Census of vultures in Herzegovina

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Summary

In this article we present the results of a study, from 1980 to 1991, which involved the census of nests and breeding pairs of ***Gypaetus barbatus***, Gyps fulvus and ***Neophron percnopterus*** in eastern Herzegovina. These three vulture species have since disappeared from their breeding habitats. The presented data may help with the planning and development of a strategy for the successful reintroduction and conservation of vultures in Bosnia and Herzegovina.

Introduction

According to Talsky (1882) and Reiser (1939), all four vulture species that are native to Europe (Black Vulture ***Aegypius monachus*** Linnaeus 1766, Bearded Vulture ***Gypaetus barbatus*** Linnaeus 1758, Griffon Vulture ***Gyps fulvus*** Hablizl, 1783 and Egyptian Vulture ***Neophron percnopterus*** Linnaeus 1758) historically inhabited Bosnia and Herzegovina. The Griffon, Egyptian and Bearded Vulture populations were present in eastern Herzegovina up to the beginning of the civil war in 1992, but subsequently a decline in numbers was observed.

During the past few decades there has been a steady increase in the population of vultures in Europe, because of both the improved protection measures and the organized reintroduction programmes. The successful protection of vultures on the Iberian Peninsula and in France suggests that their return to historical breeding sites in Herzegovina is achievable. However, any reintroduction of vultures in eastern Herzegovina will require the development and implementation of suitable conservation measures.

Griffon Vulture populations inhabited different regions of the Balkan Peninsula. Their population decreased and disintegrated into small fragments in most of the Balkan regions, except in Serbia, where the Griffon Vulture population increased. The Griffon Vulture forages over a wide area, often outside the borders of the country in which it is nesting. The improved status of the Griffon Vulture population in Serbia offers opportunity for the dispersal of individuals of this species to areas with suitable habitat, such as that available in Herzegovina.

In this article we present data that were collected during the systematic monitoring of the Griffon, Egyptian and Bearded Vulture breeding populations in eastern Herzegovina from 1980 to 1991. This baseline information can be used when planning reintroduction programmes for the restoration of extinct avifauna in Herzegovina.

Study area

The systematic monitoring of vultures in the south-western parts of the Dinaric region of eastern Herzegovina was undertaken from 1980 to 1991. The substrate of this area, between the Adriatic shore and the highest crests of the Dinara Mountains (2,200 m), consists of lime slopes and karst field planes (Marinkovic ***et al.*** 2005). Due to the proximity of the Adriatic Sea, a sub-Mediterranean climate prevails in the lower parts of eastern Herzegovina. Traditional, and extensively, cattle farming practices are carried out in the Cvrsnica, Cabulja, Prenj, Crvanj and other surrounding mountains. A special type of year-round cattle husbandry within the limits of karst field is restricted to Popovo polje area (Dedijer 1991). According to Markovi (1980) and Cvijic (1991), entire Herzegovina is divided in two parts ("Visoka Herzegovina", which covers 5,599 km^2 and Niska Herzegovina", which covers 4,236 km^2). Vultures are nesting mainly in the "Niska Herzegovina" area (Figure 1).

Material and methods

Observations along transects were executed in accordance with the methodology of Fuller & Mosher (1987). Stationary observations were conducted from a distance of 150–800 m, using both binoculars and telescopes (7–90x magnification). We selected observation sites with a good view, on the opposite side of the breeding colonies and at approximately the same height as the nests (see Bibby ***et al.*** 1992, Gibbons ***et al.*** 1996).

Specific orography of canyons and gorges enables formation of thermal lifts in the morning, which initiates vulture activity, and during the afternoon hours, when the thermals weaken (Pennycuick 1973). Therefore, we carried out censuses twice a day (from 07h00 to 12h00 and from 14h00 to 19h00). Using maps with the Universal Tranverse Mercator (UTM) coordinate system (with a 10 x 10 km grid), we plotted the localities where vultures had been observed (within and outside the breeding sites).

We used consecutive observations, which were based on the presence of eggs, or more frequently of juvenile birds, to determine whether or not nest sites were active. The breeding success of reproductive pairs was assessed on the basis of observations during three different periods that covered (a) the construction of the nest and egg-laying, (b) incubation and hatching, and (c) growth and fledging of juveniles (S.E.O. 1981, Leconte 1985, Sarrazin ***et al.*** 1996).

Three age-classes of Griffon Vultures (adults, sub-adults and juveniles, up to one-year-old) can be recognized easily on the basis of their morphological characteristics (Glutz von Blotzheim & Bauer 1971).

The maturation period is four years. Therefore, we assumed that birds occupying new nest sites were at least five-years-old (Blanco & Martinez 1996, Sarrazin ***et al.*** 1996). By monitoring

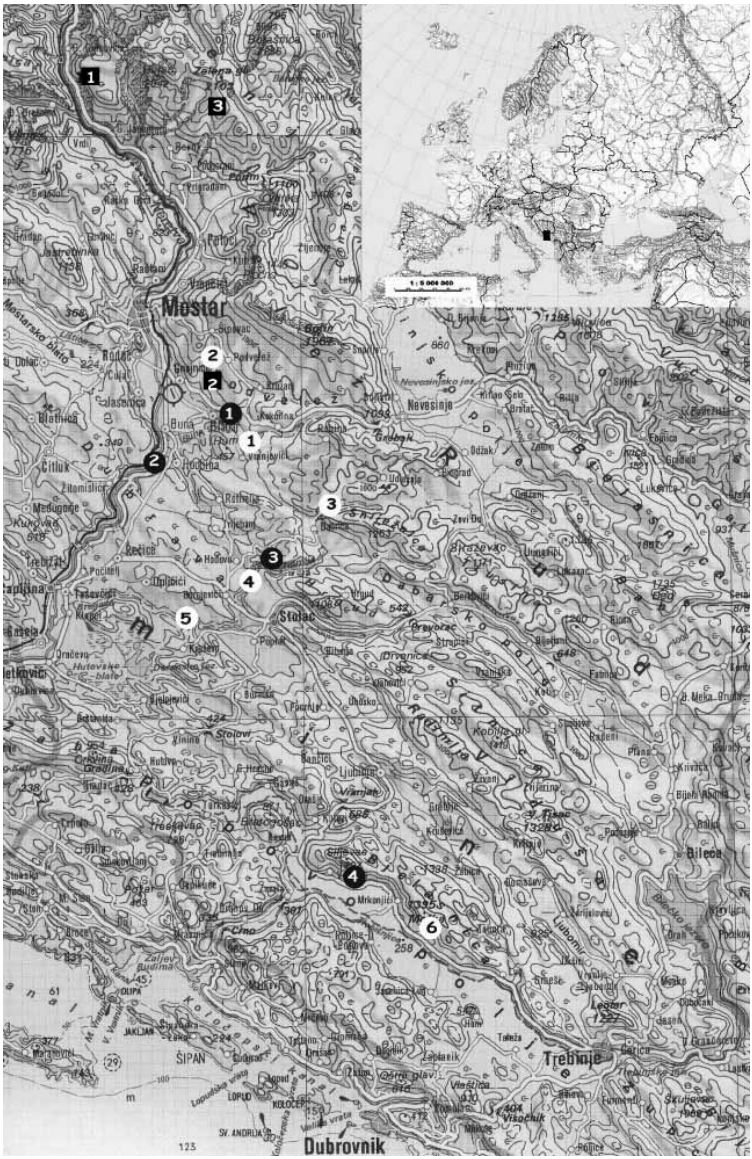

Figure 1. Map of the area investigated during the study in eastern Herzegovina. Colonies of Griffon Vultures and nests of Egyptian Vultures are denoted by black and white circles, respectively. Black squares denote localities where Bearded Vultures have been recorded.

the successive occupancy of those nesting sites, we were able to get an indication of the age structure of nesting pairs (Cramp & Simmons 1979). If a specific nest was abandoned for two years, the elimination of the pair from the population was assumed, and any subsequent re-occupancy was considered to be the appearance of a new pair. The presence of juvenile birds in the nests was used for an assessment of fecundity.

Two feeding places (***"mrcinista"*** – "vulture restaurant", Boshoff & Currie 1981) were established in the proximity of the Mostar town. The Busku feeding place was situated near the Blagaj at 420 m a.s.l. and 4000 m from the breeding site. The Golik feeding place was situated near Stolac, at 338 m a.s.l. and 2600 m from the nests. The vulture restaurants became operational in 1981 and 1985, respectively. In order to observe birds at these two feeding sites, small observation posts were built 80–150 m from the site where the animal carcasses were deposited.

Results

Although this study was focused on the Griffon Vulture, we collected data for all three vulture species (Griffon, Egyptian and Bearded Vultures), since they shared the same territory and also had similar behavioural and trophic requirements.

Griffon Vulture

Within the study area (Figure 1), the Griffon Vulture nests were located exclusively on limestone cliffs, mainly in caves and on ledges that were orientated in a westerly direction. The average altitude of the nests was 378 m a.s.l. Most nests (85%) were located below 500 m. Four colonies were found. Three colonies were located in the canyon of the Neretva River and its tributaries: Blagaj colony (43°15'N, 17°54'E), Stolac colony (43°07'N, 17°57'E) and itomislii colony (43°13'N, 17°49'E). A fourth colony was located on the edge of the "Popovo polje" karst field (42°32' N, 18°02'E) (Figures 1).

During the study period (1980–1991) a total of 61 nests, 83 pairs and 252 cases of nesting were observed.

Blagaj colony

This colony was located at the Blagaj rock (Figure 1). The colony was initially described by Reiser (1939). During the study period we observed 24 nests. A significant reduction of the number of birds was caused by poisoning incidents in 1982, 1986 and 1988 (Marinkovi 1984, 1988). We found dead vultures that had consumed poisoned baits in near proximity (4 km) of the colony. In June 1991, we detected 30 poisoned birds. Such severe poisoning caused abandonment of the colony.

Zitomislic colony

The colony in the Zitomislic gorge (YH28; YH29, UTM squares) was established in 1983 (Marinkovi ***et al.*** 1985). During the study period we

observed ten nests, the breeding colony split up after a poisoning event in 1986 (Figures 1 & 2).

Stolac colony

This colony was initially described by Rucner (1970). The colony, with 16 nests, was located in the gorges of the Radimlja River (YH47; BN58, UTM grid codes) and Bregava River (BN57; BN67, UTM coordinates). In this area the highest number of poisoned birds was recorded. After severe poisoning events in 1985 and 1986, the colony was reduced to nine birds. In the subsequent

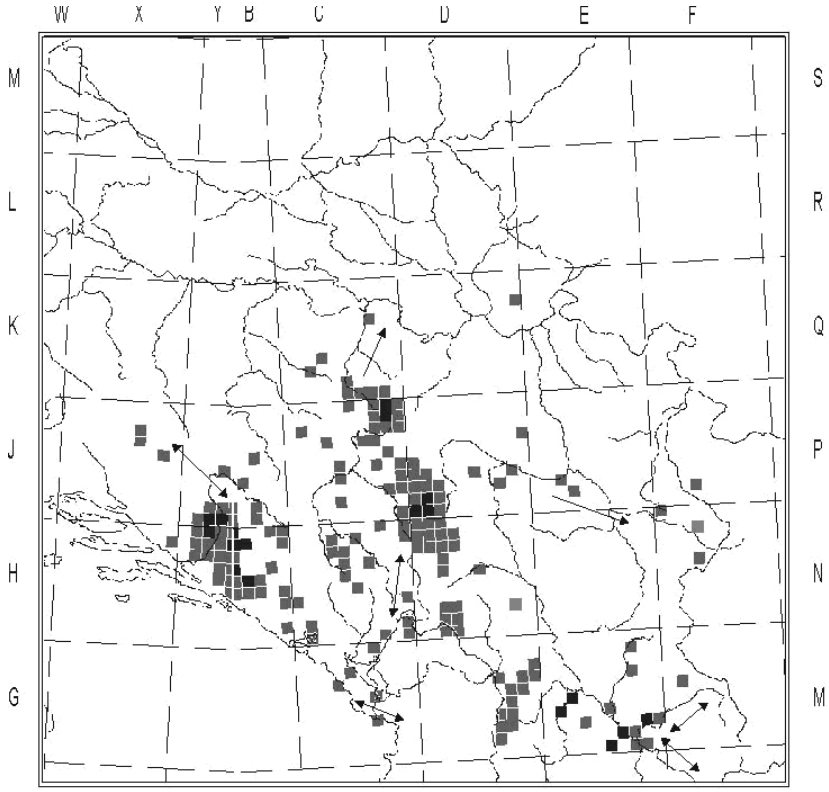

Figure 2. The distribution of the Griffon Vulture in the central parts of the Balkan Peninsula. The data were collected during the 1980–2000 period. The black points denote breeding colonies (Herzegovina, Serbia and northern parts of FYR Macedonia) and the grey points denote observations of Griffon Vultures (U.T.M. 10 x 10 km grid code).

year the colony comprised 28 birds, but only two pairs nested. Another major poisoning event in 1988 reduced the colony to only eight birds. The sudden decline in the number of birds in this colony was related to the number of poisoned birds that were found near the colony (Marinkovi 1988).

Popovo polje colony

According to S. Lovric (pers. comm.), up to 1980 a colony of Griffon Vultures was located near Zakovo village in Popovo polje area. Within this area we detected ten nests, from 1985 to 1991 (near Velicani village, BN54; BN55, UTM grid codes). An increase of birds in the colony occurred simultaneously during periods when the sizes of other colonies decreased (1988 and 1991). This positive trend corresponded with the crises of the colonies in the Mostar region.

The age structure of the breeding birds (throughout the study) indicated a high mortality of older individuals (Figure 2). The observed mortality pattern may be explained by the prolonged period of poisoning of adult individuals. Suspected mortalities caused by food shortages were apparently minimized by the provision of food at feeding stations close to a colony. The high fecundity and high survival rate of both youngsters in nests and fledged juveniles (Figure 3) indicate that the Griffon Vulture population in eastern Herzegovina has a great recovering potential. Due to such potential, the population level was recovering until the high incidence of poisoning.

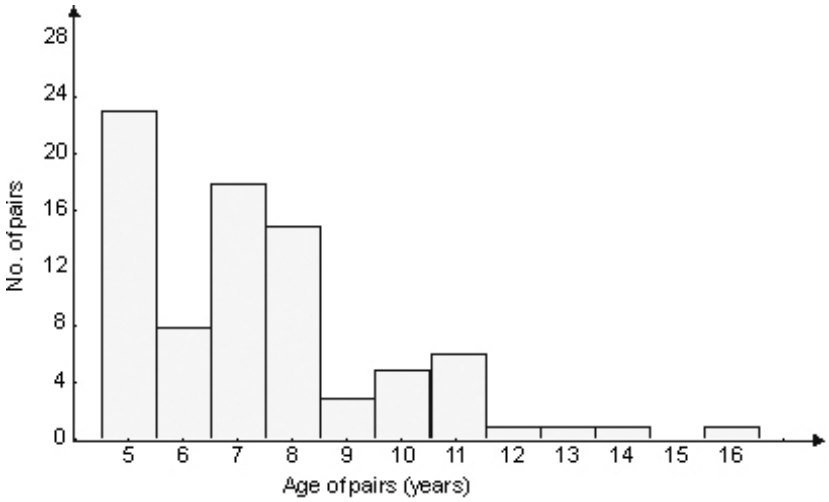

Figure 3. The age structure of nesting birds of the Griffon Vulture population in eastern Herzegovina The data are restricted to the period from 1980 to 1991.

During the study period, we located a total of 97 poisoned birds. The detailed inspection of 26 poisoned birds revealed that four individuals were juveniles, 14 sub-adults and eight were adults.

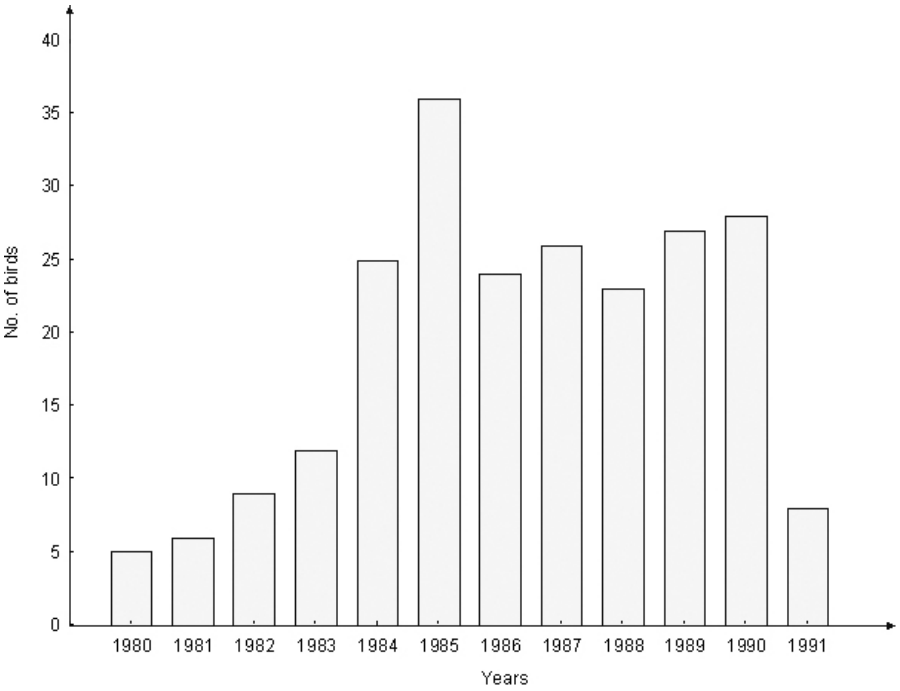

Figure 4. Number of Griffon Vulture juveniles (up to one-year-old birds) in the eastern Herzegovina population from 1980 to 1991.

Seasonal changes in number of birds at feeding stations

The number of birds at places where food was provisioned increased during the winter months. There was an increase in the number of juvenile and immature birds at the feeding places from the end of October (Table 1, Figure 5). The number of non-breeding birds decreased in summer because non-breeding birds moved to the Dinara Mountains where they formed feeding flocks.

Table 1. Proportion of age classes of Griffon Vultures recorded at the feeding stations in eastern Herzegovina.

Age class	*February*	*March*	*April*	*May*	*June*	*July*	*August*	*October*
Juveniles	4	0	0	0	6	11	9	6
Sub-adults	14	21	27	3	1	4	0	26
Adults	7	16	15	13	18	14	12	20

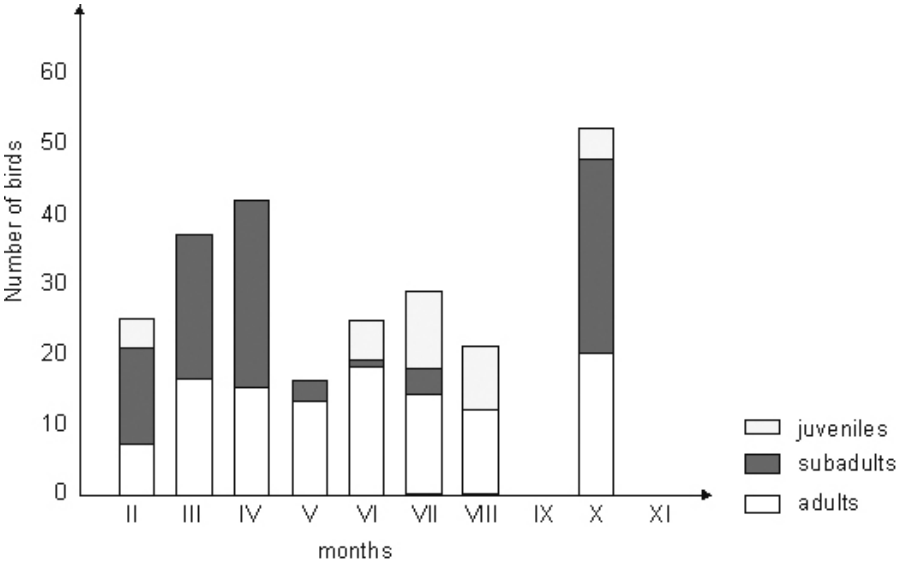

Figure 5. The seasonal changes in the age-class structure of Griffon Vultures occurring at the Busku feeding site, eastern Herzegovina.

The first feeding place, located at Busku near Blagaj, became operational in 1981 and during that year 11 tons of food from the slaughterhouse was supplied (S. Lovric, pers. comm., Marinkovic & Vasi 1996). Thereafter the feeding place operated on an irregular basis, with approximately 1,500 kg of food being provided on each occasion. This irregularity escalated during summer and autumn. As a likely consequence, no increase in the number of pairs at the Blagaj colony was recorded in the subsequent two years. From 1983, the supply of food became more regular and from February 1983 until June 1984 food was provided on ten occasions. The number of Griffon Vultures that gathered at this feeding place varied from 20 to 60 birds. Unfortunately, the frequency of food provision decreased again after 1984.

Egyptian Vulture

Six nests and ten cases of nesting were recorded for Egyptian Vultures. In Herzegovina, Egyptian Vultures bred in small numbers in close proximity to the Griffon Vulture colonies (Figure 1). According to our estimates, four pairs nested but they did not breed every year. From 1980, two adult Egyptian Vultures were observed flying with Griffon Vultures near Bregava and Blagaj as well as at the feeding place. The first Egyptian Vulture nest was found in 1984.

Table 2. Records of Egyptian Vultures nesting in Herzegovina (0=inactive, 1=observed pairs, but undetected nests, 2=active nest).

Locality of nests	***1984***	***1985***	***1986***	***1987***	***1988***	***1989***	***1990***	***Altitude***	***UTM 10 x 10 km Grid Code***
Cobanovo	0	0	0	0	0	2	1	450 m	YH 39
Vele Mt.	1	2	2	1	1	0	0	470 m	YH 39
Kruševac	2	0	2	0	0	0	0	550 m	BN 58
Pazin	0	1	0	0	0	1	2	150 m	YH 47
Kozelic	1	2	2	0	0	0	0	70 m	YH 27
Popovo polje	?	1	2	0	0	0	2	700 m	BN 64
∑	***1***	***2***	***4***	***0***	***0***	***1***	***2***	***398 m***	

A nest in Cobanovo (UTM 10 x 10 km Grid Code, YH 39 locality) was active in 1985 and 1986, but no fledged juveniles were observed (Figure 1).

One nestling was observed (5 May 1989) in a nest at the foothills of the Velez Mountain (YH 39). From 1980 the pair was observed at the Blagaj colony and at the Busku feeding place. They were probably poisoned on 5 June 1991.

A nest was located on 7 July 1984 in the gorge of the Krusevac River, close to the Griffon Vulture colony in Radimlja (BN 58). During 1984 two fully-grown juveniles that originated from this nest were observed, while in 1986 only one juvenile was recorded on 26 July.

Rucner (1970) noted a pair of Egyptian Vultures in the Stolac area. This species was resident in the areas from 1982. We recorded an Egyptian Vulture nest (12 May 1990) on the Pazin hill (YH 47) on the opposite side of the Radimlja Griffon Vulture colony. Although the nest was noted in 1989, breeding activity was not confirmed until 26 June 1990, when one juvenile was recorded.

A nest was observed at Kozelic (YH 27) in the lower Dubrava region throughout May, June and July 1985 and in May 1986. This pair was frequently sighted at the Zitomoslic Griffon Vulture colony,

as well as at the Hutovo Blato (Figure 1). One of the individuals of this pair was found poisoned on 26 May 1986.

In the Popovo polje karst field, at the "Zakovo" abandoned Griffon Vulture colony, a breeding pair of Egyptian Vultures was recorded in 23 May 1986 and 18 May 1990. This pair was observed at the Griffon Vulture colony from 1985 (Figure 1, Table 2).

Bearded Vulture

One adult bird was observed at the Dreznjica gorge in the Prenj Mountains (17 October 1985) (YJ 22, UTM grid code) (Figure 1). A juvenile bird was recorded at the Buska feeding place (1 May 1986) (YH30, UTM grid code). An adult pair was recorded at Velika bara in the Prenj Mountain (23 March 1989) (YJ52, UTM grid code) (Figure 1).

Discussion

The status of populations of long-lived birds, such as vultures, is maintained over long periods only if environmental conditions are stable. On the other hand, any factor that drastically increases the mortality rate during the short-term can cause the disappearance of the population, as has recently happened to ***Gyps*** vultures in the Indian subcontinent (Risebrough 2004). On the Balkan Peninsula, poisoning events that were fairly frequent until the late-1980s have probably been responsible for the reduction in the size of the vulture population (and their near-extinction from this region).

The maintenance of the Griffon Vulture populations was directly related to extensive livestock pastoralism. Recent changes in this form of agriculture negatively influenced the distribution and number of this species on the Balkans (Marinkovic & Karadzic 1999). As it has been demonstrated in this article, regular and frequent providing of food at feeding places may increase the breeding success. Regular and frequent food provisioning during the winter months in 1984 increased the breeding success of the Griffon Vultures (Fig. 3).

A significant dispersal of young birds across the Mediterranean area was recorded by Suši (2000). Generally, the adult birds show breeding colony fidelity and they are therefore adapted to some extent to habitat disturbance. Within our study area, colonies were located in the proximity of Mostar Airport (4.7 km), railways and busy roads (Zitomislic colony). It seems that Griffon Vultures can become habituated to noise if they are exposed to this kind of disturbance for a prolonged period. In some regions Griffon Vultures may be driven off by a shortage of food, disturbance at the nests, hunting and poisoning. They may then desert the breeding site. On the other hand, rapid colonization of suitable areas (with sufficient food, suitable nest sites) can occur with colonies becoming established within one to two years, as was the case with the Radimlja colony.

Although Griffon Vulture colonies are manifested as micro-populations,

they represent an integral part of a mega-population. The dispersal of young vultures enables them to settle down at another colony, find a mate, and eventually breed. In Spain, 30% of the juvenile Griffon Vultures migrate for long distances after fledging (Donazar 1993). Before the establishment of the artificial winter-feeding places, all juveniles that inhabited continental highland regions in Serbia migrated during the winter months from their colonies in order to avoid the harsh conditions (Marinkovic & Orlandic 1992).

The territorial behaviour of Griffon Vultures is limited to the small area around the nest. Solitary nesting is rare. Solitary nesting is mainly a consequence of the colony disappearing, as was the case in Zitomislic (in 1988 a single, isolated nest was recorded 9.3 km away) and Bregava (1983–1984, an isolated nest was 6.4 km from the original colony). At the Podvelezje colony one nest was located 4.3 km from the rest of the colony. Our observations indicated that the numbers of birds forming a colony was directly related to the amount of food being provisioned close to a colony.

A significant decline of the number of nesting birds in Herzegovina was detected during 1991. Simultaneously, an increase of the Griffon Vulture population in Uvac Gorge (western Serbia) occurred (Marinkovic 1999). It may be assumed that most of birds from Herzegovina colonies migrated into the Uvac Gorge colony.

Generally speaking, there has been a negative trend in the population of Egyptian Vultures in the Balkans. During the study period, the Egyptian Vulture irregularly nested and young birds were rarely noted. Poisoning occurred mainly in spring (March, April) overlapping with the return of birds from their wintering areas.

Historically the Bearded Vulture inhabited the mountainous areas of Herzegovina and were only occasionally seen in the lowlands. From 1980 to 1991 four vultures were seen. Within the Balkan Region, the largest population of Chamois, the preferred prey, is on the Prenj Mountain (Knaus & Schroder 1978). Although Prenj was insufficiently studied and a nest was never found, due to the presence of a pair of Bearded Vultures during the breeding season, we suspected that they might be nesting there.

Nesting success is the most well-known and useful demographic parameter, mainly because it is relatively easy to record and it is an important measure of population dynamics. Adult pairs are more experienced and more competitive, so it is the young birds that are forced to leave the colony during periods of food shortage (Piper ***et al.*** 1981). Young and non-breeding birds aggregate in flocks and roam around seeking out suitable feeding and breeding areas. Griffon Vultures do not have natural predators and survival of the young from hatchlings to fledglings is from 0.7 to 0.9 young/pair (Newton 1979). Single eggs, a prolonged period of incubation, a prolonged period of care

of the nestling are among the features of vultures. This K-selection strategy is rare compared to other species which have high rates of reproduction, but low survival (MacArthur & Wilson 1967, Pianka 1972). One of the characteristics of long-lived birds is that if the carrying capacity of the habitat is saturated, then the mortality rate is highest amongst juvenile birds (Houston 1974). The potential for an introduced population of Griffon Vultures to increase is limited by the availability of food and in some circumstances, such as was the case in France, can increase rapidly when a lot of food is available. Other factors which can improve survival include the elimination of poisoning, direct persecution and disturbance. Farmers also need to be encouraged to provide their dead livestock to the vultures. The observed increase of Griffon Vultures in France and Spain shows the potential for a similar population increase in the Balkans (Terrasse ***et al.*** 2004).

Conclusions

1. Frequent poisoning of Griffon Vultures, limited food due to abandonment of pastoral livestock breeding and, probably, disturbance of colonies during civil war, caused their disappearance in Herzegovina.
2. The recent increase in the number of vultures in the Uvac gorge (west Serbia) and the possible dispersal of immature birds could result in the recolonization of the Herzegovina area.
3. The protection of historical breeding places and the reactivation of old feeding places would be the first steps in preparing the region for the arrival of vultures from other regions, especially during the winter months.
4. Pastoralism has been reduced to a great extent in Herzegovina, but the establishment of feeding places would provide favourable feeding conditions for vultures.
5. The education of the local people is of primary importance in order to reduce the pressure of poisoning.

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Griffon Vulture ***Gyps fulvus***, Egyptian Vulture ***Neophron percnopterus***, Bearded Vulture ***Gypaetus barbatus***.

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