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POPULATION SIZE AND BREEDING PERFORMANCE OF EGYPTIAN VULTURES (*NEOPHRON PERCNOPTERUS*) IN EASTERN IBERIAN PENINSULA

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ABSTRACT.—The Iberian Peninsula, and primarily Spain, includes about 50% of the Egyptian Vulture (*Neophron percnopterus*) population in the western Palearctic. This endangered species has experienced a sharp decline in southern Europe since the end of the nineteenth century and has become extinct in most of its former distribution area. In this paper we report the Egyptian Vulture population trend between 1988–2005, and the number of breeding pairs and reproductive performance, 2003–2005, in Castellón province of eastern Spain. The number of breeding pairs increased from one pair in 1989 to 12 in 2005, probably due to the absence of poisoning and direct persecution in the Castellón province. From 2003–2005, we observed 34 breeding attempts at 23 different breeding sites. Mean chicks fledged per occupied territory was 0.91 ± 0.08, mean chicks fledged per successful pair was 1.20 ± 0.09, and mean breeding success was 0.76 ± 0.07 successful pairs per breeding pair.

KEY WORDS: *Egyptian Vulture*; Neophron percnopterus; *Castellón*; *poisoning*; *population status*; *reproductive success*; *reproductive rate*.

TAMAÑO POBLACIONAL Y PARÁMETROS REPRODUCTIVOS DE *NEOPHRON PERCNOPTERUS* EN EL ESTE DE LA PENÍNSULA IBÉRICA

RESUMEN.—La Península Ibérica, y principalmente España, alberga alrededor del 50% de la población de *Neophron percnopterus* del Paleártico Occidental. Esta especie amenazada ha sufrido una alarmante disminución en el sur de Europa desde finales del siglo diecinueve y se ha extinguido en la mayor parte de su antigua área de distribución. En este trabajo se muestra la tendencia poblacional entre los años 1988 y 2005, así como el número de parejas reproductoras y su desempeño reproductivo durante el período 2003–2005 en la provincia de Castellón (este de la Península Ibérica). Desde finales de los ochenta, el número de parejas reproductoras ha aumentado desde una en 1989 hasta doce en el 2005. Correspondiendo con este incremento poblacional, la distribución de las parejas reproductoras de *N. percnopterus* se ha expandido en los últimos años hacia el sur en la provincia de Castellón. Según nuestra información, no existen datos de envenenamiento ni de persecución directa en la provincia de Castellón, por lo cual consideramos que ésta podría ser una de las causas que explican la tendencia poblacional positiva en nuestra área de estudio. Entre los años 2003 y 2005 se observaron 34 intentos reproductivos en 23 lugares diferentes de cría. Para el periodo de estudio considerado, el número medio de volantones por pareja territorial fue de 0.91 ± 0.08, el número medio de volantones por pareja que se reprodujeron con éxito fue de 1.20 ± 0.09 y el número medio de parejas exitosas por pareja reproductora fue de 0.76 ± 0.07.

[Traducción de los autores editada]

Egyptian Vultures (*Neophron percnopterus*) are widely distributed from southern Europe through sub-Saharan Africa and the Middle East into central Asia and India (Cramp and Simmons 1980, del Hoyo et al. 1994). Most of these vultures breed in Europe and Asia and winter in Africa (Meyburg et al. 2004), with some sedentary populations in western Africa and Spanish archipelagos, Saudi Arabia, and India (Ferguson-Lees and Christie 2001). The breeding population in Europe is small (as few as 3500 pairs), and declined substantially between 1970–1990 (Donázar et al. 2002, BirdLife International 2004, Donázar 2004). The population continued to decline in most countries, including Spain and Turkey, from 1990–2000, and, consequently, has been classified as endangered in Europe (Tucker and Heath 1994).

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Figure 1. Location of the Castellón province study area (the area marked with crossing lines) within the Iberian Peninsula (the gray region in the right square).

About 50% of all Egyptian Vultures breed in the western Palearctic (Tucker and Heath 1994, Donázar 2004), and about two-thirds of those that winter in Africa breed in the Iberian Peninsula (Ferguson-Lees and Christie 2001). Based on recent surveys, there are an estimated 1320–1480 breeding pairs in Spain (Del Moral and Martí 2002, Donázar 2003). However, the number of breeding pairs has declined more than 25% over the last two decades (Donázar 2004), and these vultures are now considered endangered in Spain (Madroño et al. 2004). Reasons for this decline remain unclear, but poisoning, human persecution, and changes in traditional farming practices may be contributing factors (Liberatori and Penteriani 2001, Donázar 2004, Gómara et al. 2004).

In this paper we present data for a small Egyptian Vulture population in eastern Spain. The objectives of our study were to analyze: (1) the population trend of this species between 1988–2005; (2) the breeding performance from 2003 to 2005; and (3) nest orientation and location.

METHODS

Our study area was the Castellón province in eastern Spain (40°47′ to 39°42′N, 0°51′W to 0°32′E; Fig. 1). This province encompasses 6670 km², and ranges from 0–1814 m above sea level. The climate is Mediterranean, with annual mean temperatures varying from 17°C along the coast to 8°C in the inner highlands. The livestock industry in the area is largely restricted to intensive feedlots. Three ''vulture restaurants'' are located in the central and northern part of the province. These ''restaurants'' are traditional places near villages, where shepherds and farmers drop carcasses that serve as sources of food for carrion-eating birds (García-Ripollés et al. 2004).

Population trend of Egyptian Vultures in Castellón province was analyzed by integrating personal observations with available literature (Urios et al. 1991; Del Moral and Martí 2002; Conselleria Territori i Habitatge unpubl. data). This procedure allowed us to describe the trend of this vulture population during the period 1988–2005. For three years (2003–2005), the Egyptian Vulture population was systematically censused from early March to early September, following Sarà and Di Vittorio (2003). All known territories and about 85% of the potential nesting cliffs were visited. Observations were made with a 20–60× spotting scope at a distance of about 300 m from nesting cliffs to avoid disturbing the vultures (Fernández et al. 1996, Olea et al. 1999, López-López et al. 2004). Each pair of vultures was observed 4–9 times during each breeding season. Breeders with a paler light brown colored plumage (often mottled) were considered subadults (birds from 2–4 yr old, Forsman 1999). An occupied territory was defined as one where there was evidence of a mated pair, such as a pair of birds present, a new or repaired nest, or birds incubating, provisioning young, or exhibiting behavior typical of paired vultures such as mutual preening (Donázar and Fernández 1990, Blanco and Martínez 1996, Olea et al. 1999). A breeding pair was defined as one that has laid eggs, and a successful pair was one that raised at least one chick to fledging age. We counted the number of young at the last visit to the nest. This last visit also allowed us to record eventual late broods (i.e., chicks raised after a first unsuccessful breeding attempt). A chick was considered fledged when it was more than 60 d old at the last visit; at this age nestlings are fully feathered and ready to fly. The following reproductive parameters were calculated: fecundity = fledged young per occupied territory; flight rate = fledged young per successful pair; breeding success = successful pairs per breeding pairs (modified from Steenhof 1987). For each nest site, we also recorded: (a) the nest orientation; (b) the type of nest site (i.e., open ledge, sheltered ledge, or cave); and (c) the distance to the

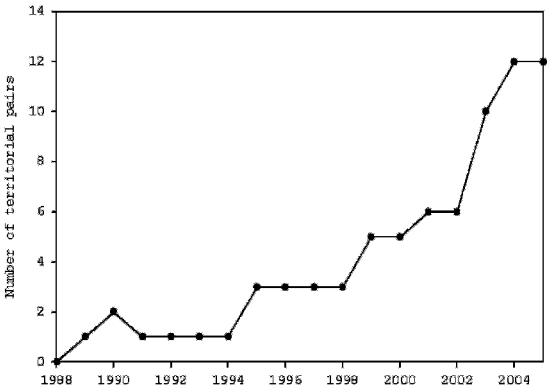

Figure 2. Number of territorial pairs of Egyptian Vultures (*Neophron percnopterus*) in the Castellón province of eastern Spain from 1988–2005.

nearest colony of Eurasian Griffon (*Gyps fulvus*), measured from the central point of the polygon defined by griffons' nests.

RESULTS

The Egyptian Vulture population in Castellón province was considered extirpated in the 1970s, when the last reproduction of two pairs was recorded (Conselleria Territori i Habitatge unpubl. data). During the 1980s, individuals were occasionally observed, but reproduction was not confirmed until 1989 (Urios et al. 1991). In 2000, five pairs were located (Del Moral and Martí 2002), and at the end of the study period the number of breeding pairs had increased to 12 (Fig. 2).

In the 3-yr study period, we observed 34 reproductive attempts and 23 different nest sites were located (see Table 1). All but one of the breeding pairs consisted of two adults (95.2%), with the remaining pair consisting of one adult and one subadult. Two pairs nested in the same place during all 3 yr, seven nest sites were used twice, and 14 sites were used only once. Five pairs changed their nest location once and three pairs twice. We found no difference in the number of young fledged per occupied territory among years (Kruskal-Wallis test; $H = 0.44$, $P = 0.80$). The adult-subadult pair fledged only one young in 2003.

Eighteen out of 23 nests (78.3%) were oriented from east to south. Of the remaining five nests, one was oriented to the northwest, two to the northeast, and two to the southwest. Twelve of 23 nests (52.2%) were in caves, 10 on sheltered ledges, and one on an open ledge. However, these nests were not all considered independent, because up to three nests per pair of birds (built in different years) were included in the data. The mean distance from the nearest Eurasian Griffon colony was 802 ± 1826 m ($N = 23$ nests), and ranged from 0–5900 m.

DISCUSSION

During the period 1989–2005 the Egyptian Vulture population in Castellón province showed remarkable growth and a southwards range expansion. Such a range expansion was also observed for the Eurasian Griffon in the same study area (López-López et al. 2004). In addition, in 2005, a new pair of Egyptian Vultures was found in the neighboring Valencia province, where the species has not bred since the 1990s (García-Ripollés and López-López unpubl. data).

The breeding performance of our Egyptian Vulture population was similar to that reported elsewhere in the Iberian Peninsula (Garzón 1973, Do-

Table 1. Annual reproduction parameters for Egyptian Vulture (*Neophron percnopterus*) in Castellón province (Eastern Spain).

	2003	2004	2005	MEAN ± SD
Monitored pairs[a]	10	12	12	11.33 ± 1.15
Total fledglings	9	10	12	10.33 ± 1.53
Pairs with 0 fledglings	3	3	2	2.67 ± 0.58
Pairs with 1 fledglings	5	8	8	7.00 ± 1.73
Pairs with 2 fledglings	2	1	2	1.67 ± 0.58
Breeding success	0.70	0.75	0.83	0.76 ± 0.07
Young per occupied territory	0.90	0.83	1.00	0.91 ± 0.08
Young per successful pair	1.29	1.11	1.20	1.20 ± 0.09

[a] Monitored pairs = Occupied territories.

názar and Ceballos 1988, Fernández 1994) and Europe (Liberatori and Penteriani 2001, Sarà and Di Vittorio 2003).

Our results indicate that Egyptian Vultures tend to nest in caves and sheltered ledges preferably oriented to east and south, as previously observed (Ceballos and Donázar 1989, Abuladze and Shergalin 1998, Vlachos et al. 1998, Liberatori and Penteriani 2001). As suggested by these authors, this highly-preferred orientation could provide adequate weather conditions for successful reproductions.

In Castellón province, Egyptian Vulture breeding pairs were generally located close to Eurasian Griffon breeding colonies, with six pairs placed within Eurasian Griffon colonies. We could not establish a direct relationship between both griffon population growth and range expansion and the observed increasing of Egyptian Vultures, but it would be interesting to study interspecific relationships between these two species that share similar trophic niche (Donázar 1993).

In some areas of the Iberian Peninsula, direct persecution and the indiscriminate use of poison to eliminate presumed livestock and game predators, such as feral dogs, foxes (*Vulpes vulpes*), Eurasian Buzzards (*Buteo buteo*), and Common Ravens (*Corvus corax*), have been proposed as the main factors influencing the decline of Egyptian Vultures and other avian scavengers, like the endangered Lammergeier (*Gypaetus barbatus*; Del Moral and Martí 2002, Donázar et al. 2002, Gómara et al. 2004). However, as far as we know, neither poisoning nor direct persecution has been reported in the Castellón province from 1990–2005 (Antídoto Program unpubl. data). Thus, it is possible that the absence of poisoning and direct persecution might explain the positive trend of the species in our study area. Moreover, the presence of some ''vulture restaurants'' in our study area could represent an additional factor explaining the observed population increase. In fact, since a supplementary feeding scheme started in 2000 in the central portion of the study area: (a) Egyptian Vultures have been observed feeding at such ''vulture restaurants'' (García-Ripollés et al. 2004), and (b) new breeding areas have been colonized in the study area. However, more information is needed before any robust conclusions on the observed population growth can be made. The understanding of the factors contributing to this population increase will be particularly important in the context of the overall declining trend of this species in Spain, as it may provide relevant information for management purposes.

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