

Bearded Vulture

Reintroduction into the Alps



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Feasibility Study on the Reintroduction of the Bearded Vulture (*Gypaetus barbatus*) in Sardinia

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1. INTRODUCTION

Up to 50 years ago Sardinia (24.090 km²), the second largest island of the Mediterranean, had important breeding populations of the Griffon, Black and Bearded Vulture (SCHENK, 1976). The only species among the three large European vultures still reproducing on the island is the Griffon which has been the object of conservation measures since 1974 and now confined to north-western Sardinia (ARESU & SCHENK, 2004). The Black and the Bearded Vulture (BV) have become extinct as breeding species: the former in about 1961 and the latter in 1967/68 (SCHENK, 1976).

A preliminary feasibility analysis concerning re-enforcement and reintroduction projects for the Griffon, Black and Bearded Vulture in Sardinia was carried out by SCHENK (1976; 1977) who calculated for the 1970s a potential range for the BV of about 4.500 km² in central-eastern Sardinia and a further 400 km² in the Iglesiente Mountains, estimating an optimal density of 20-30 individuals with 6-8 breeding pairs: Monte Limbara and mountains between Olbia and Nuoro (1-2 pairs), Supramonte of Oliena/Orgosolo (2 pairs), the calcareous area between Dorgali, Urzulei and Baunei (1-2 pairs), Sarrabus/Gerrei/Salto di Quirra (1 pair) and Iglesiente mountains (1 pair).

More recently SCHENK & GENERO (1996) carried out a feasibility study for the reintroduction of the Black Vulture on behalf of LIPU (BirdLife) and the Autonomous Region of Sardinia and a preliminary study on the reintroduction of the BV, concluding positively for the Black Vulture and discouraging a priority intervention in favour of *Gypaetus barbatus*, especially in relation to the difficulty of obtaining founders, to the lack of suitable public structures for the technical management of the project as well as of protected areas in Sardinia and finally in relation to the high financial costs of such a project (cf. IUCN, 1995).

The reintroduction project for *Aegypius monachus* was interrupted due to a temporary return of poisoned baits in the Bosa district in north-western Sardinia (ARESU & SCHENK, 2004).

For several years the Sardinian "Forester Association" - ASSFOR - has been launching the idea of a reintroduction project of the BV in Sardinia, conducting information initiatives in some areas of the island (GRAZIANO, 2002; PINTUS, 2003).

The objective of the present study is to evaluate the ecological and socio-cultural feasibility of the reintroduction of the BV as a keystone-flagship species in Sardinia. We have tried to bear in mind the "Guidelines for Reintroductions" (IUCN/SSC, 1995), the indications of D.P.R. no.120/2003 concerning the application of the Habitat Directive in Italy, the positive experience of the international project concerning the reintroduction of the BV in the Alps, started in 1978 (IUCN, 1979; ROBIN ET AL., 2004), the reintroduction of the Griffon and Black Vulture in France (TERRASSE ET AL., 2004) as well as experience acquired in Sardinia in relation to re-stocking programmes and conservation projects in favour of the Griffon Vulture (SCHENK & ARESU, 1992; ARESU & SCHENK, 2004). All these projects have been or are carried out with the participation of biologists, representatives of conservation organizations, government departments and universities, directors and veterinarians of zoological gardens and managers of protected areas.

The "FOUNDATION FOR THE CONSERVATION OF THE BEARDED VULTURE", created in the 1980s and the owner of the majority of breeding pairs in the different international reproduction stations, is playing an important role in the framework of the reintroduction of the BV in the Alps. The "Foundation" organizes annual conferences, publishes its Annual Report and guarantees the indispensable coordination and information flow on conservation projects concerning this interesting species.

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2. HISTORICAL DISTRIBUTION AND NUMBERS

The historical distribution, an estimation of numbers and the observations of BV's during the last 40 years in Sardinia are illustrated, evaluating the degree of reliability of all data.

2.1 HISTORICAL DISTRIBUTION, 1875 - 1967

The distribution of the BV in Sardinia has been reconstructed (FIGURES 1-3) for the 1875-1967 period, based on bibliography, an inquiry (1969/70) in 40 Sardinian municipalities concerning the distribution of five large birds of prey: Griffon, Black and Bearded Vulture, Sea Eagle, Golden Eagle (SCHENK, unpublished), a systematic research during the last 30 years among rural populations (shepherds, hunters) and an inquiry addressed to Italian, European and North-American natural museums and private collections containing skins, mounted specimens, skeletons and eggs of BV from Sardinia. All data have been critically evaluated.

In Annex 1 data are summarized concerning 139 samples (122 skins, mounted specimens, skeletons and 17 eggs) of BV's from Sardinia, the result of an inquiry involving some 190 natural museum and private collections. The number of certain samples may be lowered by at least two units because two skeletons in the A. Koenig Museum /Bonn/Germany may belong to two mounted specimens in the Museum für Naturkunde Magdeburg/Germany (PELLMANN, *in litt.*; cf. Annex 1).

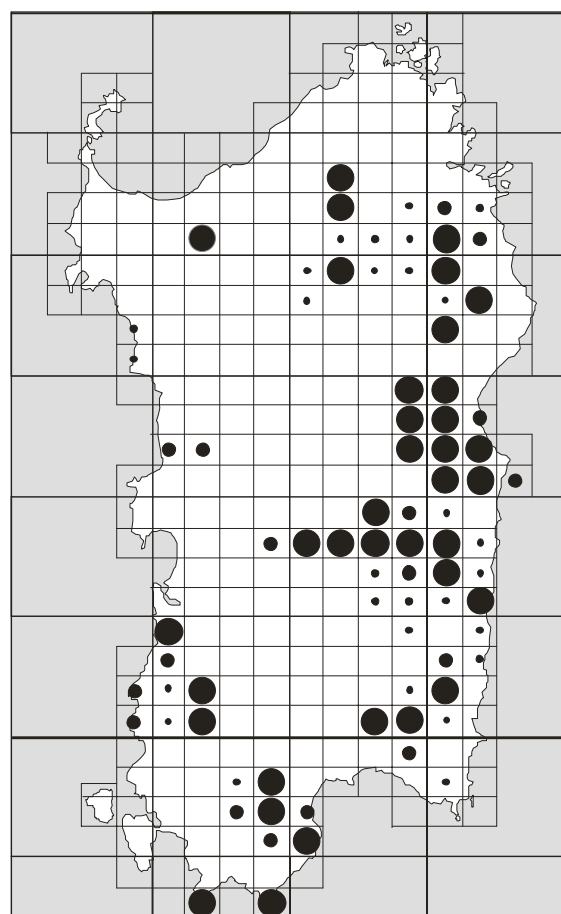
Further 10 samples (cf. TABLE 1) are of possible or probable Sardinian origin: 1 at Fermo/Italy (SALVADORI, 1865; VIOLANI ET AL., 1997), 3 at Schaffhausen/Switzerland (STEMMLER, 1932), 1 at Chur/Switzerland (GAUTSCHI, *in litt.*); 4 at Göteborg/Sweden (NILSON *in litt.*), 1 at Helsinki/Finland (STJERNBERG, *in litt.*).

Table 1. Destination of Bearded Vultures (skins, mounted specimens, skeletons) of probable or possible Sardinian origin, 2004

Possible or probable collection areas	Skin mounted skeleton	Country	Museum Collection (pu=public; pr=private)	Collection Year	Sex age class	Notes
Sardinia	1	Italy (1)	Fermo - pu	<1865	M immat	SALVADORI, 1865; VIOLANI ET AL., 1997; PAZZI & VIOLANI, ex verbis
Sardinia	1	Switzerland (4)	Chur - pu	1895	?	GAUTSCHI, in litt; BNM 758
Sardinia	1		Schaffhausen - pr	<1932	skeleton	STEMMLER, 1932
Sardinia	1		Schaffhausen - pr	<1932	skeleton	STEMMLER, 1932
Sardinia	1		Schaffhausen - pr	<1932	skeleton	STEMMLER, 1932
Italy-Sardinia?	1	Sweden (4)	Göteborg - pu	1896	M ad	bought from Dr. GIRTANNER, NILSON, in litt.
Italy-Sardinia?	1		Göteborg - pu	1896	F ad	bought from Dr. GIRTANNER, NILSON, in litt.
Italy-Sardinia?	1		Göteborg - pu	1896	F immat	bought from Dr. GIRTANNER, NILSON, in litt.
Italy-Sardinia?	1		Göteborg - pu	1896	pullus	bought from Dr. GIRTANNER, NILSON, in litt.
Europe merid.	1	Finland (1)	Helsinki - pu	ca 1870	?	STJERNBERG, in litt.
TOTAL SPECIMENS	10					

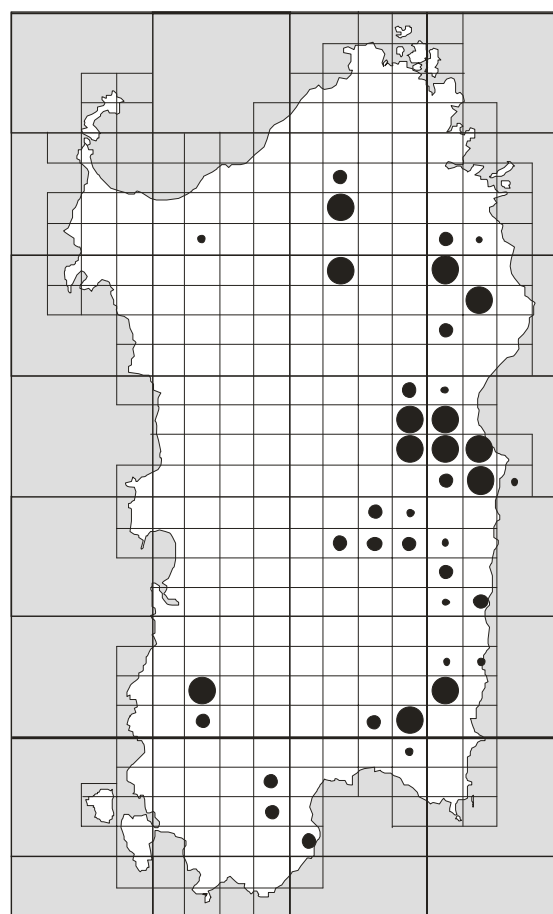
Fifty-nine (42.4%) of the 139 samples are referred generically to Sardinia and 80 (57.6%) are referable to a precise geographical locality of the island (cf. FIG. 4). Forty-three samples (53.8%) were collected in the key-area of the historical range of the BV including the Ogliastra, Supramonte and Gennargentu districts, followed by the Sulcis district with 13 samples (16.3%) and the Iglesiente district with 8 samples (10.0%); then come Monti di Alà and the area between Olbia and Nuoro; Sarrabus; Limbara; Sassari and Campidano (cf. ANNEX 1 and FIG. 5). The only specimen from outside the breeding range was collected near Sardara in 1821 in the Campidano Plain (TOFFOLI, *in litt.*).

The inquiry on the distribution of large Sardinian raptors in the 1960s (SCHENK, unpub.) produced positive and reliable results for the following municipalities: Budduso, Siniscola, Oliena, Orgosolo, Urzulei, Talana, Fonni and Gadoni. GRAZIANO & ATZENI (1997) and LEDDA (*in* Graziano, 2002) confirmed the historical presence of the BV for Monte Limbara (presumably for the 1920s-30s), the Monti di Alà and Supramonte areas.



Number of 10 km squares in which recorded	Breeding		
	Possible	Probable	Confirmed
• ● ●● = 81 (27.4%) breeding confirmed, probable and possible	● = 29	●● = 17	●●● = 35
	35,8%	21,0%	43,2%

Figure 1. Historical distribution (10 km squares) of the Bearded Vulture in Sardinia, 1875 - 1945



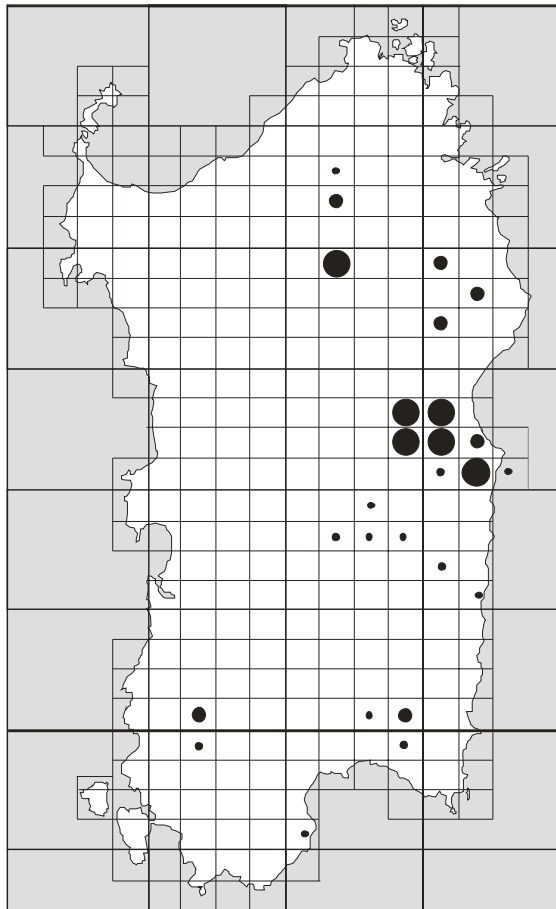
Number of 10 km squares in which recorded	Breeding		
	Possible	Probable	Confirmed
• ● ●● = 39 (13.2%) breeding confirmed, probable and possible	● = 10	●● = 16	●●● = 13
	25,7%	41,0%	33,3%

Figure 2. Historical distribution (10 km squares) of the Bearded Vulture in Sardinia, 1946 - 1955

FIGURE 1 illustrates the distribution of the BV in Sardinia for the 1875-1945 period. The range comprised Monte Limbara in the north, Monti di Alà, Monte Nieddu, Monte Albo, Supramonte, Gennargentu, Ogliastra mountains and the south-eastern massifs of the Sarrabus-Gerrei district. Separated by the Campidano Plain there was an isolated range in the south-western part of the island including the Sulcis-Iglesiente mountains, but also the sea cliffs of Teulada (cf. Annex 1). Smaller isolated nuclei were found in the north-western part of Sardinia, near Sassari (Bunnari). Breeding has been evaluated possible, probable or confirmed in eighty-one 10 km squares (27.4% of the Sardinian's 296 squares). Confirmed breeding has been proofed at least once in 35 squares (43.2% of the 81 squares where the species has been recorded); probable breeding in 17 squares (21.0%) and possible breeding in 29 squares (35.8%). It is highly probable that at the beginning of the 20th century the BV was a breeding species also in other parts of the island where unfortunately the collection of oral testimonies was difficult because the direct witnesses (shepherds, hunters) were no longer alive.

For the 1946-55 period breeding has been evaluated as confirmed, probable or possible in 39 squares (13.2% of the total of 296) with an estimated total of 10-4 breeding pairs concentrated in the central-eastern part of the island and single pairs in the north-east, in the south-east and in the Iglesias mountains. Confirmed breeding has been proofed in 13 squares (33.3%) at least in one of the 10 years considered (cf. FIGURE 2).

For the 1956-67 period breeding has been considered confirmed, probable or possible in 26 squares (8.8% of the total number of 296). Reproduction was certain in 6 squares (23.1% of the total of 26 positive squares) and 5 of them (83.3%) were situated in the calcareous mountains of Supramonte and one in the northern part of the island (cf. FIGURE 3). The breeding pairs were 3 or 4



Number of 10 km squares in which recorded	Breeding		
	Possible	Probable	Confirmed
● = 13 (50,0%)	● = 7 (26,9%)	● = 6 (23,1%)	
= 26 (8,8%) breeding confirmed, probable and possible			

Figure 3. Historical distribution (10 km squares) of the Bearded Vulture in Sardinia, 1956 -1967

(Supramonte and Monti di Alà), dropping to one in 1967, the last year with successful breeding in central-eastern Sardinia (SCHENK, 1974; 1976; MUSCAU, *ex verbis*; SANCIU, *in litt.*). The last Supramonte pair from Fruncu sos Cuzzos/ Orgosolo was present in the area up to 1969 (MUSCAU, *ex verbis*; SCHENK, 1974; 1976). The last breeding attempts of the Monte Lerno pair/Buddusò/Monti di Alà are to be collocated in the 1965-67 period (SANCIU, *in litt.*; SCHENK, 1976).

In TABLE 2 an hypothesis is advanced concerning numbers of the Sardinian population of BV for the different periods between 1870 and 2002, taking into account, as far as possible, the population structure based on collected specimens. The estimates are to be considered with caution (cf. for the western Alps MINGOZZI & BALLETO, 1996) and should represent minimum values.

2.2 RECENT RECORDS, 1962-2002

Information concerning published and unpublished observations of BV's in Sardinia have been collected and critically evaluated (* = low formal reliability; ** = not bad formal reliability; *** = good formal reliability) for the last 40 years. SCHENK (1976) supposed optimistically for the 1970s still 2-3 (4?) BV's present in Sardinia. The observations during the 1960s and 1970s probably refer to the last individuals of the Sardinian population and the data between 1980 and 2002 may refer to birds from Corsica and/or the western Alps. However, the following list is to be considered incomplete, especially concerning the 1960s and will be integrated with further data based on specific investigations among shepherds, especially in central eastern Sardinia.

Seven (43.8%) of the 16 data have been classified as having good formal reliability, 5 data (31.3%) not bad formal reliability and the remaining 4 data (25.0%) low formal reliability.

1962	1 immature ind. observed in the Limbara mountains (E. BUA, <i>ex verbis</i>); *
1964	1 ind. observed bone breaking in the Talana mountains (Serra, <i>ex verbis</i>); ***
1966	1 ind. in the Supramonte of Orgosolo (<i>fide</i> F. PRATESI, <i>in</i> SCHENK, 1974); **
March 1969	1 ind. flying near Monte Lerno/Buddusò (F. SANCIU, <i>in litt.</i>); ***
1968	1 ind. observed in the Gennargentu mountains of Fonni (L. MELONI, <i>in litt.</i>); *
1969	the last observation of the pair from Fruncu sos Cuzzos/Orgosolo (MUSCAU, <i>in</i> SCHENK, 1974; 1976); ***
1969	1 ind. observed in the Monte Albo of Siniscola (S. MUGNO, <i>in litt.</i>); *
September 1970	probably 1 immature ind. observed at Monte Spada/Fonni (DIESELHORST, 1971); **
December 1970	probably 1 ind. flying at Monte Lora/San Vito (<i>fide</i> G. MELONI, <i>in</i> SCHENK, 1976); *
23/06/1972	2 adults in the Monti di Alà (SCHENK, 1974; 1976); ***
29/03/1977	1 ind. photographed in the Supramonte of Oliena (RUIU, 1981); ***
17/11/1977	1 ind. together with 2 Griffon Vultures soaring over Serra Loduno/Urzulei (SCHENK, <i>unpub.</i>); **
14/02/1980	1 ind. near Punta Cristallo/Alghero (RUIU, 1981 and <i>ex verbis</i>); ***
10/10/1986	1 ind. near Cantoniera di Pira e'Onni/Villagrande (CANARGIU, <i>ex verbis</i>); **
05/05/1991	1 ind. mobbed by a Raven and 3 Mediterranean herring gulls near Laconi (GUILLOSSON, <i>in litt.</i> to C. DETTORI); ***
22/06/2002	1 adult a few km north of Bosa (M. RIGHI <i>in</i> GRUSSU, 2003; <i>fide</i> BACCETTI; RIGHI, <i>in litt.</i>); **

Table 2. Estimated numbers of Bearded Vultures in Sardinia, 1870 – 2002

PERIOD	BREEDING PAIRS	INDIVIDUALS	SPECIMENS (EGGS) COLLECTED	SOURCE
1870-1900	40-35	150-125	>15 (3)	BROOKE, 1873; GIGLIOLI, 1886; <i>present study</i>
1901-1920	35-20	125-65	>41 (7)	ARRIGONI DEGLI ODDI, 1929; 1931; MARTORELLI, 1960; <i>present study</i>
1921-1945	20-10	65-35	>21 (3)	STEMMLER, 1932; MOLTONI, 1949; FOSCHI, 1984; <i>present study</i>
1946-1966	10-2	35-5	>10 >10 killed by poisoned baits?	BEZZEL, 1957; SCHENK, 1974; 1976, 1977; RUIU, 1981; SCHENK & GENERO, 1996; <i>present study</i>
1967	1 (last breeding attempt 1969?)	5?	?	SCHENK, 1974; 1976; 1977; RUIU, 1981; SCHENK & GENERO, 1996; <i>present study</i>
1968-2002	0	1-2?	?	individuals from Corsica and/or the Alps?

3 CAUSES OF EXTINCTION

SALMEN (1980) and KLEMM & KOHL (1988) documented the extinction process of the BV in Rumania (cf. GLUTZ v. BLUTZHEIM *ET AL.*, 1971) attributing the population crash in the 19th century principally to persecution by hunters and the extirpation in the final phase to the use of poisoned baits (strychnine) for predator control.

For the western Alps (France, Italy) MINGOZZI & ESTÈVE (1997) and MINGOZZI & BALLETO (1996) discussed historical data on the former range and the extirpation causes of the BV based on bibliography and museum and private collection samples. At the beginning of the 20th century the species was still present in only 5 areas. The last breeding records are from about 1910 while the species probably survived for further 15-20 years; the last reliable observations are from 1924 and 1930. The causes of extinction were attributed mainly to persecution (collection for taxidermy and pest control). MINGOZZI & ESTÈVE (*I.c.*) however are of the opinion that their data analysed are still insufficient to confirm persecution as the major cause of extirpation, even though the evidence suggests this hypothesis (cf. FASCE & FASCE 1992).

The direct human-induced causes of decline and extinction of the BV in Sardinia are principally harvesting (collection of skins, eggs, trophies), followed by hunting, poaching, occasional killing and plundering of eyries; among indirect human induced causes of extinction the use of poisoned baits (strychnine; arsenic compounds; DDT) for pest control (*Vulpes vulpes*, feral dogs; locusts; *Anopheles labranchiae* - the malaria vector) probably played a major role during the 1950s. These principal causes have been accompanied by a general decline in livestock mortality, a progressive increase in the human population and roads, which together augmented human pressure on the last wilderness areas of the island (SCHENK, 1976; SCHENK & GENERO, 1996).

3.1 COLLECTION

In TABLE 3 and FIGURE 4 data are summarized concerning samples of BV from natural museum and private Italian, European and North-American collections. Collection appears to have been the main cause of the strong decline in the Sardinian population during the 1870-1934 period: 93 specimens killed (comprising 5 *pulli*) and 15 eggs collected - all legally, with a total of 108 samples or 84.4% of the 128 dated samples. Particularly "profitable" was the 1901-10 period with 47 samples (41 specimens; 6 eggs), corresponding to 36.7% of the 128 dated samples (cf. also HIRALDO *ET AL.*, 1979). The 8 specimens (6.3%) dated between 1939 and 1962 have been collected illegally, because the BV has been legally protected in Italy since 1939 (CONDER, 1977).

The geographical distribution of 79 samples collected in the Sardinian breeding range of the BV is shown in FIGURE 5. The Supramonte, Ogliastra and Gennargentu range, the key-area of the species, "produced" 43 samples (54.4%), followed by the Sulcis area (13 samples), the Iglesiente mountains (8 samples) and the other breeding areas.

Out of the 72 individuals shot (1821-1962) of which the sex is known (including also undated samples), 47 (65.3%) were males and 25 (34.7%) females. Thus the sex ratio was 1:0.53 showing nearly a two-fold incidence of killed males in relation to females. This difference is statistically significant according to the chi-squared test ($X^2 = 6,72$; $P = <0,01$). MINGOZZI & ESTÈVE (1997) report

Table 2. Estimated numbers of Bearded Vultures in Sardinia, 1870 - 2002

PERIOD	NUMBER OF SPECIMENS		
	SKINS, SKELETONS AND MOUNTED	EGGS	TOTAL
1821 - 1900	29	5	34
1901 - 1910	41	6	47
1911 - 1920	13	3	16
1921 - 1930	14	-	14
1931 - 1940	7	3	10
1941 - 1950	1	-	1
1951 - 1962	6	-	6
undated	11	-	11
1821 - 1962	122	17	139

nearly identical figures, statistically not significant, for the western Alps concerning a sample of 17 individuals: 11 males (64.7%) and 6 females (35.3%). In Sardinia many adults have been killed near or on the nest, sometimes male and female, for example: numbers 9; 33; 43/44; 93/94 of ANNEX 1.

Out of 77 specimens of which age classes are known, 47 (61.0%) were adults, 9 (11.7%) were immatures, 16 (20.8%) were *juveniles* and 5 (6.5%) were *pulli*.

Sixty-seven samples (48.2%) were actually conserved in collections in Italy, 23 (16.6%) in Germany, 15 (10.8%) in the United States, 13 (9.4%) in Switzerland, 7 (5.0%) in the United Kingdom, 7 (5.0%) in France, 3 (2.2%) in the Netherlands, 1 (0.7%) in Sweden, 1 (0.7%) probably in Hungary and 2 (1.4%) in unknown collections.

3.2 PERSECUTION AND POACHING

In TABLE 4 the known cases of persecution and poaching are summarized. Out of 125 killed individuals (1821-1962) twelve (9.6%) were collected illegally (1939 - 1962), among them 2 *pulli* taken from the nest in south-eastern Sardinia: 1945 and 1946 (SCHENK, 1977).

There are 2 known cases of BV's captured in a fox trap: 1931 near Seui (*fide* MOI & ARESU) and 1955 near Padru (RUIU, 1997) and two cases of BV's killed with sticks: 1956 near Padru (SORRENTI, *in litt*; SCHENK, 1977) and 1962 near Baunei (SCHENK, 1976).

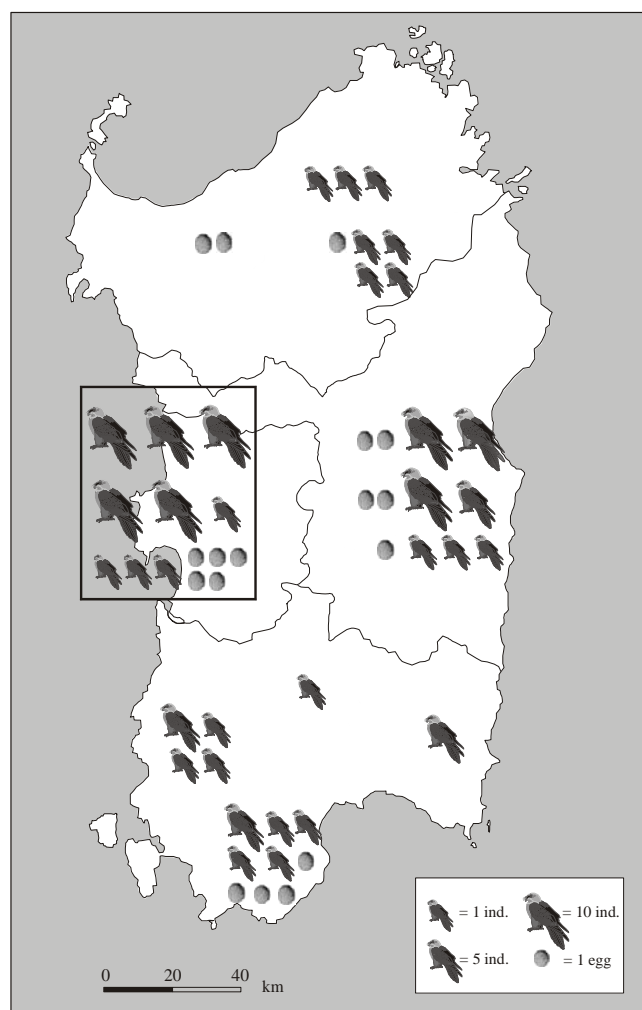
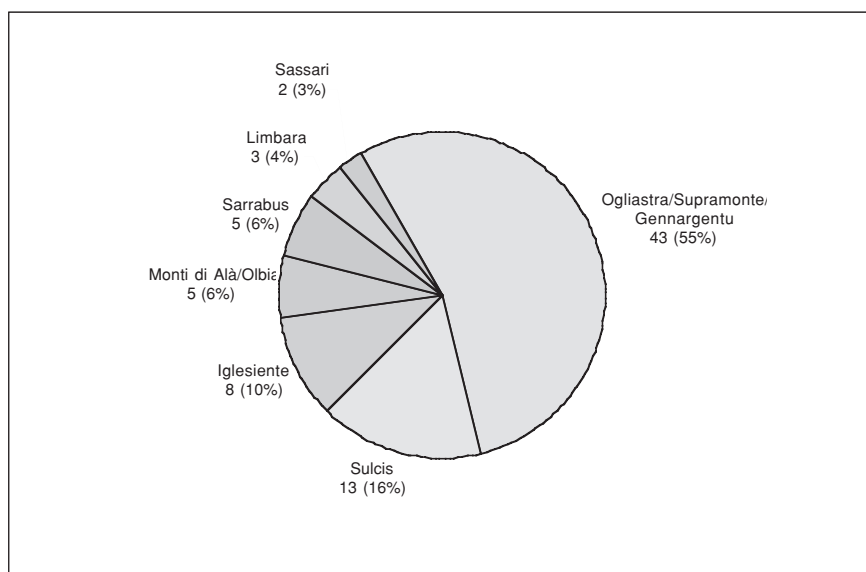


Figure 4. Distribution of 139 specimens (skins, mounted, skeletons, eggs) of Bearded Vultures collected in Sardinia, 1821 - 1962 (the box refers generally to Sardinia)

Table 4. Bearded vultures killed or collected illegally in Sardinia, 1939 - 1962

PERIOD	NUMBER OF SPECIMENS			SOURCE
	IN COLLECTIONS	UNKNOWN	TOTAL	
1939 - 1950	2	2 <i>pulii</i>	4	SCHENK, 1977; <i>present study</i>
1951 - 1962	6	2	8	SCHENK, 1976; 1977; RUIU, 1997; <i>present study</i>
1939 - 1962	8	4	12	

**Figure 5.** Distribution of 79 specimens of Bearded Vultures (skins, mounted, skeletons, eggs) collected in 10 geographical breeding areas of Sardinia, 1835 - 1962

3.3 POISONED BAITS

There are no proofs of BV's killed by poisoned baits (strychnine) put out to control foxes and feral dogs which damage livestock of Sardinian shepherds. The use of poisoned baits was legally possible up to 1976 and particularly frequent in the 1950s and 1960s in the Gennargentu-Supramonte area, in the Sulcis-Iglesiente districts and in the south-eastern part of the island, reducing significantly the numbers of Griffon Vultures which became extinct locally in many areas (SCHENK, 1976; 1977; 1986; RUIU, 1981; SCHENK & GENERO, 1996; ARESU & SCHENK, 2004). It is highly probable that also Black and Bearded Vultures were killed by poisoned baits. BASOCCU (*ex verbis*) referred to the intentional killing of one or two BV's for taxidermy purposes in the Ogliastro districts in the 1950s (not considered in TABLE 5).

During the 1979-2003 period, HEREDIA (2003) attributed 40% of BV mortality causes (14 cases) in the Spanish Pyrenees to the use of poisoned baits.

3.4 FOOD SHORTAGE

Concerning food resources, the three species of large Sardinian vultures were dependent on carcasses of free-ranging livestock (sheep, goat, cattle, horses and swine), locally integrated by carrion of wild ungulates such as Mouflon, Wild Boar, Corsican Red Deer and Fallow Deer (SCHENK *ET AL.*, 1987).

In TABLE 5 numbers of livestock species are illustrated for some selected years from the beginning of the 20th century up to 1961. The progressive increase in sheep and the decrease in goats, horses, cattle and swine are evident. Mortality rates were rather high, reaching 50 % for cattle (carrion) due to insufficient veterinary assistance. Only from the 1950s did a significant improvement in the hygienic conditions of livestock raising take place with a consequent decrease in mortality rates and less carrion available for vultures.



Mouflons in the Gennargentu Mountains, Sardinia

Photo: N. MARRAS, Italy

In 2003 research on mortality rates of live-stock was carried out in an area of 46 km² in the Bosa region (north-western Sardinia), in the framework of a conservation project for the Griffon Vulture. The annual mortality rate of sheep was 10.1% and 14.1 % for goats (MOZZO, *in* ARESU ET AL., 2004). Similar values should be expected in other districts of Sardinia with free-ranging domestic livestock (cf. also SCHENK ET AL., 1987). - HEREDIA (1991) indicates for the range of the BV in

the Spanish Pyrenees mortality rates for sheep and goats in only 3%. The carcasses of these two domestic species, integrated in winter by those of the Chamois constitute the principal food resources for this species. HIRALDO ET AL. (1979) evaluated the medium need of trophic resources for one pair of BV and its chick as a minimum of 350 kg/year or about 50 carcasses of sheep or Chamois. CLOUET (1984) calculated theoretically ca. 7 kg of bones available in the eastern Pyrenees from every carcass (sheep, Chamois) and concluded that the availability of food for three territorial pairs of BV is more than ten times higher than their real need of trophic resources.

Table 5. Number of livestock in Sardinia, 1908-1961 (selected years)

YEAR	LIVESTOCK CATEGORIES AND NUMBERS				
	SHEEP	GOATS	HORSES	CATTLE	SWINE
1908	1,876,741	506,966	89,854	376,606	158,022
1930	2,054,138	436,202	101,691	240,564	102,063
1941	2,015,323	399,025	72,016	220,956	95,202
1951	2,385,380	512,010	83,760	211,270	103,710
1961	2,384,800	358,000	58,900	224,500	120,950

Source. *Compendio Statistico della Regione Sarda, 1960-61.*

Also bearing in mind that not all carcasses could be reached by the BV's as well as competition for food resources with other carrion feeders (*Gyps fulvus*, *Aegypius monachus*, *Milvus milvus*, *Aquila chrysaetos*, *Corvus corax*, *Corvus corone*; *Sus scrofa*, *Vulpes vulpes*; pig, dog), it is reasonable to suppose that food resources in Sardinia were more than sufficient both at the beginning of the 20th century and in the 1960s with only few birds left (cf. TABLES 1 and 5).

3.5 HABITAT LOSS AND FRAGMENTATION

Precise habitat losses are difficult to measure and habitat fragmentation is a less obvious, but also an insidious threat to species. Since the beginning of the 20th century Sardinia has undergone numerous environmental modifications and transformations which have negatively influenced the habitat quality of the BV and other Sardinian wildlife: increased road network, agricultural reforms, power lines, dams, industrial and tourist settlements, mainly along the coastline.

All these interventions are correlated with the human population increase and development which have caused progressive habitat loss and fragmentation, thus reducing the BV's preferred environment and creating a significant impact of human disturbance, especially in the vicinity of breeding sites.

Former breeding habitat of the Bearded Vulture in Sardinia.

Photo: M. ARESU, Italy



Table 6. Resident population and population density in Sardinia, 1871 - 2001

YEAR	1871	1901	1911	1921	1931	1951	1961	1971	1981	1991	2001
Population (inhabitants)	636,000	796,000	868,000	885,000	984,000	1,276,000	1,419,000	1,474,000	1,594,000	1,648,000	1,632,000
Population density (inh/km ²)	26	33	36	37	41	53	59	61	66	68	68

Source. Istat (1994; 2005)

The resident human population increased in Sardinia between 1871 and 2001 by 157% (cf. TABLE 6). Present demographic density is 68 inhabitants/km², varying at the provincial level between 38 (Nuoro) and 110 (Cagliari).

Roads have undesirable effects, especially on endangered species (Bear, Wolf, *Lynx*, *Tetraonidae*, raptors, Bearded Vulture), that require large areas of undisturbed environment (PLACHTER, 1991; NEWTON, 1979). Roads fracture natural or nearly natural ecosystems and also facilitate recreational access to these areas by tourists, hunters and the general public and increasing human disturbance. The length of roads (national, provincial, municipal, agricultural) per unit area, generally expressed in km of road/100 km², is a simple indicator of the apportionment of the remaining habitat into smaller, more isolated pieces of an area.

If human disturbance is heavy and frequent in the vicinity of an occupied breeding site of the BV, the pair may even desert the site forever (LAYNA & RICO, 1991). DONAZAR (1993) underlined occasional breeding failures of BV's in the Spanish Pyrenees caused by bird-watchers and photographers, army manoeuvres, Wild Boar hunters, mountain gliders and mountain climbers and found that breeding success was negatively correlated with the density of paved roads. Decreased breeding success of Bald Eagles was observed by ANTHONY & ISAACS (1989) in the Oregon Cascades/Canada with proximity to clearcuts.

TABLE 7 illustrates the development of national and provincial roads in Sardinia for the 1951-2001 period and some indicators which correlated the roads with the resident human population and the surface.

The Sardinian road network has increased by 138.5% and the availability of national and provincial roads per 10,000 inhabitants by 86.4%, while the population increased during the same period only by 27.9%. Comparing these values, referring to 2000, with those concerning Italy, it is seen that Sardinia (52.2 km) has a higher availability of roads/10,000 inhabitants than the mean Italian figure (29.2 km), corresponding to +78.8%. On the other hand, Sardinian road density (km/100 km²) is 36.1% lower than the mean Italian value (cf. TABLE 7).

The increase in the main road network from 1951 to 1961 probably had only a marginal effect on the extinction process of the BV in Sardinia by providing easier public access to island's wilderness

Table 7. Road network (national and provincial) in Sardinia, 1951-2000 (selected years) and in Italy, 2000

YEAR	ROAD CATEGORY AND KM			KM/100 KM ²	KM/10.000 INHABITANTS
	STATE	PROVINCIAL	TOTAL		
1951	1,448	2,121	3,569	14.8	28.0
1961	2,179	3,379	5,558	23.1	39.2
1991	2,939	5,216	8,155	33.9	49.5
2000	3,097	5,417	8,514	35.3	52.2
Italy 2000	46,556	119,644	166,200	55.2	29.2

Source: Compendio Statistico della Regione Sarda, 1960-61; Annuario Statistico della Sardegna, 1994; 2003

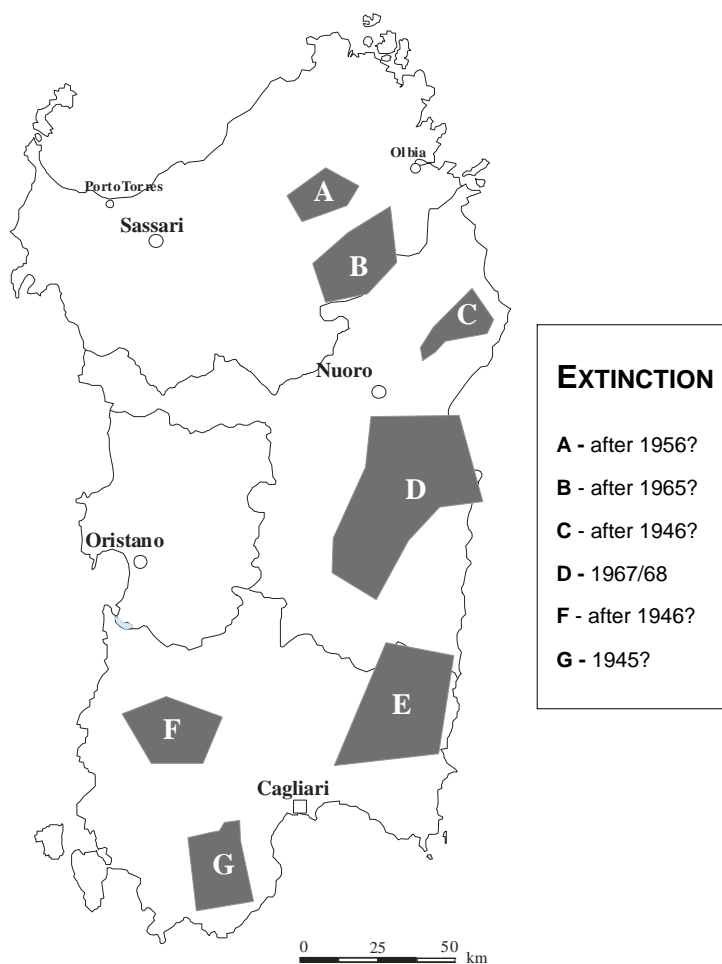


Figure 6. Selected geographical areas (A=Monte Limbara, B=Monti di Alà; C=Monte Albo; D=Supramonte, Gennargentu; E=Sarrabus, Gerrei, Quirra, F=Monte Linas, G=Sulcis) for the feasibility study concerning the reintroduction of the Bearded Vulture in Sardinia

areas and increasing the risk of poaching and human disturbance near the last breeding sites. However, more information is needed on the existing municipal and extra-urban roads in the selected reintroduction areas.

4. FEASIBILITY EVALUATION

The specific feasibility study comprises the selection of potentially suitable areas for the reintroduction of the BV, the ecological and socio-cultural analyses of the potentially suitable areas, an evaluation of the availability of founders and some considerations on the effects the reintroduced BV's will have on the ecosystems concerned.

4.1 SELECTION OF POTENTIAL REINTRODUCTION AREAS

Based on the historical distribution of the BV in Sardinia from 1945 to 1967 (FIGURES 2 and 3), seven geographical areas (FIGURES 6) were selected for feasibility evaluation: Monte Limbara (A), Monti di Alà (B), Monte Albo (C), Supramonte and Gennargentu (D), Sarrabus, Gerrei, Quirra (E), Monte Linas (F) and Sulcis (G).

4.2 EVALUATION CRITERIA

Evaluation criteria comprise eight groups, each one containing different parameters applied to each of the eight selected areas: physical (4), climatic (1), ecological

(11), actual impacts (5), future impacts (6), socio-cultural (3), actual structure (2), legal institutions (3) - for a total of 35 parameters.

In ANNEX 2 values are illustrated for the single parameters and the relative score, generally in the range of -3 to +3. The score was attributed on the bases of the effective values found, for example, the surface of an area or the altitudinal gradient, direct knowledge of all areas and, inevitably on the subjective opinion of the authors. On some ecological and socio-cultural parameters more specific research will be needed during the preparatory phase of the prospective reintroduction project.

4.2.1 PHYSICAL AND CLIMATIC PARAMETERS

The physical parameters concerned are surface, geology, morphology and altitudinal gradient (cf. Annex 2). The most heavily weighted physical parameter was surface with a range from 1 to 7 scores. The three areas with the highest score are area D (Supramonte, Gennargentu) with 16 scores, area E (Sarrabus, Gerrei, Quirra) with 12 scores and area F (Monte Linas) with 11 scores. - The climatic criteria (Arrigoni, 1968) is identical for 6 areas and only the Supramonte, Gennargentu area (D) totalised 3 scores due to the presence of at least 5 phytoclimatic horizons.

4.2.2 ECOLOGICAL PARAMETERS

This group of criteria (cf. ANNEX 2) comprises the following parameters: percentage incidence of nearly natural, modified and transformed ecosystems (*sensu* IUCN, 1978), arbitrary evaluation of the quality of breeding and feeding habitats, fragmentation of habitats, availability of food (carrion), approximate date of last breeding attempt, presence of Griffon Vulture and Golden Eagle and an estimation of the carrying capacity of the area for the BV (breeding pairs and individuals).

Areas D (Supramonte, Gennargentu), F (Monte Linas) and G (Sulcis) are the only ones with a percentage higher than 20% of nearly natural ecosystems; the areas with the best breeding habitats are the Supramonte, Gennargentu (D), the Monte Albo (C) and the Monte Linas (F), mainly constituted by limestone, while the best feeding habitats are confined to the Supramonte, Gennargentu area (D). The last breeding records or attempts were also from the Supramonte (1967/69) and from the Monti di Alà (B) areas, where the last breeding attempt should be placed in the 1960-65 period. The highest score for the presence of Golden Eagle and Griffon Vulture (irregular) was also reached by area D.

The carrying capacity parameter represents in some way an evaluation of synthesis concerning suitability of every one of the 7 areas to reintroduce the BV. With 4-5 pairs and 12-15 individuals Supramonte, Gennargentu (D-900 km²) has the highest carrying capacity, followed by Sarrabus, Gerrei, Quirra district (E-450 km²) and Monte Linas (F-320 km²), both the latter areas with 2 pairs and 5-7 individuals. All remaining areas (A,B,C and G) have a carrying capacity of 1 pair and 2-5 individuals. The total theoretic carrying capacity of the island could be placed in the range of 12-13 breeding pairs and 32-44 individuals. Similar values – 10 pairs in 2003 - have been found for the present Corsican population (FASCE & FASCE, 2003) with which the built-up Sardinian population will constitute a meta population.

In TABLE 8 numbers of domestic livestock are shown for every area, based on municipal data referring to 2000, compared to the total numbers of all 7 areas and the whole Island. Considering only sheep and goats with a mortality rate of about 10% (ARESU ET AL., 2004), we have the following ranking: Supramonte, Gennargentu (D-193,065 heads), Monti di Alà (B-74,514 heads), Sarrabus, Gerrei, Quirra (E-72,432 heads), Monte Albo (C-62,303 heads), Monte Linas (F-60,658 heads), Sulcis (G-48,197 heads) and Limbara (A-39,388 heads). However, livestock in the Monte Limbara, in the Monte di Alà, in the Sulcis mountains and to a lesser degree also in the Monte Linas and Monte Albo areas graze at lower altitudes and partially in the plains. This implies a lower rate of carcasses reachable by the BV in these areas with a higher degree of human impact.

The Supramonte, Gennargentu range hosts a vital population of the Mouflon, recently estimated in 2,800-3,000 individuals; this species is present also in the Monte Albo area (about 150 individuals) and with lower numbers in the Monti di Alà; Sarrabus, Gerrei, Quirra range and in the Monte Linas area (SCHENK ET AL., in press). In all seven areas there are good populations of Wild Boar and, in the Sulcis range and in the Sarrabus, Gerrei, Quirra area of *Cervus elaphus corsicanus*, present also in small numbers in the Monti di Alà and Monte Linas areas and locally in the Gennargentu mountains.

The modest food requirement of the BV's to reintroduce in Sardinia and the high number of carcasses available in nearly all the areas selected make the birds independent of the presence of feeding places. However, if for different reasons the organization of feeding places should be realized, we have to take in consideration the Animal By-Products Regulation of the European Community n° 1774/2002. This regulation considers the possibility of utilizing animal by-products and carcasses of domestic livestock to feed birds of prey, especially scavengers (vultures), in fenced feeding places under the control of veterinary authorities.

The overall evaluation of ecological parameters produced the following ranking: Supramonte, Gennargentu, D – 37 scores, followed by Monte Linas, F with 29 scores and Monte Albo, C with 24 scores and then come all the other areas (cf. ANNEX 2).

Table 8. Number of livestock in 7 selected areas of Sardinia, 2000

AREA	LIVESTOCK CATEGORIES AND NUMBERS				
	SHEEP	GOATS	HORSES	CATTLE	SWINE
Monte Limbara -A	35,869	1,519	254	17,298	3,116
Monti di Alà - B	71,903	2,611	278	9,071	2,428
Monte Albo - C	55,763	6,540	158	2,404	2,083
Supramonte,Gennargentu - D	144,896	48,169	1,022	20,118	14,114
Sarrabus,Gerrei,Quirra - E	40,875	31,557	292	6,854	9,034
Monte Linas - F	44,167	16,491	179	1,640	4,716
Sulcis - G	32,069	16,128	197	4,224	2,981
All 7 areas	425,542	123,015	2,380	61,609	38,472
<i>Sardinia</i>	<i>2,808,713</i>	<i>209,487</i>	<i>16,487</i>	<i>250,334</i>	<i>193,947</i>

Source. Istat, 2003. 5° Censimento generale dell'agricoltura.

4.2.3 ACTUAL IMPACTS

The following parameters are analysed: road density, impact from tourism and hunting, presence of power lines and wind parks and the illegal use of poisoned baits (cf. ANNEX 2).

The only areas that obtained a positive score were Monte Albo (C) and Monte Linas (F) – both with 1 score. The areas with the highest actual impact are Monti di Alà (B-10 scores) and Monte Limbara (A-8 scores). The use of poisoned baits appears to be irregular in areas B, D and E while it is unknown in the remaining areas. Hunting activity is actually "high" in the Supramonte, Gennargentu and in Sulcis areas; it is "average" in all other districts.

4.2.4 FUTURE IMPACTS

The parameters analysed are the same ones as those of paragraph 4.2.3, plus agricultural and forest transformations (cf. ANNEX 2).

The only area totalising a positive score is Monte Albo (+5 scores), followed by Monte Linas (-3 scores), the Sulcis district (-5 scores), the Supramonte, Gennargentu range (-6 scores), Monte Limbara (-8 scores), Monti di Alà (-9 scores) and the Sarrabus, Gerrei, Quirra area (-10 scores). Risks deriving from future wind parks have been reduced by the recent regional law concern-

ing landscape planning (L.R. no. 8/2004) and the creation of new wind farms is subordinated to approval of the regional landscape plan (PPR), which is now being drafted. If the protected areas foreseen by Regional Law no. 31/1989 or the national law concerning protected areas (Law no. 394/1991) should be established, hunting will be absent from the following



Adult Bearded Vulture

Photo: L. ARRU, Italy

areas: Monte Limbara (regional park), Monte Albo (natural reserve), Supramonte, Gennargentu (national park), Monte Linas (regional park), Sulcis (regional park) and partially from the Sarrabus, Gerrei, Quirra area (regional park).

4.2.5 SOCIO-CULTURAL PARAMETERS

This group of criteria attempts to objectify some parameters which may be essential for the success of the reintroduction project: knowledge of the species by local people, attitude of local people towards vultures and the prevision of cooperation for a reintroduction project of the BV. Evaluations concerning potential cooperation have been expressed independently by the three authors and thus they are characterised by a certain degree of subjectivity. To obtain a better consensus for the reintroduction project by local people, an information campaign is needed to explain in a target-specific way the content of the programme.

The score (cf. ANNEX 2) varies from 3 (D-Supramonte, Gennargentu) to 6 scores (A-Monte Limbara; E-Sarrabus, Gerrei, Quirra).

4.2.6 ACTUAL STRUCTURES

Only two parameters are considered (cf. ANNEX 2): presence of the Ente Foreste della Sardegna (regional forest authority) as a management structure of the Regione Sarda and that of non-governmental organizations.

Environmental groups working in Sardinia which have promoted and carried out conservation projects concerning birds of prey, and especially the last Sardinian vultures, are in chronological order:

WWF International (SCHENK, 1975), LIPU-BirdLife (SCHENK & ARESU, 1992; SCHENK & GENERO, 1996) and Legambiente Sardegna (ARESU & SCHENK, 2003; SCHENK *ET AL.*, 2004).

According to Art. 3 the Regional Law no. 24/1999, the Ente Foreste della Sardegna has, among other duties, that of "to administer the woodland-agricultural-forest and faunistic patrimony of the Sardinian Regional Administration under concession or rented by it, by municipalities or other public or private bodies, through organization of its management, surveillance, rational preservation, improvement and by operating, generally, in compliance with forest plans" and "to promote through outside operators, activities of captive stock-breeding and distribution of fauna, tourism, rural and recreational tourism, as well as all other collateral activities useful for the best economic utilization of properties, works and resources of the Ente Foreste della Sardegna".

4.2.7 LEGAL INSTITUTIONS

Parameters considered are hunting institutions, environment planning instruments and the existence or prevision of protected areas (cf. ANNEX 2).

The highest score was obtained by the Sulcis area (19 scores), owing to the presence of a Special Protected Area (Monte Arcosu) according to the Wild Bird Directive of the EC, followed by the Supramonte, Gennargentu area, the Sarrabus, Gerrei, Quirra districts (both 17 scores) and the Monte Limbara with 16 scores.

The chance for the establishment and concrete management of protected areas (national and regional parks) appears to be uncertain in consideration of the 16 years passed since the approval of the relative regional law and the very complicated situation of the formally instituted Gennargentu National Park, which has not been accepted by the local municipalities.

The success of the international project for the reintroduction of the BV in the Alps could be partly attributed to the presence and management of protected areas (national and regional parks) which covered, at least in part, the project costs (cf. FREY, 2003; HEGGLIN *ET AL.*, 2003; JENNY, 2003; FASCE & FASCE, 2003). ROBIN *ET AL.* (2004) produced a detailed summary of the first 25 years of the programme, underlining that the availability of financial resources constitutes a permanent problem and that the contributions of private and public sponsors are important for the continuation of the project (cf. also PACHLATKO, 1991; IUCN, 1995).

4.3 SELECTION OF TARGET AREAS

In TABLE 9 the total scores are illustrated which were obtained for the 8 criteria groups in the 7 different geographic areas taken into consideration.

The first rank was reached by the Supramonte, Gennargentu (about 900 km²) area with 70 scores which was evaluated as the most suitable area for reintroduction of the BV in Sardinia; the

Table 9. Final feasibility evaluation of the reintroduction of the Bearded Vulture in 7 geographical areas of Sardinia/Italy, 1995-2004

CRITERIA	GEOGRAPHICAL AREAS PARTIAL AND TOTAL SCORE						
	A MONTE LIMBARA 150 KM ²	B MONTI DI ALÀ 300 KM ²	C MONTE ALBO 150 KM ²	D SUPRA- MONTE GENNARGEN- TU 900 KM ²	E SARRABUS GERREI QUIRRA 450 KM ²	F MONTE LINAS 320 KM ²	G SULCIS 300 KM ²
PHYSICAL	8	9	9	16	12	11	9
CLIMATE	1	1	1	3	1	1	1
ECOLOGICAL	11	11	24	37	23	29	18
ACTUAL IMPACTS	-8	-10	1	-6	-4	1	-4
FUTURE IMPACTS	-7	-9	5	-6	-10	-3	-5
SOCIOCULTURAL	6	5	4	3	6	4	4
ACTUAL STRUCTURES	6	3	6	6	6	6	6
LEGAL INSTITUTIONS	16	7	11	17	17	16	19
TOTAL SCORE (RANK)	33 (6)	17 (7)	61 (3)	70 (1)	51 (4)	65 (2)	48 (5)

second rank was obtained by the Monte Linas (320 km²) with 65 scores, followed by Monte Albo (61 scores), the Sarrabus, Gerrei, Quirra district (51 scores), the Sulcis 48 scores), Monte Limbara (33 scores) and Monti di Alà areas (17 scores).

Only the Supramonte, Gennargentu area (D), Sarrabus, Gerrei, Quirra (E) and Monte Linas (F) areas have a carrying capacity of more than one pair. To built up a viable Sardinian population of the BV, the historical central-eastern range of the species will assume a strategic role, with an estimated carrying capacity of 4-5 pairs and 12-15 individuals. The Supramonte, Gennargentu area (D) is contiguous to Monte Albo (C - 150 km²) in the north and through the Ogliastra region to the Sarrabus, Gerrei, Quirra area (E - 450 km²) in the south, constituting nearly a continuous range of more than 1.500 km² with a total carrying capacity of 7-8 pairs and 20-27 individuals.

Although the Supramonte, Gennargentu area has the lowest score of socio-cultural parameters (cf. TABLE 9), due to a locally negative attitude towards vultures and an articulated opposition to the Gennargentu National Park, a reintroduction project of the BV should start exactly in central-eastern Sardinia which more than all others areas has the ecological requisites to build up a viable population (cf. ANNEX 2). The municipalities with the highest number of historical breeding sites which still correspond to the requisites of habitat quality for this species are Urzulei, Baunei, Orgosolo, Olieana, Dorgali and Talana.

A second choice to consider is the Monte Linas area (320 km²) with an estimated carrying capacity of 2 breeding pairs and 5-7 individuals; unfortunately the Linas mountains are separated by the large Campidano Plain from the continuous historical range in central eastern Sardinia.

4.4 AVAILABILITY OF RELEASE STOCK

According to HIRALDO ET AL. (1979) there are only two subspecies of the BV: *Gypaetus barbatus barbatus* (Europe, Asia and North Africa) and *Gypaetus barbatus meridionalis* (south and east Africa). All individuals of the Bearded Vulture Endangered Species Breeding Programme (EEP) and those released in the Alps belong to the nominal subspecies *G.b. barbatus* (FREY, 2002).

GAUTSCHI (2001) and GAUTSCHI *ET AL.*, 2003) have demonstrated that genetic variability in the captive BV population is similar or more variable than the largest natural population in Europe (Pyrenees). Allelic diversity of the captive population is higher than that found in natural museum collections from the two large extinct alpine and Sardinian populations. The same authors (GAUTSCHI *ET AL.*, 2003) suggest a further recruitment of founders to reduce the risk of loss of genetic variability and an improvement of genetic flow among populations in captivity, released and wild ones.

During the last 26 years (1978-2003), 200 *pulli* of BV's have been reproduced (FREY, 2003), with an average number of 7.7 *pulli*/year (min 1; max. 17). 121 birds have been released in four different Alpine countries (Austria, France, Italy and Switzerland), with an average number of 6.7 BV's/year (min 2; max 10) between 1986 and 2003.

TERRASSE (*in* FASCE & FASCE, 2003) reports that the actual breeding population is constituted by 12 breeding pairs and about 73-75 individuals and postulates the need in the coming years of an overall strategy to be developed and carried out, to re-colonize the suitable habitats of the entire Alps and also other formerly occupied areas in Europe, for instance establishing bridges between wild populations and reintroduced ones, for example Alps, Corsica, Sardinia.

All the birds released were generated by pairs reproducing in captivity. To increase breeding success, artificial incubation is used as well as the utilization of foster parents. For release in nature the hacking technique is considered to be the most successful for the BV (FREY, 1985; FREY & WALTER, 1989). This technique imitates the fledging of young birds from the nest. Two nestlings of about 90-100 days old and not able to fly, but to feed autonomously are put in a natural cave, similar to a BV's nest from which they take off afterwards (GENERO, 1995). The actual situation of the 33 adult pairs in captivity and the up-to-date documentation of the international breeding network are illustrated by FREY (2003).

The availability of founders for a reintroduction project of the BV in Sardinia has been discussed with representatives of the Foundation for the Conservation of the Bearded Vulture and particularly with MICHEL TERRASSE, HANS FREY, MAARTEN BIJLEVELD and PAOLO FASCE.

If there is agreement among all qualified public and private operators and the guarantee of sufficient financial resources to start the reintroduction programme, the Foundation will make available every year two BV's for the Sardinian project from the different breeding units of the EEP. In this way the reintroduction programme in the Alps can continue and an important part of the former range of the BV in Europe, Sardinia, will be re-colonized.

4.5 EFFECTS OF THE REINTRODUCED SPECIES ON THE ECOSYSTEMS CONCERNED

The reintroduction of a species in a certain area may create problems in relation to the equilibrium of the present biotic community as well as to human activities.

In consideration of the relatively recent extinction of the BV in the Supramonte, Gennargentu range and the few environmental modifications that have taken place there, a gradual reintroduction of this species should not produce relevant effects on the ecosystems concerned.

The BV is generally the last species of scavengers that arrives on a carcass (GLUTZ V. BLOTZHEIM *ET AL.*, 1971; DONAZAR, 1993) and does not compete directly with the Griffon and the Black Vulture (the two species formerly present in central-eastern Sardinia), but waits until they depart, then consumes bones and skins on which it specializes (CRAMP, 1980).

Potentially, there could be some competition between the BV and the Golden Eagle, but the very high availability of suitable breeding sites for these two species, especially in the calcareous mountains of the Supramonte, should factually exclude it.

Concerning human activities, some changes have taken place during the last 30 years. Many shepherds have abandoned the Supramonte and their flocks of sheep and goats have been partially substituted by Mouflons. During summer this area is frequented by an increasing number of tourists (trekking, free-climbers) and the Gennargentu mountains also in winter. All these activities may create some negative impact on the released BV's and thus they need regulations which must be strictly adhered to.

5. FINAL CONSIDERATIONS

The principal cause of extinction of the BV in Sardinia was the collection of specimens and apparently to a lesser degree the use of poisoned baits. Collection and the legal use of poisoned baits have been removed and thus the basic condition is met for a possible reintroduction project of the BV in Sardinia.

This project should be part of a common strategy for the conservation of the Griffon, Black and Bearded Vulture on the island to be defined in the framework of a multidisciplinary approach invol-

ving a team of persons coming from different backgrounds and possessing different skills: persons from regional natural resource management agencies (Ente Foreste della Sardegna, Corpo Forestale e di Vigilanza Ambientale), experts from NGO's with experience in the management of conservation projects for vultures, veterinarians and experts in communication in rural areas.

Summarizing, the reintroduction of the BV in Sardinia is feasible if there is agreement among all public and private operators and a political commitment of the regional (Regione Autonoma della Sardegna, Provincia di Nuoro, Provincia di Cagliari, local municipalities) and national (Ministero dell'Ambiente, Istituto Nazionale della Fauna Selvatica) authorities to guarantee financial resources and the necessary cooperation to cover a period of 3 years for the preparatory phase of the project. The present study has demonstrated that the most suitable area for the reintroduction of this species is the Supramonte, Gennargentu area (**D** - 900 km²), of which essential parts are included in the formally instituted Gennargentu National Park, with an estimated carrying capacity of 4-5 breeding pairs and 12-15 individuals. A second possibility could be the Monte Linas area (**F** - 320 km²) with an estimated carrying capacity of 2 breeding pairs and 5-7 individuals.

During the estimated three-year preparatory phase of the project, a capillary public awareness and information campaign is needed with special reference to local administrations, shepherds, hunters and schools at every level.- A further important action in the first phase should be the reintroduction of the Griffon Vulture into the Supramonte area where it became extinct at the beginnings of the 1980s. *Gyps fulvus* could be considered as a test species to prepare and to improve the socio-cultural acceptance of a conservation project by the local populations in a critical area like the Supramonte. If successful, this action will facilitate considerably the successive/following reintroduction of the Bearded and the Black Vulture in the same area.

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Annex 1. *Bearded Vultures (skins, mounted specimens, skeletons, eggs) from SARDINIA conserved in public and private collections.*

COLLECTION AREA	NUMBER	SKIN, MOUNTED SKELETON	EGGS	COUNTRY	MUSEUM COLLECTION (pu=public; pr=private)	COLLECTION YEAR	SEX, AGE CLASS	NOTES
Campidano	1	1		ITALY	Torino - pu	1821	M, immat.	TOFFOLI, <i>in litt.</i>
Sardinia	2	1			Torino - pu	1835	M, ad.	TOFFOLI, <i>in litt.</i>
Sardinia	3	1			Cagliari - pu	< 1863	M, ad.	SALVADORI, 1865; <i>fide</i> NISSARDI
Sardinia	4	1			Cagliari - pu	< 1863	F, ad.	SALVADORI, 1865; <i>fide</i> NISSARDI
Sardinia	5	1			Cagliari - pu	< 1863	juv.	SALVADORI 1865; <i>fide</i> NISSARDI
Sardinia	6	1			(Cagliari) - pu	< 1863	ad.	SALVADORI, 1865; lacking
Sardinia	7	1			Milano - pu	< 1864	M	CHIOZZI, <i>in litt.</i>
Sardinia	8	1			Rovereto - pu	1866	ad.	PROSSER & PREDINI, <i>in litt.</i>
Sulcis	9	1			Firenze - pu	1875	M, ad.	GIGLIOLI, 1886; POGGESI, <i>in litt.</i>
Sulcis	10	-	1		Firenze - pu	1875	-	GIGLIOLI, 1886; POGGESI, <i>in litt.</i>
Limbara	11	1			Liceo Sassari - pu	1888	M, ad.	TOGNOLI, <i>in litt.</i>
Ogliastra	12	1			Firenze - pu	1892	M	POGGESI, <i>in litt.</i>
Sardinia	13	1			Roma - pu	1899	M, ad.	FOSCHI ET AL., 1996
Iglesiente	14	1			Roma - pu	1899	M, ad.	FOSCHI ET AL., 1996
Iglesiente	15	1			Roma - pu	1899	M, ad.	FOSCHI ET AL., 1996
Monti di Alà	16	1			Sassari - pr	appr. 1895	ad.	<i>fide</i> PISU Coll. Argittu
Sardinia	17/18	-	2		(Milano) - pu	1850-99?	-	GIRTANNER, 1903; lacking
Iglesiente	19	1			Liceo Iglesias - pu	1850-99?	immat.	<i>fide</i> PERDIXI; VITTORI, <i>in litt.</i>
Iglesiente	20	1			Liceo Iglesias - pu	1850-99?	immat.	<i>fide</i> PERDIXI; VITTORI, <i>in litt.</i>
Gennargentu	21	1			Roma - pu	1900	<i>pullus</i>	FOSCHI ET AL., 1996; lacking
Ogliastra	22	1			Firenze - pu	1901	M, juv.	FOSCHI ET AL., 1996
Gennargentu	23	1			Roma - pu	1901	M, ad.	FOSCHI ET AL., 1996
Sarrabus	24	1			Roma - pu	1901	<i>pullus</i>	FOSCHI ET AL., 1996
Gennargentu	25	1			Roma - pu	1902	F, ad.	FOSCHI ET AL., 1996
Iglesiente	26	1			Firenze - pu	1906	M	POGGESI, <i>in litt.</i>
Gennargentu	27	1			Firenze - pu	1907	F	POGGESI, <i>in litt.</i>
Gennargentu	28	1			Genova - pu	1907	M	DORIA, <i>in litt.</i>
Ogliastra	29	1			Firenze - pu	1907	M, juv.	POGGESI, <i>in litt.</i>
Limbara	30	1			Firenze - pu	1907	M	POGGESI, <i>in litt.</i>
Ogliastra	31	1			Roma - pu	1908	M, juv.	FOSCHI ET AL., 1996; lacking
Sulcis	32	-	1		Firenze - pu	1908	-	POGGESI, <i>in litt.</i>
Sulcis	33	-	1		Firenze - pu	1908	-	POGGESI, <i>in litt.</i>
Sulcis	34	1			Firenze - pu	1908	M, ad.	POGGESI, <i>in litt.</i>
Ogliastra	35	1			Roma - pu	1908	M, ad.	FOSCHI ET AL., 1996
Ogliastra	36	1			Roma - pu	1909	F, ad.	FOSCHI ET AL., 1996; lacking
Ogliastra	37	1			Roma - pu	1909	M, ad.	FOSCHI ET AL., 1996; lacking
Supramonte	38	1			Roma - pu	1910	M, ad.	FOSCHI ET AL., 1996
Sulcis	39	1			Genova - pu	1910	M	DORIA, <i>in litt.</i>
Sarrabus	40	1			Ozzano-Emilia - pu	1911	M, ad.	BACCETTI, <i>in litt.</i>
Gennargentu	41	1			Ozzano-Emilia - pu	1912	M, juv.	BACCETTI, <i>in litt.</i>
Gennargentu	42	1			Lonato - pu	1914	M, juv.	BRICHETTI, <i>in litt.</i>
Sarrabus	43	1			Lonato - pu	1914	M, ad.	BRICHETTI, <i>in litt.</i>
Sarrabus	44	1			Lonato - pu	1914	F, ad.	BRICHETTI, <i>in litt.</i>
Sulcis	45	1			Liceo Parma - pu	1919	F, ad.	ZILIOI, 1988; ROSCELLI <i>in litt.</i>
Sulcis	46	1			Napoli - pu	1910-30	M, juv.	MAIO <i>in litt.</i>
Sardinia	47	1			Udine - pu	1921	?	GENERO, <i>in litt.</i>

COLLECTION AREA	NUMBER	SKIN, MOUNTED SKELETON	EGGS	COUNTRY	MUSEUM COLLECTION (pu=public; pr=private)	COLLECTION YEAR	SEX, AGE CLASS	NOTES
Sardinia	48	1		ITALY	(Milano?) - pu	1922	?	MOLTONI & SCIACCHITANO, 1926
Ogliastra	49	1			Ravenna - pu	1922	F, ad.	ORTALI, 2001; GRILLANDA, <i>in litt.</i>
Sardinia	50	1			(Italy) - pu ?	1924	?	MOLTONI & SCIACCHITANO, 1926
Supramonte	51	1			Milano - pu	1924	F	CHIOZZI, <i>in litt.</i>
Sardinia	52	1			Camaldoli - pu	1926	M, juv.	<i>fide</i> TORRE; CRUDELI, <i>in litt.</i>
Ogliastra	53	1			Forlì - pr	1931	M, ad.	FOSCHI, 1984
Gennargentu	54	1			Seui - pu	1931	ad.	MARRAS & ARESU, <i>in litt.</i>
Sardinia	55	1			(Italy?) - pr	thirties	?	DONATI Coll.; MOLTONI, 1948
Sardinia	56	1			Randazzo - pu	1934	juv.	MASSA, <i>in litt.</i>
Supramonte	57	1			Terrasini - pu	1939	M, subad.	MASSA, <i>in litt.</i>
Gennargentu	58	1			Belvi - pr 1)	> 1945?	ad.	<i>fide</i> TOLU
Limbara	59	1			Randazzo - pu	1956	M, ad.	MASSA, <i>in litt.</i>
Monti di Alà	60	1			(Italy?) - pr?	1956	?	SORRENTI, <i>in litt.</i> ; SCHENK, 1976
Monti di Alà	61	1			Sassari - pr	1959	ad.	SANCIU, <i>in litt.</i>
Supramonte	62	1			(Italy?) - pu?	1959	?	BASSU, <i>in litt.</i> ; SCHENK, 1976
Monti di Alà	63	1			(Italy?) - pr ?	1960	?	<i>fide</i> MELONI; SCHENK, 1977
Supramonte	64	1			(Catania?) - pr	1961/62	?	<i>fide</i> Meloni; SCHENK, 1976
Sardinia	65	1			Sassari - pu	undated	ad.	<i>fide</i> DELITALA
Sardinia	66	1			Genova - pu	undated	?	DORIA, <i>in litt.</i>
Sardinia	67	1			Genova - pu	undated	immat.	DORIA, <i>in litt.</i>
TOTAL SPECIMEN		62	5	67				
Sardinia	68	1		GERMANY	Bonn - pu	1900	M	VAN DEN ELZEN, <i>in litt.</i>
Ogliastra	69	1			Bonn - pu	1900	<i>pullus</i>	VAN DEN ELZEN, <i>in litt.</i>
Sarrabus?	70	1			Bonn - pu	1902	M	KLEINSCHMIDT, 1935-38
Supramonte	71	1			Bonn - pu	1903	F, ad.	KLEINSCHMIDT, 1935-38
Sardinia	72	1			Kiel - pu	1903	?	DREYER, <i>in litt.</i>
Sardinia	73	1			Berlin - pu	1904	M, juv.	FRAHNERT, <i>in litt.</i>
Sardinia	74	1			Berlin - pu	1904	F, juv.	FRAHNERT, <i>in litt.</i>
Sardinia	75	1			Berlin - pu	1905	F, juv.	FRAHNERT, <i>in litt.</i>
Sardinia	76	1			Hamburg - pu	1905 ?	?	HAAS, <i>in litt.</i>
Sardinia	77	1			(Bonn?) - pu	1905	?	GAUTSCHI ET AL., 2003 ; lacking ?
Sardinia	78	1			(Bonn?) - pu	1905	?	GAUTSCHI ET AL., 2003 ; lacking ?
Ogliastra	79	1			Bonn - pu	1906	?	VAN DEN ELZEN, <i>in litt.</i>
Ogliastra	80	1			Bonn - pu	1906	?	VAN DEN ELZEN, <i>in litt.</i>
Sardinia	81	1			Bonn - pu	1900 - 09 ?	?	KLEINSCHMIDT, 1935-38
Sardinia	82	1			Bonn - pu	1900 - 09 ?	?	KLEINSCHMIDT, 1935-38
Sardinia	83	1			Bonn - pu	1900 - 09	?	KLEINSCHMIDT, 1935-38
Sardinia	84	1			Bonn - pu	1900 - 09 ?	F	VAN DEN ELZEN, <i>in litt.</i>
Supramonte	85	1			(Bonn?) - pu	1915	F, ad.	HIRALDO ET AL., 1979; lacking?
Sardinia	86	1			(Bonn?) - pu	1925	M, juv.	HIRALDO ET AL., 1979; lacking?
Sardinia	87	1			Münster - pu	1925 ?	immat.	TERLUTTER, <i>in litt.</i>
Sardinia	88	1			Berlin - pu	undated	M	FRAHNERT, <i>in litt.</i>
Supramonte	89	1			Magdeburg - pu	undated	F	PELLMANN, <i>in litt.</i>
Sardinia	90	1			(Magdeburg) - pu	undated	M	PELLMANN, <i>in litt.</i> ; lacking
TOTAL SPECIMEN		23	-	23				
Monti di Alà?	91	-	1	UNITED STATES	Wilmington - pu	1854	-	WOODS, <i>in litt.</i>
Supramonte	92	1			New York - pu	1902	F	CAPAINOLO, <i>in litt.</i>
Sulcis	93	1			New York - pu	1903	M	CAPAINOLO, <i>in litt.</i>
Iglesiente	94	1			New York - pu	1903	M, ad.	CAPAINOLO, <i>in litt.</i>

1) A recent control revealed that the stuffed BV is not more present in the collection (N. MARRAS); further investigations are going on.

COLLECTION AREA	NUMBER	SKIN, MOUNTED SKELETON	EGGS	COUNTRY	MUSEUM COLLECTION (pu=public; pr=private)	COLLECTION YEAR	SEX, AGE, CLASS	NOTES
Iglesiente	95	1		UNITED STATES	New York -pu	1903	F, ad.	CAPAINOLO, <i>in litt.</i>
Gennargentu	96	1			New York -pu	1903	M	CAPAINOLO, <i>in litt.</i>
Sardinia	97	1			New York -pu	1903	F	CAPAINOLO, <i>in litt.</i>
Sardinia	98/99	-	2		Wilmington -pu	1905	-	WOODS, <i>in litt.</i>
Iglesiente	100	1			New York -pu	1907	F	CAPAINOLO, <i>in litt.</i>
Sulcis	101	-	1		Wilmington -pu	1912	-	WOODS, <i>in litt.</i>
Supramonte	102/103	-	2		Wilmington -pu	1932	-	WOODS, <i>in litt.</i>
Supramonte	104	-	1		Wilmington -pu	1934	-	WOODS, <i>in litt.</i>
Sardinia	105	1			New York -pu	undated	?	CAPAINOLO, <i>in litt.</i>
TOTAL SPECIMEN		8	7	15				
Sardinia	106	-	1	SWITZERLAND	Bern -pu	1866	-	BLÖCHLINGER, <i>in litt.</i>
Sardinia	107	1			St. Gallen -pu	1873	M, ad. ?	GIRTANNER, 1878; BARANDUM, <i>in litt.</i>
Sardinia	108	1			(St. Gallen?) -pu	1876	immat.	GIRTANNER, 1878
Sardinia	109	1			Bern -pu	1888	M, subad.	BLÖCHLINGER, <i>in litt.</i>
Sulcis	110	1			Lausanne - pu	1912	M, ad.	(MZL 5467); GLAIZOT, <i>in litt.</i>
Sardinia	111	1			Lausanne - pu	1915	M, juv.	(MZL 5535); GLAIZOT, <i>in litt.</i>
Ogliastro	112	1			Schaffhausen - pr	1921	F, ad.	STEMMLER, 1932
Ogliastro	113	1			Schaffhausen - pr	1922	F, subad.	STEMMLER, 1932
Sardinia	114	1			Basel -pu	< 1926	F, ad.	STEMMLER, 1932; WINKLER, <i>in litt.</i>
Ogliastro	115	1			Schaffhausen - pr	< 1932	M, juv.	STEMMLER, 1932
Sardinia	116	1			Schaffhausen - pr	< 1932	F, ad.	STEMMLER, 1932
Sardinia	117	1			Winterthur -pu	undated	M, ad.	STEMMLER, 1932
Sardinia	118	1			Winterthur -pu	undated	F, ad.	STEMMLER, 1932
TOTAL SPECIMEN		12	1	13				
Sardinia	119	1		UNITED KINGDOM	London -pu	1871	pullus	ADAMS, <i>in litt.</i>
Gennargentu	120	1			Liverpool - pu	1893	F, ad.	PARKER, <i>in litt.</i> ; PICCHI, 1904
Sardinia	121	1			London -pu	1850-99?	ad.	ADAMS, <i>in litt.</i>
Ogliastro	122/123	-	2		London -pu	1904	-	ADAMS, <i>in litt.</i> ; lacking
Sassarese	124/125	-	2		London -pu	1920	-	ADAMS, <i>in litt.</i>
TOTAL SPECIMEN		3	4	7				
Sardinia	126	1		FRANCE	Grenoble -pu	1906	?	GAUTSCHI ET AL., 2003
Sardinia	127	1			Grenoble -pu	1907	?	GAUTSCHI ET AL., 2003
Sardinia	128	1			Paris -pu	1911	?	PASQUET, <i>in litt.</i>
Sardinia	129	1			Grenoble -pu	1912	?	GAUTSCHI, 2001
Sulcis	130	1			Grenoble -pu	1913	?	GAUTSCHI ET AL., 2003
Sardinia	131	1			Grenoble -pu	1925	?	GAUTSCHI ET AL., 2003
Sardinia	132	1			Grenoble -pu	undated	?	GAUTSCHI ET AL., 2003
TOTAL SPECIMEN		7	-	7				
Sardinia	133	1		THE NETHERLANDS	Leiden -pu	1825-35	ad.	VAN GROUW, <i>in litt.</i>
Sardinia	134	1			Leiden -pu	1825-35	juv.	VAN GROUW, <i>in litt.</i>
Sardinia	135	1			Amsterdam -pu	undated	F, ad.	ROSELAAR, <i>in litt.</i>
TOTAL SPECIMEN		3	-	3				
Sulcis	136	1		SWEDEN	Stockholm -pu	1907	ad.	FRISK, <i>in litt.</i>
Supramonte	137	1		HUNGARY	(Budapest?) - pu?	1926	pullus	STEMMLER, 1932
Ogliastro	138	1		UNKNOWN	?	< 1923	ad.	STEMMLER, 1932
Gennargentu	139	1		UNKNOWN	Collezione Picchi ?	1896	M, ad.	MINGOZZI, <i>in litt.</i> ; PICCHI, 1904
TOTAL SPECIMEN		122	17	139				

Annex 2. Feasibility evaluation of the reintroduction of the Bearded Vulture in 7 geographical areas of Sardinia/Italy, 1995-2004.

CRITERIA	GEOGRAPHICAL AREAS CHARACTERISTICS - QUALITY (C) AND SCORE (P)													
	A MONTE LIMBARA		B MONTI DI ALÀ		C MONTE ALBO		D SUPRA- MONTE GENNARGENTU		E SARRABUS GERREI QUIRRA		F MONTE LINAS		G SULCIS	
	c	p	c	p	c	p	c	p	c	p	c	p	c	p
PHYSICAL CRITERIA														
<i>surface (km²)</i> ¹⁾	150	1	300	2	150	1	900	7	450	4	320	3	300	2
<i>geology</i> ²⁾	gra	2	gra	2	lim, gra, sci	3	lim, gra, sci	3	gra, mro, lim	3	sci, gra, lim	3	gra, sci	2
<i>morphology</i> ³⁾	dom, clf	3	dom, tab, clf	3	clf, can, dom	3	clf, can, dom, tab	3	clf, cue, tab, can	3	clf, can, dom	3	clf, dom, can	3
<i>altitudinal gradient (m)</i> ⁴⁾	400- 1.362	2	500- 1.094	2	400- 1.127	2	0-1.834	3	500- 1.069	2	400- 1.236	2	400- 1.116	2
Partial score	8		9		9		16		12		11		9	
CLIMATE ⁵⁾	mst, mq, cwq	1	cwq, mq	1	cwq, mq	1	mst,ma,cwq mq,fom	3	cwq, mq, fom	1	mst, cwq, mq	1	mst, cwq	1
Partial score	1		1		1		3		1		1		1	

1) SURFACE: up to 200 km² (1 score); from 201 to 300 km² (2 scores); from 301 to 400 km² (3 scores); from 401 to 500 km² (4 scores); from 501 to 600 km² (5 scores); from 601 to 700 km² (6 scores); > 700 km² (7 scores).

2) GEOLOGY: lim = limestone; gra = granite; mro = metamorphic rocks; sci = schist: lim dominant: 3 scores; gra and mro dominant: 2 scores; sci dominant: 1 score;

3) MORPHOLOGY: clf = hill-ridge with high cliffs; canyons = can; cue = cuestas; scf = seacliffs; dom = hill-ridge with gentle forms; tab = tableland; clf and can dominant: 3 scores; cue and scf dominant: 2 scores; tab dominant: 1 score;

4) ALTITUDINAL GRADIENT: > 1.000 m (3 scores); 500-1.000 m (2 scores); < 500 m (1 score);

5) CLIMATE: ma = horizon of the littoral woodlands and "maquis"; fom = horizon of the mixed forests of evergreen sclerophylls in the southern hot-dry sectors; mq = mesophyllous horizon of the Quercus ilex forests; cwq = cold-wet horizon of the mountain Quercus ilex and Quercus pubescens forests, with relicts elements of the Quercus-Tilia-Acer and Laurocerasus belts; mst = climax of prostrate shrubs of Mediterranean mountain steppes, on the higher ridge beyond the timberline: 1-3 horizons (1 score); >3 horizons (3 scores).



Annex 2(2)

CRITERIA	GEOGRAPHICAL AREAS CHARACTERISTICS - QUALITY (c) AND SCORE (p)													
	A MONTE LIM- BARA 150KM ²		B MONTI DI ALÀ 300KM ²		C MONTE ALBO 150KM ²		D SUPRA- MONTE GENNARGENTU 900KM ²		E SARRABUS GERREI QUIRRA 450KM ²		F MONTE LINAS 320KM ²		G SULCIS 300KM ²	
	c	p	c	p	c	p	c	p	c	p	c	p	c	p
ECOLOGICAL CRITERIA														
<i>natural (nearly) ecosystems in % ⁶⁾</i>	< 10	2	< 5	1	> 15	4	> 20	5	> 10	3	> 20	5	> 20	5
<i>modified ecosystems ⁷⁾</i>	< 70	3	> 50	2	< 80	3	< 70	3	> 70	3	> 70	3	> 70	3
<i>transformed ecosystems ⁸⁾</i>	> 20	-2	> 40	-2	< 5	1	> 10	-1	> 10	-2	< 5	1	< 5	1
<i>breeding habitat ⁹⁾</i>	suf	1	suf	1	exc	5	exc	5	m	3	exc	5	m	3
<i>feeding habitat ¹⁰⁾</i>	suf	1	m	3	suf	1	exc	5	exc	5	m	3	suf	1
<i>habitat fragmentation ¹¹⁾</i>	m	1	h	-2	l	3	m	1	m	1	l	3	m	1
<i>food resources (carrion) ¹²⁾</i>	l	1	m	3	m	3	h	5	m	3	m	3	l	1
<i>last breeding record ¹³⁾</i>	1950/60?	2	1960/65?	3	1950/55?	2	1968/69	3	1945/50?	1	1945/50?	1	1940?	1
<i>presence of Griffon Vulture ¹⁴⁾</i>	abs	0	abs	0	abs	0	irr	1	irr	1	irr	1	abs	0
<i>presence of Golden Eagle ¹⁵⁾</i>	1-2 pairs	1	2 pairs	1	1-2 pairs	1	10-12 pairs	5	5-6 pairs	3	3 pairs	2	2 pairs	1
<i>carrying capacity (number of pairs and individuals) ¹⁶⁾</i>	1 pair 3-4 ind.	1	1 pair 2-3 ind.	1	1 pair 3-5 ind.	1	4-5 pairs 12-15 ind.	5	2 pairs 5-7 ind.	2	2 pairs 5-7 ind.	2	1pair 2-3 ind.	1
Partial score	11		11		24		37		23		29		18	

6) NATURAL (NEARLY) ECOSYSTEMS: up to 5% (1 score); 5 to 10% (2 scores); 10 to 15% (3 scores); 15 to 20% (4 scores); >20% (5 scores);

7) MODIFIED ECOSYSTEMS: up to 30% (1 score); 30 to 60% (2 scores); >60% (3 scores);

8) TRANSFORMED ECOSYSTEMS: up to 5% (1 score); 5 to 10% (-1 score); 10 to 15% (-2 scores); >15% (-3 scores);

9) BREEDING HABITAT (quality): exc = excellent (5 scores); m = medium (3 scores); suf = sufficient (1 score);

10) FEEDING HABITAT (quality): exc = excellent (5 scores); m = medium (3 scores); suf = sufficient (1 score);

11) HABITAT FRAGMENTATION: l = low (3 scores); m = medium (1 score); h = high (-2 scores);

12) FOOD RESOURCES/CARRION (availability): h = high (5 scores); m = medium (3 scores); l = low (1 score);

13) LAST BREEDING RECORD: after 1960 (3 scores); 1951 -1960 (2 scores); between 1940 and 1950 (1 score);

14) PRESENCE OF GRIFFON VULTURE: reg = regular (3 scores); irr = irregular (1 score); abs = absent (0 score);

15) PRESENCE OF GOLDEN EAGLE: up to 2 pairs (1 score); 3 - 4 pairs (2 scores); 5 - 6 pairs (3 scores); > 6 pairs (4 scores);

16) CARRYING CAPACITY: 1 pair (1 score); 2 pairs (2 scores); 3 pairs (3 scores); 4 pairs (4 scores); >4 pairs (5 scores).



Annex 2(3)

CRITERIA	GEOGRAPHICAL AREAS CHARACTERISTICS - QUALITY (c) AND SCORE (p)													
	A MONTE LIM- BARA 150KM ²		B MONTI DI ALÀ 300KM ²		C MONTE ALBO 150KM ²		D SUPRA- MONTE GENNARGENTU 900KM ²		E SARRABUS GERREI QUIRRA 450KM ²		F MONTE LINAS 320KM ²		G SULCIS 300KM ²	
	c	p	c	p	c	p	c	p	c	p	c	p	c	p
ACTUAL IMPACTS														
<i>roads (density) ¹⁷⁾</i>	l	-1	mh	-3	l	2	ml	-1	ml	-1	l	2	ml	-1
<i>tourism ¹⁸⁾</i>	l	-1	l	-1	l	-1	m	-2	l	-1	l	-1	l	-1
<i>hunting ¹⁹⁾</i>	l	-1	m	-2	l	-1	h	-3	m	-2	l	-1	h	-3
<i>powerlines and windparks ²⁰⁾</i>	m	-3	l	-1	abs	3	abs	3	abs	3	abs	3	abs	3
<i>poisoned baits ²¹⁾</i>	ukn	-2	irr	-3	ukn	-2	irr	-3	irr	-3	ukn	-2	ukn	-2
Partial score	-8		-10		1		-6		-4		1		-4	
FUTURE IMPACTS														
<i>new roads ²²⁾</i>	l	-1	m	-2	abs	3	m	-2	l	-1	l	-1	l	-1
<i>agriculture and forest transformations ²³⁾</i>	l	-1	l	-1	l	-1	l	-1	l	-1	l	-1	l	-1
<i>tourism (new infrastructures) ²⁴⁾</i>	l	-1	abs	3	abs	3	m	-2	l	-1	l	-1	l	-1
<i>hunting ²⁵⁾</i>	l	-1	m	-2	l	-1	m	-2	m	-2	l	-1	h	-3
<i>new powerlines and wind- parks ²⁶⁾</i>	l	-1	h	-5	abs	3	abs	3	m	-3	abs	3	abs	3
<i>poisoned baits ²⁷⁾</i>	ukn	-2	ukn	-2	ukn	-2	ukn	-2	ukn	-2	ukn	-2	ukn	-2
Partial score	-7		-9		5		-6		-10		-3		-5	

17) ROADS (density): vh = very high (-5 scores); mh = medium-high = (-3 scores); ml = medium-low (-1 score); l = low (2 scores).

18) TOURISM: h = high impact (-3 scores); m = medium impact (-2 scores); l = low impact (-1 scores).

19) HUNTING: h = high impact (-3 scores); m = medium impact (-2 scores); l = low impact (-1 score).

20) POWERLINES AND WINDPARKS: h = high impact (-5 scores); m = medium impact (-3 scores); l = low impact (-1 score); abs=absent (3 scores).

21) POISONED BAITS: irr = irregular (-3 scores); ukn = unknown (-2 score).

22) NEW ROADS: h = high impact (-3 scores); m = medium impact (-2 scores); l = low impact (-1 score); abs = absent (3 scores).

23) AGRICULTURAL AND FOREST TRANSFORMATIONS: h = high impact (-3 scores); m = medium impact (-2 scores); l = low impact (-1 score).

24) TOURISM (new infrastructures): h = high impact (-3 scores); m = medium impact (-2 scores); l = low impact (-1 score); abs = absent (3 scores).

25) HUNTING: h = high impact (-3 scores); m = medium impact (-2 scores); l = low impact (-1 score); abs = hunting absent (3 scores).

26) NEW POWERLINES AND WINDPARKS: h = high impact (-5 scores); m = medium impact (-3 scores); l = low impact (-1 score); abs = absent (3 scores).

27) POISONED BAITS: ukn = unknown (-2 score).



Annex 2(4)

CRITERIA	GEOGRAPHICAL AREAS CHARACTERISTICS - QUALITY (C) AND SCORE (P)													
	A MONTE LIM- BARA 150KM ²		B MONTI DI ALÀ 300KM ²		C MONTE ALBO 150KM ²		D SUPRA- MONTE GENNARGENTU 900KM ²		E SARRABUS GERREI QUIRRA 450KM ²		F MONTE LINAS 320KM ²		G SULCIS 300KM ²	
	c	p	c	p	c	p	c	p	c	p	c	p	c	p
SOCIOCULTURAL CRITERIA														
<i>knowledge of the species</i> ²⁸⁾	msp	3	msp	3	mvu	1	msp	3	msp	3	mvu	1	mvu	1
<i>attitude to vultures</i> ²⁹⁾	ind	1	ind	1	ind	1	ind/neg	-2	ind	1	ind	1	ind	1
<i>probable cooperation</i> ³⁰⁾	m	2	l	1	m	2	m	2	m	2	m	2	m	2
Partial score	6		5		4		3		6		4		4	
ACTUAL STRUCTURES														
<i>ENTE FORESTE SARDEGNA</i> ³¹⁾	pre	3	pre	3	pre	3	pre	3	pre	3	pre	3	pre	3
<i>N.G.Os.</i> ³²⁾	pre	3	abs	0	pre	3	pre	3	pre	3	pre	3	pre	3
Partial score	6		3		6		6		6		6		6	
LEGAL INSTITUTIONS														
<i>hunting institutions</i> ³³⁾	oap, zor, zau	6	oap, zor, zau	6	zau	1	oap, zor, zau	6	oap, zor, zau	6	oap, zor, zau	6	oap zor, zau	6
<i>environmental planning</i> ³⁴⁾	idr land	1 3	idr land	1 3	idr land	1 3	idr land	1 3	idr land	1 3	ldr land	1 3	idr land	1 3
<i>protected areas</i> ³⁵⁾	pSCI, (RP)	5 1	abs	0	pSCI, NRI	5 1	pSCI, (SPAp), (PN)	5 1 1	pSCI, (SPAp), (RP)	5 1 1	pSCI, (RP)	5 1 1	pSIC ZPS, (RP)	5 3 1
Partial score	16		7		11		17		17		16		19	

28) KNOWLEDGE OF THE SPECIES: msp = memory of the species (3 scores); mvu = memory of vultures (1 score);

29) ATTITUDE TO VULTURES: pos = positive (3 scores); ind = indifferent (1 score); ind/neg = indifferent-negative (-2 scores); neg = negative (-3 scores);

30) PROBABLE COOPERATION (local): h = high (4 scores); m = medium (2 scores); l = low (1 score);

31) ENTE FORESTE DELLA SARDEGNA: pre = present (3 scores); abs = absent (0 score);

32) N.G.O.s. (non governmental organizations): pre = present (3 scores); abs = absent (0 score);

33) HUNTING INSTITUTIONS: oap = oasi faunistica permanente (4 scores); zor = zona di ripopolamento e cattura (1 score); zau = zona in concessione auto-gestita (1 score).

34) ENVIRONMENTAL PLANNING: idr = idrogeological legislation (1 score); vpa = landscape legislation (3 scores);

35) PROTECTED AREAS: pSCI = proposed Site of Community Importance (5 scores); SPA= Special Protection Area (3 scores); SPAp = Special Protection Areas proposed (1 scores); PN = National Park-instituted but not functioning (1 score); RP = regional park to be established (1 score); NRI= natural reserve to be established (1score); abs = absent (0 score).

