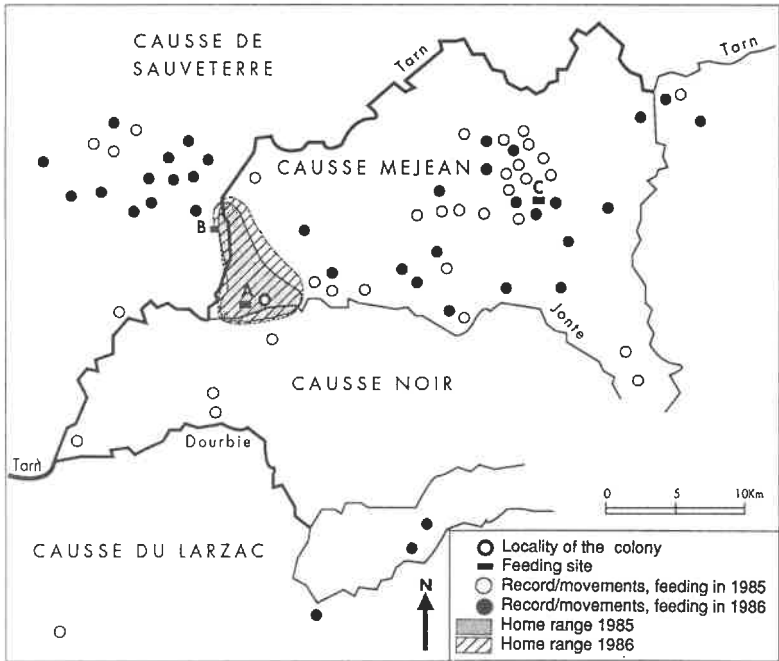


Figure 4. Range and foraging area of Griffon Vultures in 1985-1986.



RESULTS

Adaptation of released Griffon Vultures to the wild

The behaviour of the first released adults and of younger released birds must be distinguished (Figure 2).

During the first two to four weeks, the released adults presented poor flight abilities (Bonnet *et al.* 1990). They dispersed and adults of the same pair were sometimes several kilometres apart. They divided their time between long rests and flapping flights. The dispersal area, centred on the canyons of Tarn and Jonte, covered about 500 km² (Figure 3). The correct use of thermal currents began at the end of this period, during which these vultures did not feed. Thus one individual sustained 3 weeks without feeding but another bird died after 40 days. The energy cost of flight learning was certainly high, therefore their ability to endure starvation is remarkable. From 1983, 2-4 years old birds were released. They were in captivity for less than one year and consequently they could fly within less than two weeks. The released fledglings seemed to have the same flying ability as the wild-born fledglings. Among 59 released marked birds, 8 were found dead and 5 were removed from the wild. Furthermore, among 76 marked wild-born individuals, 10 were found dead and 4 were removed from the wild. Electrocution was the main cause of mortality (10 dead marked birds from 1981 to 1991). To date it has killed 15 marked or non-marked Griffon Vultures in the Causses.

Establishment and increase of the colony

** settling of the breeding group (1981-1983).*

In order to favour the settling of the first released birds, several caves and ledges on the cliff closest to the aviary were cleared and painted with white to mimic occupied sites. This site had harboured the last known colony of Griffon Vultures in the Grands Causses (Heim de Balzac 1922; Rochon-Duvigneaud 1921). In February 1982, three pairs (Table 1) settled in a 500 m portion of that cliff and one pair succeeded in rearing a chick. In 1983, the colony extended along 1200 m of this same cliff.

Table 1. Timing of the settlement of the Griffon Vulture's colony in the Causses.

year	Released birds	Wild born birds	Dead birds	Recaptured birds
1980	1*	0	0	0
1981	10	0	0	0
1982	8	1	3	2
1983	17	1	1	1
1984	11	1	0	2
1985	12**	5	4	0
1986	2	6	0	0
1987	0	12	1	1
1988	0	10★	3	0
1989	0	9	2	1
1990	0	15	5	1
1991	0	17	1	1
Total	61	77	20	9

*This marked Griffon Vulture escaped and came back three years later.

**Two non-marked birds escaped.

★One fledgling was not marked.

Figure 5. Range and foraging area of Griffon Vultures in 1987-1988.

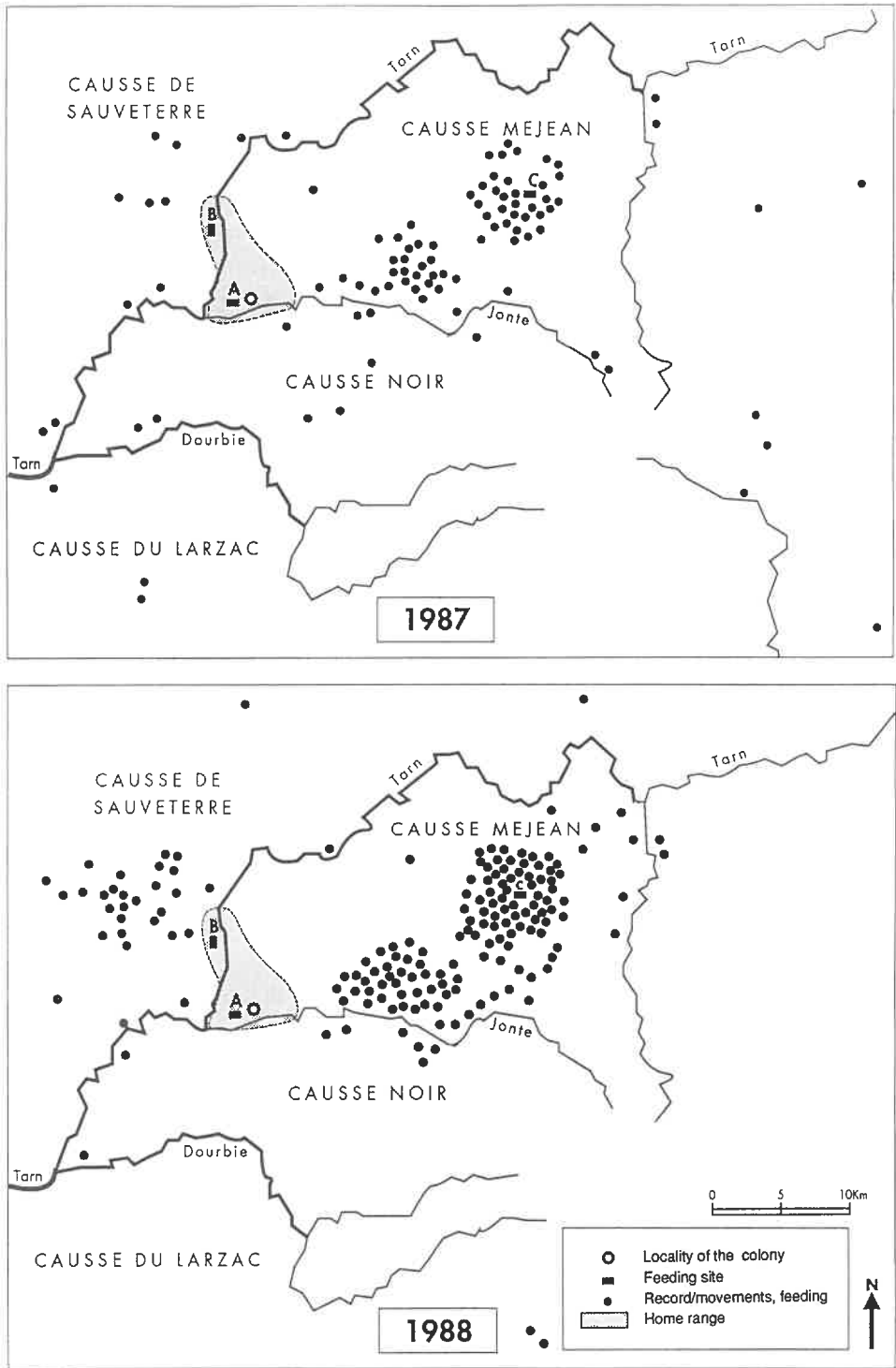


Figure 6. Number of total breeding pairs and nests in Jonte and Tarn canyons.

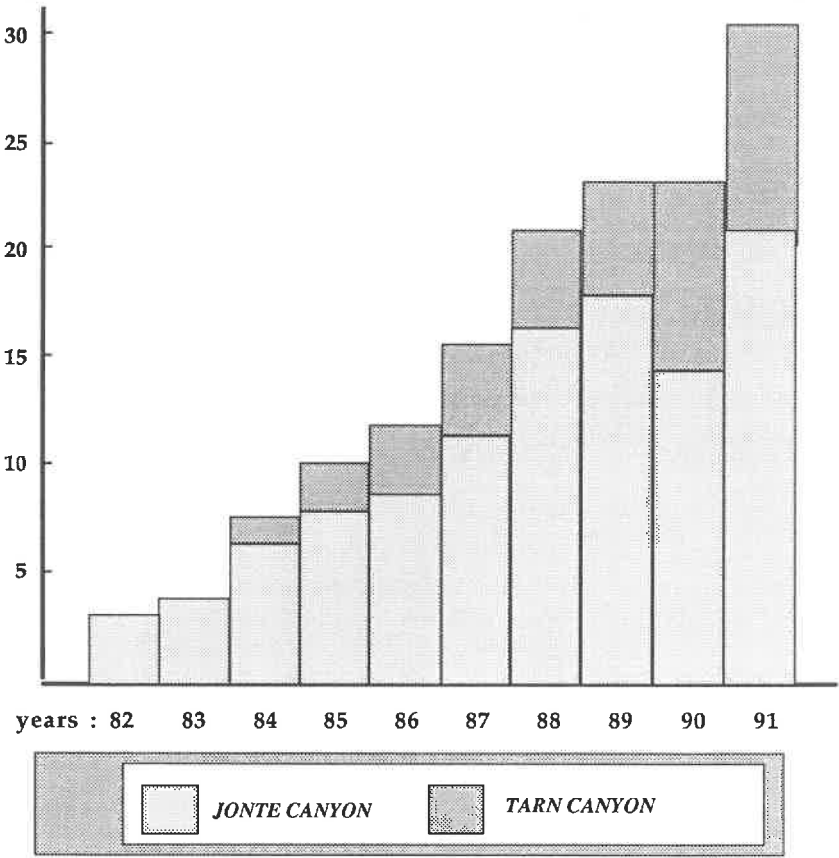
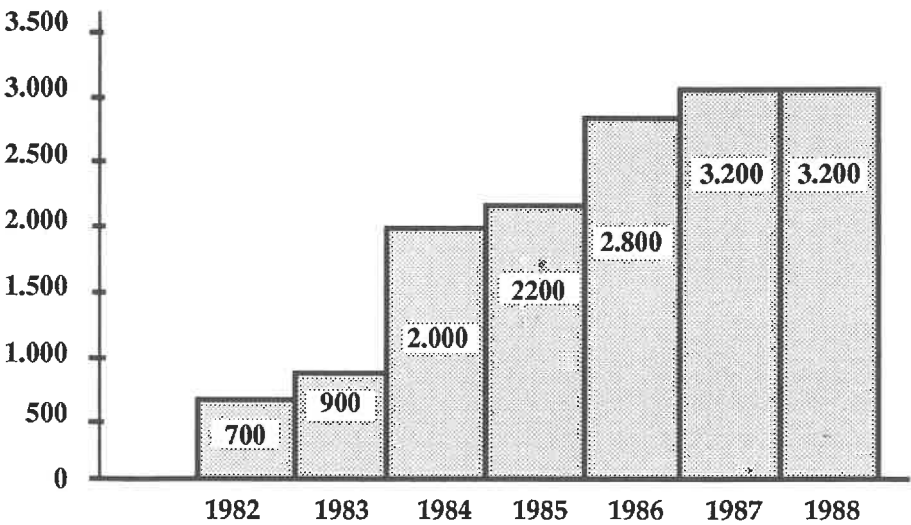


Figure 7. Area (hectares) of the home range.



** spatial increase of the colony*

From 1984, the increase in the number of free vultures favoured the split-up of the breeding group. Several pairs settled in the Tarn valley at 3 - 6 km from the first breeding group (Figure 3, 4, 5 and 6). The Tarn cliff chosen by these vultures was precisely one where this species nested a century ago (Solanet 1894). The first successful reproduction occurred in 1985 in this second breeding group. Therefore the cliff length occupied by the overall colony increased from 500 m in 1982 to 4 km in 1991 with a 6.2 km distance between the outermost nests. Here we define the home range as the area that embraces all the activities of the overall colony during the breeding period instead of the activities of one pair (Newton 1979). After a rapid increase, the home range seemed to stabilize in 1987 with an area of 3000 ha. This home range is centred on the release point and the feeding site A (Fig. 7).

Reproduction in the wild

The increase in the number of breeders across years and a faulty ringing system (ring loss, non-marked immigrants...) make good monitoring information more and more difficult to obtain. Therefore the following trends should be interpreted as minimal. Furthermore, a population dynamics study is now in progress and only a few preliminary descriptive data will be given here.

** recruitment*

Among 140 marked individuals, 46 built a nest and were considered as breeders for at least one year (Figure 8). 35 released birds were identified as breeders. Because of no information on the age of most of them we cannot discuss their breeding success according to age. However, one individual released as juvenile in 1984 paired and built a nest when 3 years old but did not lay. Nine wildborn vultures were recruited, 8 when 4 years old and 1 when 5 years old. Therefore it seems that age at first breeding is 4 in our colony instead of 5 or 6 in other natural populations (Terrasse 1977; Elsegui 1989).

The first Griffon Vulture which was born in the wild in 1982 never paired nor reproduced. In 1991, when it was 9 years old, its plumage still exhibited signs of immaturity.

** breeding success*

The temporal evolution of the number of breeding pairs and clutch, hatching and fledging successes (Figure 9) shows the dynamism of this population and is helpful to understand its demographic increase (Figure 10). Because of small population size, the breeding success is not studied in relation to age but is calculated over all breeding pairs (Table 2). However, the production of pairs with one or two wild-born breeders is for the whole period relatively high (0.92 i.e., 12 fledglings for 13 "annual pairs" having at least one wild-born individual). Only one pair is surely composed of two wild-born individuals. These two vultures began to breed when 4 years old. They failed in their first breeding attempt in 1989 but succeeded in 1990 and 1991.

Table 2. Yearly breeding success parameters

Year	Number of clutches	Hatching success	Fledging success	Breeding success
1982	2	0.50	1.00	0.50
1983	4	0.25	1.00	0.25
1984	7	0.29	0.50	0.14
1985	9	0.56	1.00	0.56
1986	12	0.50	1.00	0.50
1987*	12	0.83	1.00	0.83
1988*	15	0.65	0.88	0.53
1989*	20	0.50	0.88	0.40
1990*	24	0.72	0.88	0.62
1991	29	0.72	0.81	0.59

*In order not to artificially maximize breeding success, only early recorded breeding pairs have been taken into account.

Figure 8. Recruitment of released, young and suspected immigrant Griffon Vultures for the first year of breeding.

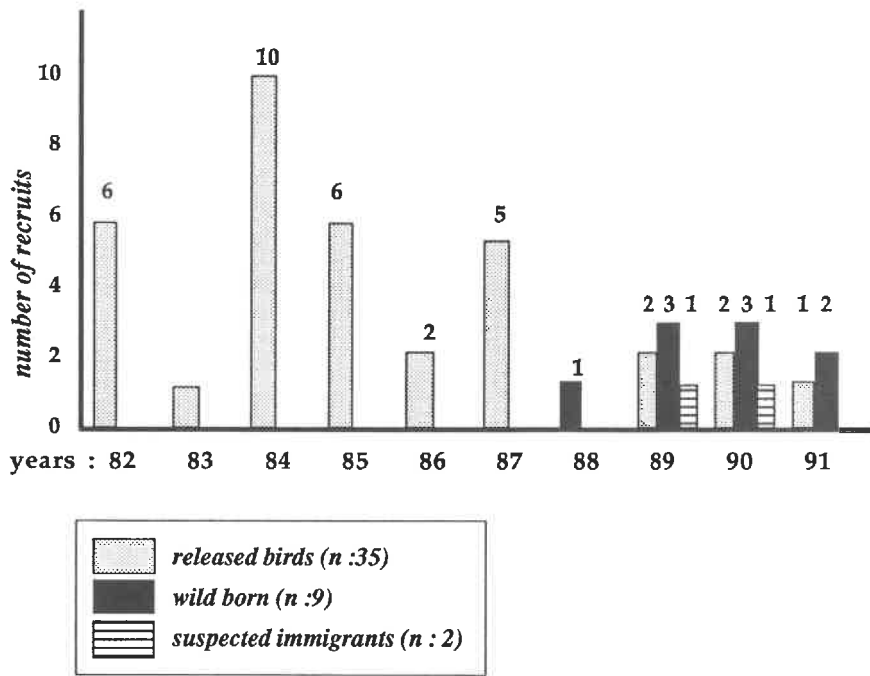
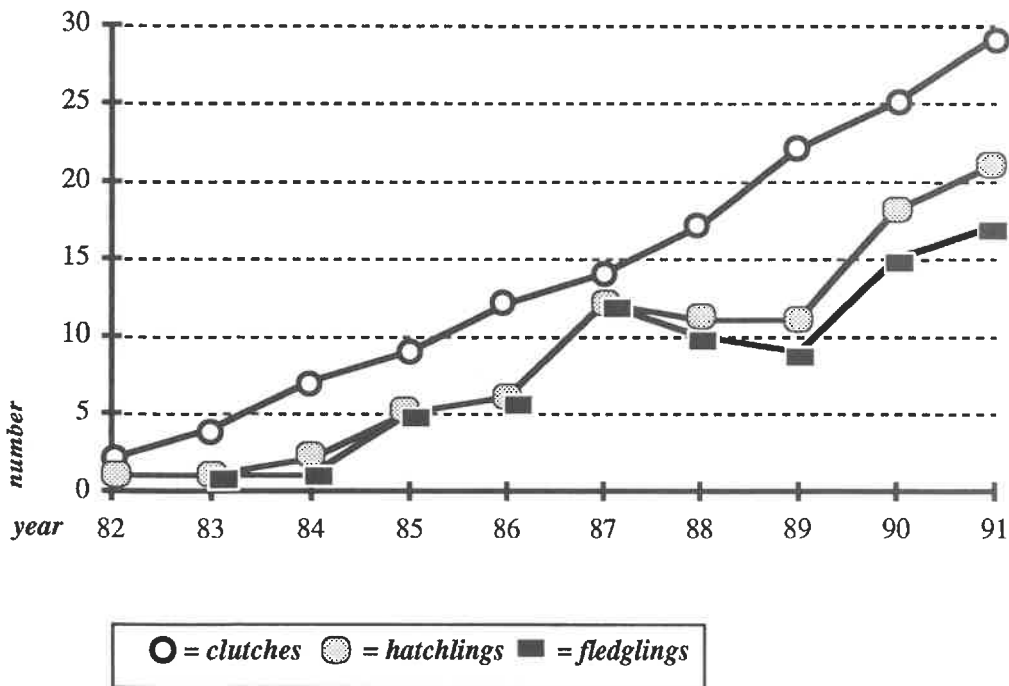


Figure 9. Annual number of clutches, hatchlings and fledglings.



** juvenile mortality*

From 1982 to 1991, 77 Griffon Vultures were born in the wild and 76 of them were ringed. Among these birds, 4 disappeared and 10 died, all of them before the end of their second year (8 as yearlings, 5 before 2 years, 1 before 3 years).

Exchange with other populations

Seasonal movements of Griffon Vultures have been recorded in the Austrian Alps (Perco *et al.* 1983), the Crau (Jaubert & Lapommeraye 1859) and in the Pyrenees (Dendaletche 1970; Elosegui 1987). These vultures forage on areas with high food availability. This could be the case for Crau or Basque country in winter and also for Iberian vultures in the central and Catalanian Pyrenees in summer. In Pyrenean colonies, these movements include only immatures and non breeders and fundamentally differ from those of yearlings in autumn (Elosegui & Elosegui 1977). This behaviour is not a real migration but a juvenile dispersion with a south south-west direction for Pyrenean colonies which lead some individuals to cross the Mediterranean from Gibraltar to Africa (Mauritania and Senegal).

** wandering juveniles in the Causses colony*

Because of the low number of free fledging birds before 1984 (Table 1), the only known case of juvenile dispersion was the disappearance of a yearling in December 1985 and its return to the colony in April 1988. Analyses of juvenile survival and recapture rates are currently being conducted and should confirm this juvenile tendency to move around. Recently, we have received a report on the recovery of a juvenile, born in 1991 and found poisoned in North Senegal, proving that our colony can be involved in the south migration down to sub-Saharan Africa.

** movements of foreign vultures*

In spite of its geographical isolation, the colony of the Causses attracted Iberian and Pyrenean Griffon Vultures. Since 1983, about 9 immigrants settled more or less definitively in the colony (Figures 8 and 10). At least two stayed and one of them paired and reproduced successfully. Five non-marked birds were recaptured in 1988 and 1991 but three of them could have been local birds.

One Griffon Vulture 1 or 2 years old was caught and released at Malaga (Spain) on 14 June 1985. This bird was recaptured in Cuers (Var department) 1159 km away and released in the Causses, where it joined the breeding group of which it is now a member. On the other hand, it is very difficult to know the origin of about 30 vultures observed in France since 1977 (Figure 11). Most of them (especially those observed before the first releases in 1981) probably came from Spanish colonies. These birds usually appear in France after April, in spring and summer, and follow a north-east direction. They come from the eastern Pyrenees and go to the southern Alps following the Rhône valley.

Foraging

Two aims of the project were to settle the colony and to facilitate spatial and feeding emancipation of the breeding group. Thus the feeding places A and B were first established. Feeding site C was later built far away from the colony and the first feeding sites were closed from time to time.

**foraging area*

From 1981 to 1984 the foraging area was equal to the home range (Figure 3). Vultures attracted by the feeding place A did not move away and avoided flying over the Causse. In 1984, the first vultures settled in the Tarn canyon and feeding place B began to be overflown more regularly. Thus the foraging area expanded to both sides of the valley. It seems that no spontaneous feedings occurred during these first years in spite of the great flying ability of some individuals.

From 1985 to 1988, the foraging area increased (Figures 4 and 5). In 1985, vultures fed at feeding site B and some spontaneous feedings were recorded. When exploring the eastern part of the Causse Méjean, the vultures discovered feeding site C. They landed for the first time in May 1986 and fed there for the first time in April 1987. This event was followed by a more regular exploitation of the food resources of this region (Table 3) and a significant increase of the average

Figure 10. Number of marked birds entering the population with time.

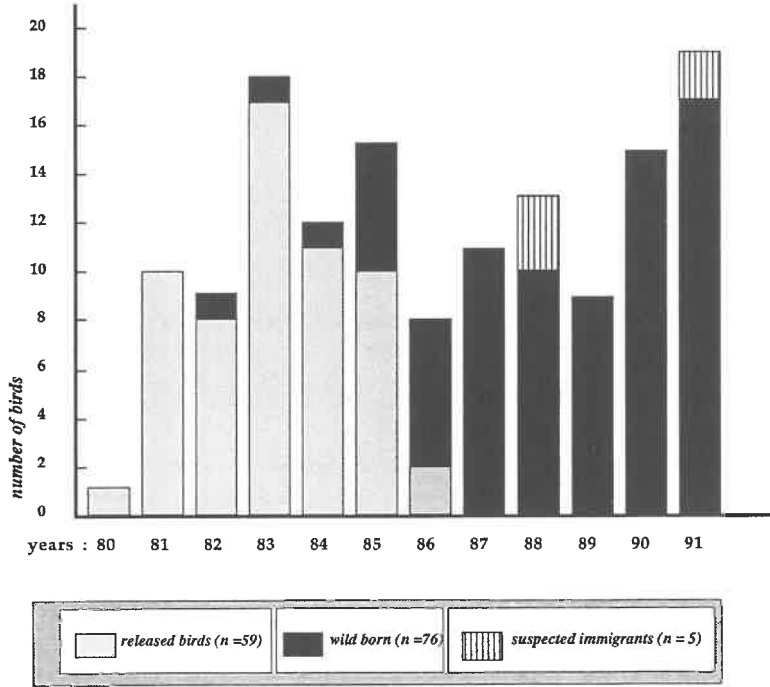
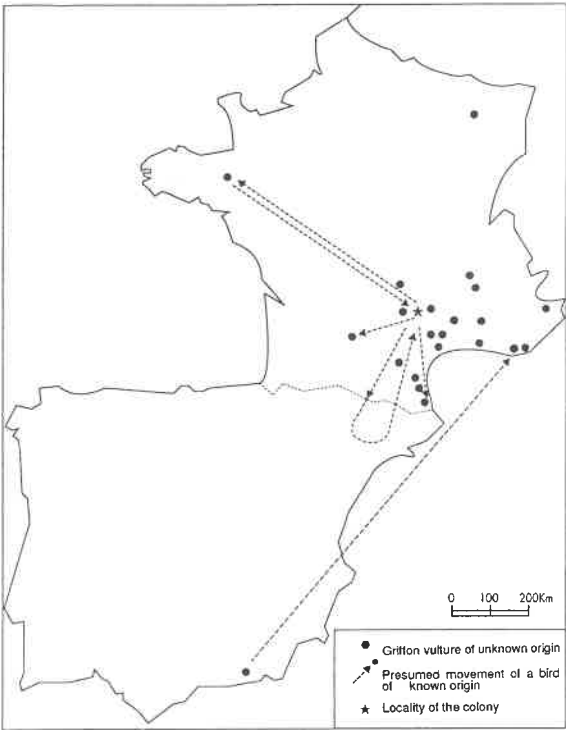


Figure 11. Records of Griffon Vultures from 1977 to 1989 (outside of the Pyrenean zone).



distances between feeding sites. Table 4 and Figures 4 and 5 show the increase of the foraging area and the exploitation of the Causses around the colony. Area measurement only takes into account records of feeding excluding unusually far sightings. They are thus to be considered as minima. Since 1989 it seems that there was little effort to explore new foraging areas.

Table 3. Distance between observed feeding sites (other than fixed sites A and B) and the release site of the vultures.

Distances (km)	0-5	6-10	11-15	16-20	21-25	Mean Distance	n
1985	5	3	-	-	-	4.6	8
1986	2	3	5	-	1	10.3	11
1987	3	13	8	13	4	12.6	41
1988	11	16	3	28	5	13	63

** foraging method*

The emancipation of released birds and the appearance of wild-born individuals influence the foraging strategy of the whole group. Furthermore, a better flying ability in bad weather conditions allowed Griffon Vultures to forage in winter. The vultures currently forage up to 15 km from the release site.

Table 4. Area (hectares) covered by foraging vultures around the colony.

	1985	1986	1987	1988
Causse Méjean	15.000	17.000	23.800	37.000
Causse de Sauveterre	4.700	8.000	8.300	12.800
Causse Noir (et du Larzac)	3.000	3.400	12.500	6.000
Total	22.700	28.400	44.600	55.800

DISCUSSION

First established in December 1981, the new colony of Griffon Vultures in the Causses is now more than one hundred individuals strong and its increase solely depends on its ability to reproduce and to exploit food resources available on its territory. In studying the number of sheep carcasses produced by local ranching, R.Briquet (1987) showed that four Grands Causses, excepting the south Larzac, on a 200,000 ha area could support a mean population of 700 Griffon Vultures with a monthly fluctuation from 300 in August and September to 1200 in November and December. In order to facilitate the emancipation of the colony and to help foraging on new territories north and south of the current home range, new feeding places are sometimes opened by farmers themselves. This method, associated with the progressive desertion of feeding sites close to the colony, should make the population less dependent on the project team and create closer links with local shepherds. Considering the favourable food resources availability, we can hope for a significant demographic increase during the next years. In spite of a lower breeding success than in the Pyrenees, where an average 0.60 to 0.81 young/pair/year are produced (Elosegui 1989) the turnover of the population with the recruitment of wild-born birds when 4 years old is a good indicator of the vitality of this population.

We saw that this new colony plays an attractive role for even the distant Pyrenean Griffon Vultures. The appearance of Egyptian Vultures *Neophron percnopterus* in 1982 and the settling of the first pair in 1988, albeit without reproduction, are good signs for the return of this species

whose nearest nest sites are 80 km away from the Grands Causses. Finally, the reintroduction project of Black Vulture, *Aegypius monachus*, within the framework of the European Black Vulture Conservation Programme scheduled for spring 1992, should complete this scavengers' community.

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Bay Owl *Phodilus badius*