

A Success Story: The Reintroduction of Eurasian Griffon *Gyps fulvus* and Black *Aegypius* *monachus* Vultures to France

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ABSTRACT

By the end of the 1960s, the future of vultures in France appeared bleak. Apart from the western half of the Pyrenees, with residual populations of Eurasian Griffon *Gyps fulvus* and Bearded Vultures *Gypaetus barbatus*, and Corsica with a few Bearded Vultures, most of France had lost its large vultures including the Black Vulture *Aegypius monachus*.

Within the scope of a national conservation campaign, a process to restore raptor communities began. Concerning vultures, this was completed through reintroduction programmes. After the success of the Griffon Vulture reintroduction, started in 1968 in the Grands Causses of the Massif Central, other programmes followed in the 90s: Black Vultures in the Massif Central and then Griffon Vultures in the Southern Alps.

In 2003 a viable population of Griffon Vultures in the Massif Central contained around 110 pairs. The same situation occurred in the Alps with about 50 breeding pairs of Griffon Vultures. Ten years after the beginning of the Black Vulture releases, the free ranging population included 11 breeding pairs. Accurate monitoring during the reintroduction period allowed us to estimate demographic parameters such as survival and breeding rates, evolution of breeding and foraging territories, main threats, movements between reintroduced populations and those from neighbouring countries, acceptance by people and the beneficial part played by vultures in what is called sustainable development.

INTRODUCTION

Since the 19th century, the sharp decrease and in some cases extinction of raptors in France were the consequences of a true "raptor war", where poisoning and shooting played a major role. Black *Aegypius monachus* and Griffon *Gyps fulvus* Vultures disappeared from the south of the Massif Central and the Alps between the end of the 19th Century and 1945 (Berthet 1946; Terrasse 1983). For these scavengers, a reduction of food availability due to the decline of wild ungulates and the set up of veterinary legislation preventing the disposal of carrion in the field, played an additional role in these extinctions.

In the 1960s, all European countries (France, Italy, Former Yugoslavia...) had lost most of their vultures (Schenk 1972) except for Spain with about 2,000 pairs of Griffon and 200 pairs of Black Vultures (Bernis 1966, 1974). In France the Black Vulture was extinct and the Pyrenees were the last stronghold of our vultures, with less than 10 pairs of Bearded Vultures and about 50 pairs of Griffon Vultures (Terrasse & Terrasse 1967) in the western half of this mountain range.

The first measure to reverse this negative trend was the set up of the first "vulture restaurants" in the 1960s, in the French Pyrenees, in order to provide a safe source of food without the threat of poison (Terrasse & Terrasse 1970).

In 1968, a group of raptor enthusiasts and later on the Fonds d'Intervention pour les Rapaces (now LPO) and the Parc National des Cevennes (PNC) started a reintroduction project near the last recorded Griffon Vulture breeding site in the Jonte Gorges in the southern part of the Massif Central (Heim de Balzac 1922). The success of this programme enabled us to build up a restoration strategy for both Griffon and Black Vultures at the scale of the whole of southern France. We present here a brief summary of the main outputs of these programmes in order to discuss success parameters that could be beneficial for other reintroductions.

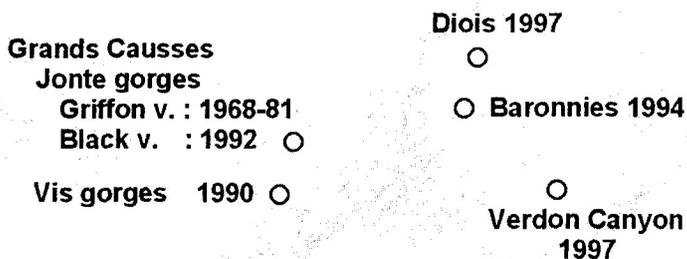
METHODS

Release area

The study area covers all the Grands Causses and adjacent canyons of the southern Massif Central, and the Provençale Pre-Alps (Fig. 1). These areas are still good habitat for vultures. They provide cliffs and limestone mountains or plateaux, where important sheep rearing is still present (Tessier 1992; Terrasse *et al.* 1994).

After the successful reintroduction of Griffon Vultures in the Jonte Gorges, a reintroduction attempt occurred in the Vis Gorges, in the southern Grands Causses, with first releases in 1993. This was followed by three programmes in the southern Alps, first releases starting in 1996 in the Baronnies, in 1999 in Diois and in 1999 in the Verdon Canyon. In 1992, in the Grands Causses, the reintroduction of the Black Vulture began with the help of the Black Vulture Conservation Foundation.

Figure 1. Location of release sites of Griffon and Black Vulture reintroductions in Southern France during the first year of programme preparation.

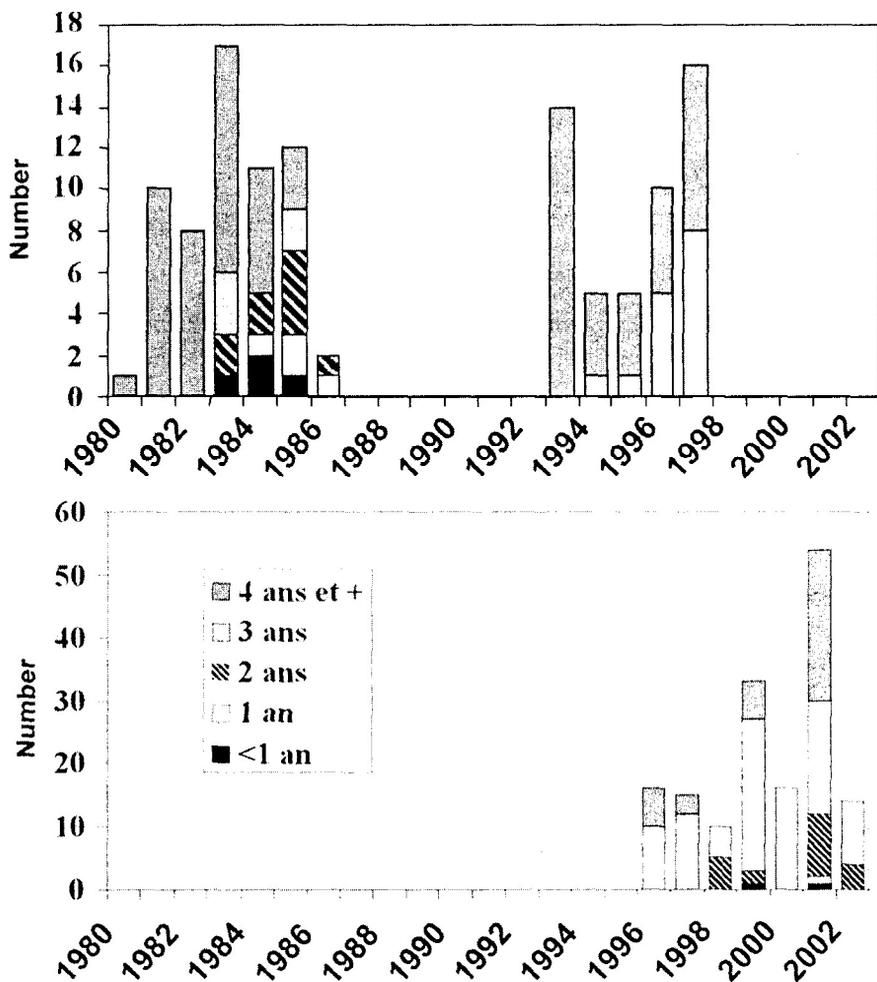


Reintroduction protocols

Griffon Vulture:

After some unsuccessful trials in releasing one year old Griffon Vultures in 1970, we decided to release adult pairs with the major intention of fixing a breeding group as soon as possible. Younger birds could be released after the settlement of these initial pairs. This method differs fundamentally from those usually used in other raptor reintroduction projects (Cade 2000; Sarrazin & Legendre 2000). The international regulations through CITES were not operational in the 70s and it was very difficult to find Griffon Vultures for the first project. This explains the delay to get enough birds. From 1970 to 1987, 86 Griffon Vultures were obtained from different origins. Only 47 came from the wild or from rehabilitation centres, the others were donated by zoos, seized from poachers or born in our aviary. However, from the 80s it became easier to get Griffon Vultures from Spain, and later on also from the Pyrenees, most of them being captured, exhausted or unable to fly, during the first months of their life (Terrasse *et al.* 1994; Sarrazin *et al.* 2000). In the Jonte Gorges 61 birds were released -- 41 adults and 20 immatures and juveniles (Fig. 2). The same method was used in the following Griffon vulture reintroduction programmes. From 1993 to 2002, 148 Griffon vultures, mostly young, adult or subadult, were additionally released (Fig. 2). Some of these birds were obtained in the same way from post-fledgling recaptures in the first reintroduced population in the Grands Causses.

Figure 2. Number of releases per year and age classes in the Grands Causses (upper figure) and the southern Alps (lower figure).



Black Vulture :

Two techniques were successfully used for this species. The 'Hacking' technique consists of releasing nestlings only, similarly to the release of Bearded Vulture in the Alps (Frey & Bijleveld 1994). This method differs from the 'Cage' technique consisting of releasing juveniles or immature birds, kept in captivity in an acclimatization aviary built at the top of a cliff in the middle of the colony. The regular presence of wild vultures feeding nearby helped to accustom the captive birds to their release environment. From 1992 to 2002, 47 Black Vultures were released, 24 by hacking and 23 by the cage technique (Clémente & Lecuyer 2002). Birds released by hacking were born in captivity and originated from zoos or breeding centres from Austria, Belgium, France, Germany, Italy, Spain and Switzerland. Birds released by the other method came from rehabilitation centres, national or natural parks in Spain (Andalucia, Extremadura, Valencia, Castilla, Murcia).

Public education

The first project starting in the Grands Causses in 1968 had to wait until 1981 to release the first vultures, because of problems in obtaining birds from Spain and also due to the continuing presence of poisoning with strychnine in the region. That delay was efficiently used to organise a complete education programme in the whole region in order to prepare local opinion for the return of the vultures. Firstly, this activity was devoted to hunters with leaflets, posters, cartoons; and then, secondly to farmers and shepherds by means of countless lectures and film shows in the smallest farms of the region. Later, with the presence of increasing populations of vultures foraging farther in areas where they were unknown, we produced a special information letter to help local people to live with these scavengers.

Feeding strategy

In the Grands Causses area, livestock was estimated to be 152,000 adult sheep (mainly used to produce Roquefort cheese), and the mortality rate annually produced about 4,000 dead sheep and 11,000 dead lambs (Queleuennec 1998). In order to follow veterinary regulations, two types of feeding places were used. The first were supplied from the beginning of the programme with carcasses mainly coming from farms and sometimes from two nearby slaughterhouses. Carcasses were collected and transported by LPO and PNC staffs. Four sites were still used in 2003. However, after 1985, vultures began to feed on carcasses set out by farmers. In 1998, the veterinary regulations evolved, recognising the role of vultures as natural collaborators in sanitary disposal of carcasses (Joncour 1999). New feeding places managed by the shepherds themselves, but under our control, could then be set up. Twelve of these *farmer feeding places* were operational by the end of 2002.

Monitoring

Griffon Vulture:

The monitoring programme set up for the first project (Terrasse 1994; LPO Grands Causses 2001) was also implemented by the other programmes (Henriquet *et al.* 2003; Tessier 2003). All the released birds were monitored with radio transmitters and ringed with a metal and a plastic ring. In the Grands Causses, combinations of coloured rings were used during first releases from 1992 to 1994 but were finally abandoned because of high loss rates. We then used white or yellow Darvic rings engraved with three black letters. These were provided by the CRBPO, Muséum National d'Histoire Naturelle. So far, more or less all the chicks born in the wild have been ringed in the same way. We consider that all released or wild born vultures in these reintroduction programmes were ringed (except a very few nestlings where ringing was impossible). In the Grands Causses, regular recapture sessions occurred every year to ensure that birds were well marked. Using the old release aviaries, 163 Griffons have been captured from 1988 to 2002.

This intensive ringing programme allowed us to run regular resighting sessions, particularly while vultures were feeding. In that way, 20,300 identifications of Griffon Vultures were collected in the Grands Causses at the

end of 2002 and integrated into a database (Clémente & Lécuyer 2002). A national database is being co-ordinated that will also be used at a European level (Sarrazin *et al.* in press). Moreover, we have collected all the sightings of individuals (in local literature and through a questionnaire), whether marked or not, to pinpoint Griffon movements all over France outside the usual regions.

Black Vulture:

Similarly to Griffon Vultures, all Black Vultures were ringed, using both metal and plastic rings. Additionally, birds released by the cage technique were fitted with tail-mounted radio transmitters. It was not possible to fit hacked birds with such transmitters since the growth of their feathers was still under way and their durability therefore not sufficient. Consequently they were marked by bleaching some primaries or tail feathers. These marks usually last about two years. Up to 2003, more than 3,000 identifications of these birds have been compiled in a database.

RESULTS

Post release adaptation to the wild

Griffon Vulture:

In 1970 the released juveniles showed a strong dispersal tendency and were lost, leading to the change of release method. The behaviour of the birds released from 1981 to 1986 in the Grands Causses was greatly dependent on the duration of their captivity. The older the vultures (most of them were more than five years old), the more difficult their adaptation to the wild, especially during the first releases. Dispersal of mates, difficulties of learning foraging flight, especially in bad weather conditions, were the commonest problems observed. Such behaviour was responsible at this stage for most of the losses though inability to adapt to the wild and electrocution. Among the 59 Griffon Vultures released that were marked, eight were found dead and five were put back into captivity. Annual survival estimates obtained through Capture-Mark-Resighting (CMR) methods confirmed these results. For released adults they were significantly lower for the first year following release but extremely high thereafter, whereas birds released as juveniles or immatures had a lower survival rate during their first two years of freedom (Sarrazin *et al.* 1994; Robert 2003). This led, despite observed losses, to a better demographic efficiency of adult releases (Sarrazin & Legendre 2000). Later in the Vis Gorges or in the Alpine programmes, a duration of captivity never exceeding five years and releases of immature vultures (three years old), have given good results.

Black Vulture:

This species benefited from the presence of a free-ranging colony of Griffon Vultures when the first releases of this species occurred. In addition, no bird released through the hacking or cage technique was released exceeding two years of age (Lécuyer & Clémente 2002). Among 47 Black Vultures released, eight were found dead and two were removed from the wild, revealing 21% of

overall losses. These observed losses were not significantly lower than those recorded for Griffon Vultures ($\chi^2=0.914$, $df=2$, $P=0.633$). However they did not account for dispersing birds and further CMR studies are requested to accurately compare local survival estimates in both reintroduced populations.

Establishment and increase of the colonies

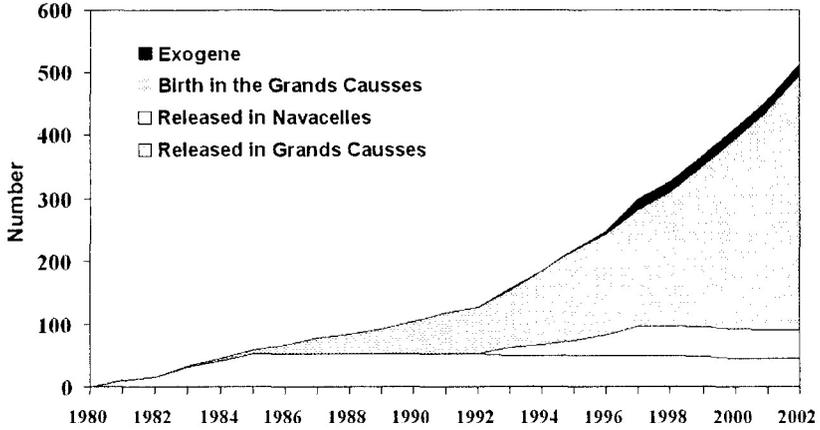
Griffon Vultures :

Since the first releases, the Grands Causses colony continuously increased in number of breeding pairs as well as spatially (Bonnet *et al.* 1990; Sarrazin *et al.* 1996; Sarrazin, 1998; Sarrazin *et al.* 2000). Here, we define the colonial area for birds like Griffon Vultures, as the area where they breed, roost and perform their tandem and colonial flights. From 1982 to 2003, we noted a steady increase of the size of this colonial area proportional to the number and evolution of the foraging activity of the colony. The first successful breeding event occurred in 1982, a few months after the first releases, in cliffs that were occupied by the last autochthonous pairs in 1920 (Rochon-Duvigneaud 1921). Measuring about 20 km² in 1984, the home range was exclusively located along the Jonte canyon. Slowly the vultures settled in the nearby Tarn Gorges cliffs, increasing their territory to 32 km² in 1991 (Sarrazin *et al.* 1996). With a new spreading of the colony to the lower Tarn Valley, 8km downstream, in 1999, and in the Dourbie Gorges, 15km south-west in 2003, the colonial area extended to about 70km². Conspecific attraction, particularly on cliffs with good breeding success, played a big role in this aggregation (Sarrazin *et al.* 2002). It is important to underline the cliffs' suitability within this area, allowing a potential increase in the number of breeding pairs without increasing the range of the colony.

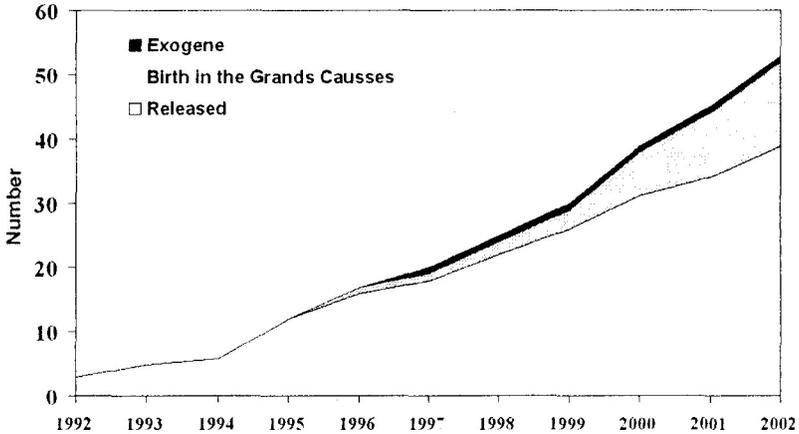
It is very difficult to accurately estimate the total population size in the Grands Causses colony. Indeed, this basically depends on local survival and birth as well as immigration and emigration. A crude and optimistic count of released birds, fledglings, identified immigrants, dead recoveries and definitive recaptures, gives an estimate of maximum population size (Fig.3 a.). However, because the movements of vultures leaving the colony (migration or dispersal), or foreign vultures coming in from the Alpine programmes or even farther from the Pyrenees, Spain, Italy or Croatia, and considering the losses of plastic rings (and more rarely of metal rings), these estimates may be biased. Demographic modelling, including robust survival estimates coping with ring losses, yearly breeding success and immigration scenarios, allowed us to fix the annual number of observed breeding pairs and fledglings, with a total number of around 430 birds in 2003 (Robert 2003). Globally, the mean annual growth rate of breeding pair numbers was around 15 % from the last releases in 1986 to 2003. This was due to the extremely high adult survival rate over the whole period (over 0.97 from 1983 to 2003, Sarrazin *et al.* 1994; Robert 2003). Indeed, population growth rate is extremely sensitive to this parameter in such a long lived species (Ferrière *et al.* 1996; Sarrazin, 1998). The recruitment of young locally born in the wild was also very important. However, immigrants from both natural and reintroduced populations also recruited into the colony. Indeed, most of the birds released in the Vis Gorges, about 35km south of the Jonte Gorges, were attracted and integrated into this colony.

Figure 3. Maximum numbers of birds potentially present in the Grands Causses populations of (a) Griffon and (b) Black Vultures per year.

a. Griffon



b. Black Vulture



A fairly similar dynamics was observed in the Alps, where the first programme in the Baronnies exhibited a strong increase. In the same way, conspecific attraction induced a strong connection between individuals released in Diois and Baronnies located only 45km apart. There, the relative proximity of the three release places, including Verdon, played a positive role, helping the birds to discover their habitat more rapidly and creating interactions.

To summarise, these new colonies, numbered between 274 and 474 birds in the Grands Causses (Clémente & Lecuyer 2002) and between 147 and 162 in the southern Alps, by the end of 2002 (minimum and maximum estimates).

Black Vultures :

The first birds released by the hacking technique were immediately established in a suitable place, a small wooded valley, located about 2km from the Griffon Vulture release aviaries. They directly followed the Griffons, returning to roost near the hacking place. Four years after the first releases, a breeding pair was formed in 1996 and bred successfully. In 2003 the home

range of this colony was estimated as 36km². This year, four pairs settled in the small valley near the hacking place occupying 0,9km².

The population in 2003 numbered between 34 and 57 birds, including 19 young produced in the wild and one Spanish bird coming from Madrid Province (minimum and maximum estimate; Fig. 3 b.).

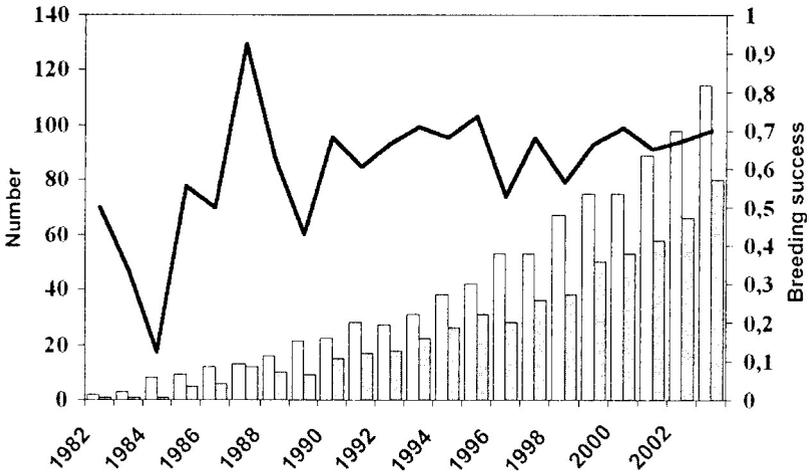
Reproduction

Griffon Vulture :

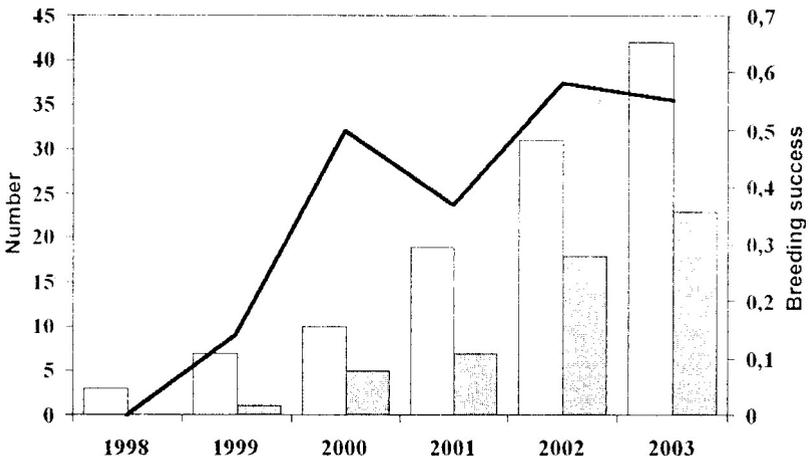
For the Grands Causses programme, Figure 4a. summarises 22 years of reproduction, showing a regular increase in the number of breeding pairs, fledglings and breeding success. With 110 breeding pairs and 87 fledglings in 2003, the breeding success was steadily growing. Since the very first releases, the Grands Causses colony have produced 590 fledglings.

Figure 4. Number of breeding events (white bars), fledglings (dark bars) and breeding success of Griffon Vultures since the first releases: a) in the Grands Causses, b) in the southern Alps.

a. Grands Causses



b. Southern Alps

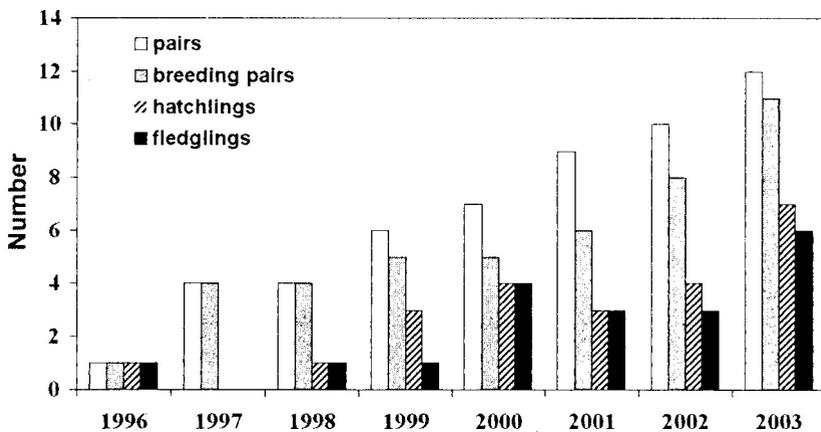


In the Alpine programmes, the results were contrasting. Six years after the beginning of the releases in the Baronnies, the local colony was already important (36 to 38 pairs in spring 2003) playing an attractive role for the Griffons released in the Diois. Indeed, after a first breeding attempt in 2002, these birds were attracted by and incorporated into the Baronnies colony. On the contrary, the Verdon colony, although very recent (first releases in 1999), numbered seven breeding pairs in 2003 which produced five fledglings. With 42 breeding pairs having produced 23 young (breeding success = 0.55), the fourth year of successful reproduction in the southern Alps was encouraging according to the age structure of these colonies (Fig. 4 b.).

Black Vulture :

From 1992 to 2003, 44 breeding attempts were monitored and 19 young fledged. All the nests were built in *Pinus sylvestris* growing in the slopes of the Jonte and Tarn Gorges (Eliotout unpublished). The heights of the nests above the ground varied from 3 to 15 metres. The breeding parameters showed a regular increase in the number of breeding pairs, but a still suboptimal breeding success (0.43, $n=44$, Fig. 5). Possible reasons of this poor success might have been linked with the immaturity of the birds. Indeed some birds paired when two years of age and the mean age of the potentially breeding birds in 2002 was 6.9 years ($n=29$). However, in 2003, two pairs successfully bred although one mate was only three years old.

Figure 5. Breeding parameters of the population of Black Vultures reintroduced to the Grands Causses.



Mortality causes

The monitoring of any reintroduced population requires a careful study of the mortality causes in order to find possible ways to eliminate non-natural ones. This is particularly true for long-lived species with population dynamics highly sensitive to this parameter. Thus we carried out veterinary studies in order to identify the origin of all mortalities (Philippe 2001). However, for half of them, the cause could not be clarified since dead birds were usually discovered or analysed too late. In the Grands Causses programme 114 Griffon and 8 Black Vultures were found dead from 1980 to 2002 and 28 Griffon and 2 Black

Vultures were definitely recaptured.

The main mortality causes are listed in Table 1. For the Griffons (which were better documented than Black Vultures), two prevailed. Most of the mortality causes of juveniles included falling from the nest and death by starvation during the post-fledging period. Among anthropic origins, electrocution ($n= 38$) and collision with electric wires ($n= 12$) constituted the major risk with 87% of the cases of non-natural death.

Table 1. Mortality and recapture causes of Griffon ($n=142$) and Black Vultures ($n=8$) from 1982 to 2002.

Causes of mortality or recapture	Number	Percentage
Electrocution	38	25 %
Starvation (?)	23	15 %
Imprinting	15	10 %
Wire collision	12	8 %
Injury, old-age	6	4 %
Poisoning	3	2 %
Likely poisoning	3	2 %
Unknown	42	29 %
Others	8	5 %

On the other hand we can point out the very low number of poisoned birds ($n=6$) suggesting that these were probably not voluntary. These poisoning events might have been due to chronic intoxication with phytosanitary chemicals (e.g. Organochlorids like Lindane, Organophosphates) used in the local sheep rearing. The recent discovery of these new threats will need further study. Another surprising finding was the absence of vultures killed or injured by shooting. No record of such an event occurred since 1982. However, not all dead vultures were x-rayed, which could have revealed some lead shot.

Dead recoveries and mortality causes were consistent with survival estimates obtained through CMR methods, at least for Griffon Vultures in the Grands Causses (Sarrazin *et al.* 1994; Robert, 2003). Analysing the mortality causes by age classes, a high juvenile mortality was detected (their lack of experience exposed them to a great number of anthropogenic and natural threats), a lower one for immature birds and a high probability of survival (except for electrocution) for adults.

In the Alps, with 27 dead Griffon, the main natural mortality cause was clearly the lack of experience of the released birds ($n=10$). The main anthropogenic threat remained electrocution ($n=8$), with only one intoxicated bird (phytosanitary chemical) and the absence of any shot bird.

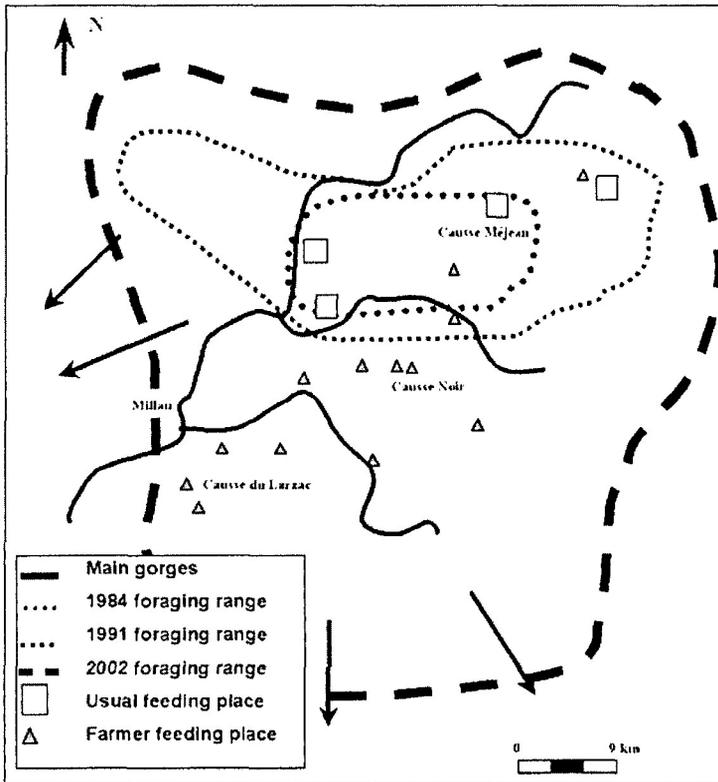
Foraging

Grands Causses Programme:

Besides establishing a Griffon Vulture colony, the main aim of this project during the last 22 years, was to facilitate the spatial extension and feeding autarchy of the breeding group (Terrasse *et al.* 1994). Until 1984, the foraging area was small (about 200 km²) and restricted around the confluence of the

Tarn and Jonte rivers (Fig. 6). Slowly, from 1984 to 1988, vultures began to extend their foraging area to 560km² in 1988. This was probably enforced by more and younger birds and also by a new feeding place in the centre of Causse Mejean, (Bonnet *et al.* 1990). This expansion was immediately followed by the first spontaneous feedings and a more regular exploitation of the food resources of this region. In a continuous way, the vultures slowly increased their foraging area. They had to improve their experience in terms of flight performance and knowledge of the flight conditions. This factor seemed crucial and restricted specific flight routes in some instances, according to meteorology. Probably it took years for birds to learn how to exploit specific flight conditions most efficiently.

Figure 6. Foraging range of Griffon Vultures in the Grands Causses in 1984, 1991 and 2002.



Another event helped these vultures to further increase their range: The release of Griffon Vultures in the Vis Gorges from 1994 to 1999 enabled them to include the Causse Noir and the Causse of Larzac in their daily foraging area.

Finally, the new feeding strategy based on 'farmer feeding places, was immediately followed by a clear increase of the foraging range. As a consequence, the vultures are now actively searching for food, in a huge area of about 4,000km², except during some winter months (Fig. 6).

The Black Vultures, as soon as released, followed the Griffons. They participated in the same feeding events but were able to show distinctive

abilities to forage differently, using sometimes smaller prey (hare, for instance) and in worse weather conditions. In 2003 we assessed that both species were using the same foraging areas, each with its own way of exploiting the carcass.

Alpine programmes

The managers of the three Alpine reintroduction programmes followed the same feeding policy that was used in the Grands Causses. However, at the early stage of these projects, they concentrated on collecting carcasses to supply feeding places (Henriquet 2001; Henriquet et al. 2003; Tessier, 1992, 2003). Their objective was to include the establishment of new feeding places with the shepherds as quickly as possible.

However the emancipation of the Griffon Vulture colonies occurred much more rapidly than expected. Only six years after the first releases in the Baronnies, and three years after the beginning of the Diois and Verdon projects, it was amazing to note the great ability of these birds to explore a large foraging area. The two northern colonies (Baronnies and Diois) almost immediately mixed during foraging, exploring about 5,000 km². In the Verdon Canyon, Griffons explored a smaller area of at least 600km².

There are several reasons of these differences: i) the synchrony of the three release programmes, ii) the release of younger birds (at maximum 3 to 4 years old) and iii) the excellent flight conditions (i.e. extended period of sunshine and frequent wind in suitable mountain terrain). Together, these factors created the best conditions for the establishment and emancipation of these colonies. The food resources were more diversified than those of the Causses, with domestic ungulates, both sedentary and transhumant, often reared in an extensive way. Finally, populations of wild ungulates (e.g. Chamois *Rupicapra rupicapra*, Wild boar *Sus scrofa*, Mouflon *Ovis aries*, Red Deer *Cervus elaphus*, Roe Deer *Capreolus capreolus* and Ibex *Capra ibex*) were increasing and played a beneficial role.

Movements and dispersal

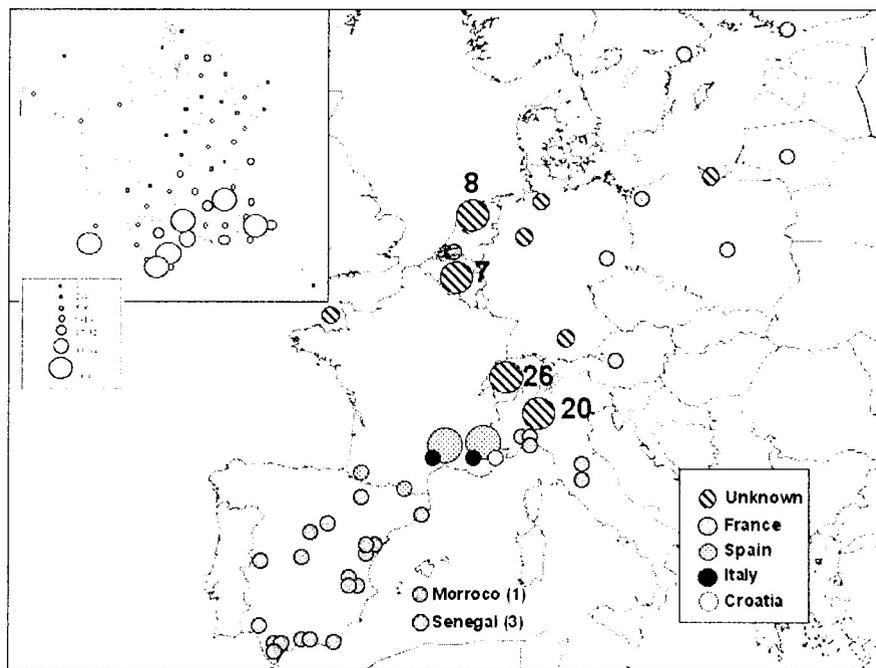
Griffon Vulture :

From 1976 to 2002, 452 sightings of Griffon Vultures have been collected in France. Each sighting is based on the observation of one or more vultures, taking into account only the birds observed outside their normal ranges (i.e. north-western part of the Pyrenees, foraging ranges of the Grands Causses and Alpines reintroduced populations).

These kinds of observations were exceptional in France until the 80s, with a frequency of one to five sightings a year. After 1990/1992 the vultures were observed more frequently in the south of France (Terrasse *et al.* 1994). This was certainly linked to the new release site in the south of the Causses (Vis Gorges). This trend increased more obviously after 1996 with the presence of reintroduced Griffon Vultures in the south of the Alps. The French territory that was historically poorly explored by vultures (except in the western half of the Pyrenees) is now regularly visited during spring and summer. Figure 7 shows the regions where most movements have been observed. It appeared that birds moved north-easterly, following the relief, from the east of the Pyrenees to the south of the Massif Central and further on to the Alps, Jura, Vosges and

Ardennes to the north of France. This movement to the north-east and east was confirmed by resightings collected mostly from June to August, in Switzerland ($n=26$), Belgium ($n=7$), Holland ($n=8$), Germany ($n=4$) and the western part of the Italian Alps ($n=20$) from 1980 to 2002 (Fig. 7).

Figure 7. Recoveries and resightings of Griffon Vultures of different origins from 1976 to 2002 in France and Europe.



A precise analysis of this phenomenon was complicated for different reasons. There were difficulties in reading the rings or marks for most of the dispersing vultures. It was also impossible to know the origin of non-ringed or non-marked birds. Similarly, it was impossible to differentiate between foreign vultures and autochthonous ones around the existing colonies. Therefore these data must be considered as minimum. For instance the Grands Causses colony, attracted at least nine immigrants (probably from the Pyrenees or Spain) from 1983 to 1991, including one pair which settled and reproduced. From 1991 to 2002, a minimum of nine Griffons ringed in the French Pyrenees and 10 from the three Alpine release programmes joined this colony more or less permanently. Furthermore, 14 ringed Spanish birds were seen in the Causses colony during this period but the real number is assumed to be closer to 50 for the last five years. At least one Griffon released in Italy (Abruzzi mountains) was observed in May 1997.

The three alpine release programmes exchanged many birds during the whole period. From 1999 to 2002 the Diois and Baronnies colonies attracted at least three ringed birds from the Grands Causses, one from the Pyrenees, four from Spain and two or three from Croatia. Additionally, during spring 2002, 15 non-ringed birds were observed. Immature birds were also observed in late June 2002 and 2003 in the Diois and Baronnies colonies. During the same time

and 110km further to the south-east, the Verdon colony attracted at least 16 non-ringed birds, mainly juveniles or immatures. Among the identified Griffon Vultures visiting this place, one was released in the Abruzzi mountains, Italy, in 1999, two from Spain (coming from Asturias and Rioja) and two from Croatia (the same as the ones observed in Baronnies).

On the other hand, identified vultures from reintroduced French colonies were recovered as far as Corsica, Austria, Eastern Germany, Poland, Sweden and the Apennine mountains in Italy. One vulture born in the Grands Causses colony in 1998 was observed in southern Finland (more than 2,000km from its colony) in the spring of 2000 and later on in western Latvia (from the end of July to the 12th of August). It was observed again in the Grands Causses in May 2003. Finally, these vultures also participated in the normal movements south-westwards and we have collected 19 recoveries from Spain, one from Morocco and three from Senegal.

Black Vulture:

Since the beginning of the reintroduction project in 1992, interesting observations revealed large movements of Black Vultures in France. More or less similar to those of the Griffon Vultures, birds were observed mainly in spring and summer from the eastern Pyrenees to the southern Massif Central and also in the Alps. Some travelled as far as Switzerland, Belgium, Holland, Germany and the Czech Republic. Among 52 sightings, all refer to solitary birds except for eight observations (small groups of 2 to 5 birds). In at least eight cases we assume that the bird was of a foreign origin, probably from Spain, because of the absence of rings and bleached feathers.

Since the beginning of the releases, some of our Black Vultures showed a great ability to travel huge distances. These birds seemed to disperse or participate in the migrating movements of the Griffons, following the Mediterranean shores of Spain up to Gibraltar, and returning one year later. 'Arian', a juvenile released by hacking in August 1992, left the Causses in October, was seen in the north-east of the Pyrenees, and returned to the colony in May 1993. From October until November of the same year she was observed near Gibraltar. She returned to France in April 1994 and was found dead in July in the south of Spain (Andalusia). 'Munster', born in the Munster Zoo in 1993, was released in August. This bird left the Causses region in October 1993 and in the following spring (April 1994) was observed in the west of the Massif Central (150km from the release place), then, some days later, in Aragon (Spain) and the French Pyrenees. After nine months of dispersal it returned in July 1994. We must point out also the travel of a Spanish bird, 'Iber', ringed near Madrid (Grefa) in October 1996 and observed in the Pyrenees in May 1997 and in the Causses colony in the same month. Since this date, Iber has belonged to this colony.

DISCUSSION

The first report (Terrasse *et al.* 1994) had given an encouraging review of the Grands Causses programme until 1991. More than ten years later, with the building of new populations of Griffons in the French Alps and the return of the Black Vulture as a breeding species in France, all parameters point to the

success of this long term enterprise.

From a socio-economic point of view, vultures are well integrated everywhere in France in what is now called sustainable development (Quillard 1995). Not only in the Grands Causses with a special exhibition centre (*Le Belvedere des Vautours*) dedicated to this project, but also in the Pyrenees or in the Alps, the vultures are used in local politics as advertisements for Green Tourism, since they are able to attract a new public of birdwatchers from other countries during a low season. On the other hand, the growing positive role played by the vultures as free garbage collectors, is more and more appreciated and officially recognised.

With at least 400 Griffon and Black Vultures in the Grands Causses area we are approaching the estimate proposed by Briquet (1987) for this region, with a host capacity in terms of food resources of 700 vultures (with monthly fluctuation of from 300 in August and September to 1,200 in November and December). It seems that the strategy to help the vultures to forage farther has helped in the increasing of their number, still without reaching limits. One interesting clue in this respect is the continuous increase of the reproduction parameters. The breeding success of 2003 was similar to the values estimated in Spain (Donazar 1993) or in the Pyrenees (Leconte & Som 1996) which fluctuates from 0.65 to 0.77. However we lack reliable and accurate estimates of both, adult and juvenile survival rates from wild populations to achieve a full demographic comparison. For this reason a long-term ringing programme started in 1993 in the Ossau valley in the French Pyrenees. The set-up of other monitoring programmes in Spain, Croatia, Israel etc. during recent years will be extremely fruitful in this context.

Among the positive roles played by these new population, is the attraction of vultures from foreign colonies and the newly observed movement patterns which are certainly consequences of the increase of the Spanish and Pyrenean colonies, possibly reinforced by the creation of new populations, not only in France but also in Italy. These northward movements, regularly observed during the last 10 years in the eastern part of the Pyrenees, can be interpreted as indicating a relatively high plasticity in the migration or dispersal behaviour of these birds, previously known to migrate mostly southward. Each new reintroduction programme seems to speed up the extension of the movements, acting as a relay.

Really curious are the sightings of vultures from Switzerland to Belgium and Holland. Surprisingly, these countries have welcomed an amazingly high number of vultures of the four species since 1993; these individuals usually seem able to find food and in most cases they successfully returned in their original territories (Dutch Birding 1992 to 2002). It is probably too early to speak of a summering behaviour as described in the eastern Alps (Perco *et al.* 1983), but this pattern is fundamentally different from the one described so far (Bernis, 1980).

More generally, these movements form a link between the healthy Pyrenean or Iberian populations and the still threatened Croatian colonies. They are not only a positive factor for the restocking of Balkan populations, but also a symbol of hope for the future.

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REFERENCES

- BERNIS, F. 1966.** El Buitre negro en Iberia. *Ardeola*, 12. Pp. 45-100.
BERNIS, F. 1974. Pers. com. in : Bijleveld, M. (Eds.), *Birds of Prey in Europe*. MacMillan Press LTD. London. Pp. 68.

- BERNIS, F. 1980.** La migración de las aves en el estrecho de Gibraltar I : Aves planeadoras. Universidad Computense Madrid, Pp. 481.
- BERTHET, G. 1946.** Les derniers Vautours fauves du Massif Central. *Rev. Soc. For. Franche-Comté*, Pp. 1-6.
- BONNET, J., M. TERRASSE, C. BAGNOLINI & J.-L. PINNA 1990.** Installation et extension d'une colonie de Vautours fauves *Gyps fulvus fulvus* réintroduite dans les Grands Causses du Massif Central. *L'Oiseau et la RFO*. V 60 N° 3, Pp, 181-206.
- BRIQUET, R. 1987.** Les ressources alimentaires des Vautours fauves dans la région des Grands Causses. Paris. Rapport de Stage enseignement optionnel de 4^{ème} année. Maisons-Alfort.
- CADE, T.J. 2000.** Progress in translocation of Diurnal Raptors.. In : Chancellor, R.D. & B.-U. Meyburg (Eds) : *Raptors at risk*. WWGBP / Pica Press. Pp, 343-372.
- CLÉMENTE, C. & P. LECUYER 2002.** Situation des populations de vautours fauves et percnoptères dans les Grands Causses en 2002 et mise en place de mesures conservatoires. Unpublished Technical report. LPO Grands Causses. 39 pp.
- DONAZAR, J.-A. 1993.** *Los buitres ibéricos*. Ed. J.M.Reyero. Pp. 156-157.
- FERRIÈRE, R., F. SARRAZIN, S. LEGENDRE & J.P. BARON 1996.** Matrix population models applied to viability analysis and Conservation: Theory and Practice using the ULM software. *Acta Oecologica*, 17 (6) 629-656
- FREY, H. & M. BIJLEVELD 1994.** The reintroduction of the Bearded Vulture, *Gypaetus barbatus aureus* into the Alps. Pp. 459-464 in R.D. Chancellor, B.-U. Meyburg & J.J. Ferrero. (Eds.) *Raptor Conservation Today*. WWGBP./ Pica Press. Berlin.
- HEIM DE BALZAC, H. 1922.** Excursion ornithologique dans la région des Causses. *Rev. Fr. Orn.* 162, Pp. 337-341, 163, Pp. 358-362.
- HENRIQUET, S. 2001.** Programme de réintroduction du Vautour fauve (*Gyps fulvus*) dans les gorges du Verdon. Bilan des actions engagées et du premier lâcher. Unpublished Technical report. LPO PACA & Vautours en Haute-Provence, Pp. 25.
- HENRIQUET, S., C. FAUDOT, M. BOISSEIN & R.VIAL 2003.** Programme de réintroduction du Vautour fauve (*Gyps fulvus*) dans les gorges du Verdon. Rapport d'activité 2001-2002. Bilan du 2^{ème} et du 3^{ème} lâcher. Unpublished Technical report. LPO PACA & Vautours en Haute-Provence, Pp. 46.
- JONCOUR, G. 1999.** Les vautours, collaborateurs naturels de l'équarrissage en France. Technical document .Vetarvor. BP 109, Landerneau, Pp.43.
- LECONTE, M. & J. SOM 1996.** La reproduction du Vautour fauve *Gyps fulvus* dans les Pyrénées Occidentales : Historique d'une restauration d'effectifs et paramètres reproducteurs. *Alauda*, 64 , Pp. 135-148.
- LÉCUYER, P. & C., CLÉMENTE 2002.** Situation de la population de vautours moines dans les Grands Causses en 2002. Unpublished Technical report. LPO Grands Causses. 20 pp.
- LPO GRANDS CAUSSES 2001.** Bilan des Connaissances sur les Vautour fauve, moine et percnoptère dans les Grands Causses (1980-2001). LIFE Nature Vautours moine et rapaces nécrophages des Gorges de la Jonte. Unpublished Technical report. LPO Grands Causses. 66pp.
- PERCO, F., S. TOSO, G. SUSIC & M. APOLLONIO 1983.** Initial data for a study on the status, distribution and ecology of the Griffon vulture *Gyps fulvus fulvus* in the Kvarner archipelago. *Larus*. 33-35. Pp, 99-134.
- PHILIPPE, C. 2001.** Etude vétérinaire relative à la mortalité des vautours dans les Grands Causses.
- QUELENNEC, M. 1998.** Les vautours, équarrisseurs naturels des Grands Causses. Thèse, Ecole Nationale Vétérinaire de Lyon. Pp. 270.
- QUILLARD, V. 1995.** Valeur sociale et économique de la Protection de la Biodiversité *in situ*, l'exemple de la réintroduction du Vautour fauve *Gyps fulvus fulvus* dans les Grands Causses. Rapport de Stage. Université de Rennes, Pp. 66.
- ROBERT, A. 2003.** Interactions démographiques et génétiques dans les petites populations: applications aux populations restaurées. PhD Thesis. Université Pierre et Marie Curie. Paris, France.
- ROCHON-DUVIGNEAUD, A. 1921.** Les grands rapaces des Gorges du Tarn. *Rev. Fr. Orn.*, 142, Pp. 21-25, 143, Pp. 33-37.
- SARRAZIN, F. 1998.** Modelling establishment of a reintroduced population of Griffon vultures *Gyps fulvus* in Southern France. In. Chancellor, R.D., Meyburg, B.U. & Ferrero J.J., (Eds.) *Holarctic Birds of Prey*. ADENEX/ WWGBP: 405-416.
- SARRAZIN, F., C. P. ARTHUR, C. BAGNOLINI, J. BONNET, J. P. CHOISY, P. LECUYER, P. MAIGRE, R. MORVAN, J.L. PINNA, M. TERRASSE & C. TESSIER 2000.** Re-introduction of griffon vultures in France. Special Bird Issue. Soorae, P.S. & Seddon, P.J., (Eds) *Re-Introduction News* (IUCN, SSC). Re-introduction Specialist Group, Abu Dhabi, UAE. 19: 52-54.
- SARRAZIN, F., C. BAGNOLINI, J.L. PINNA & E. DANCHIN 1996.** Breeding biology during establishment of a reintroduced Griffon Vulture (*Gyps fulvus*) population. *Ibis*. 138: 315-325.
- SARRAZIN, F., C. BAGNOLINI, J.L. PINNA, E. DANCHIN & J. CLOBERT 1994.** High survival estimates in a reintroduced population of Griffon Vultures. *The Auk*. 111 (4): 853-862.
- SARRAZIN, F., P. LAPENU, C.P. ARTHUR, A. GAULT & A. ROBERT (in press)** EGVWG Database: a tool for international network. *Vulture News*.

SARRAZIN, F., N. LECOMTE, C.P. ARTHUR, J.L. PINNA, P. LECUYER & G. FRECHET 2002. Comparative dynamics and habitat selection strategy of natural and reintroduced populations of Griffon vultures in Southern France. In *Raptors in the New Millennium*, Yosef, R., Miller, M.L., & Pepler, D. (Eds.) IBRCE: 192.

SARRAZIN, F. & S. LEGENDRE 2000. Demographic approach to releasing adults versus young in reintroductions. *Conservation Biology*. 14(2): 488-500.

SCHENK, H. 1972. Situazione faunistica dei Rapaci (*Accipitriformes*) in Sardegna e proposte per la loro salvaguardia. *Pro Avibus*. 7 (3/4), Pp.4-8.

TERRASSE, J.F. & M. TERRASSE 1967. Les Vautours de France. *Le Courrier de la Nature, Nouvelle Série*. N°. 3, 44-9, N°.4, Pp. 86-90.

TERRASSE, J.F. & M. TERRASSE 1970. Menaces dans les Pyrénées. *Le Courrier de la Nature*, N°. 14, 2^e trim.: 83.

TERRASSE, M. 1983. The status of Vultures in France. In : *Vulture Biology and Management*. Wilbur, S.R. (Ed.), Univ. of California Press, Berkeley. Pp. 81-85.

TERRASSE, M., C. BAGNOLINI, J. BONNET, J-L. PINNA & F. SARRAZIN 1994. Reintroduction of the Griffon Vulture *Gyps fulvus* in the Massif Central, France, in: Meyburg, B.-U & R.D. Chancellor (Eds) : *Raptor Conservation Today*. WWGBP / Pica Press. Pp. 479-491.

TESSIER, C. 1992. Réintroduction du Vautour fauve dans les Alpes du Sud. Unpublished technical report, Parc Naturel Régional du Vercors, 27 pp.

TESSIER, C. 2003. Bilan du suivi des vautours des Baronnies. Année 2002. Technical report. Association "Vautours en Baronnies". Pp. 17.

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