

# Is growing tourist activity affecting the distribution and number of breeding pairs in a small colony of the Eleonora's Falcon?

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## Abstract

*Is growing tourism activity affecting the distribution or number of breeding pairs in a small colony of the Eleonora's Falcon?*— Human disturbance is a common threat for species of conservation concern such as the Eleonora's Falcon. This paper shows that the rise in tourist presence from 1992 to 2000 has not affected the overall number of breeding pairs or their productivity in a small archipelago of the western Mediterranean (Columbretes Islands). However, the increasing tourist activity has coincided with a shift in the degree of occupancy on two islands within the archipelago, favoring that with a lower human presence close to colonies. Several conservation actions are reported and suggested, aimed at both testing and preventing the role of human presence as a factor influencing long-term colony persistence and growth.

Key words: Eleonora's Falcon, Human disturbance, Navigation tourism, Columbretes, Conservation, western Mediterranean.

## Resumen

*¿Está afectando la creciente actividad turística a la distribución o el número de parejas reproductoras de una pequeña colonia de halcón de Eleonora?*— Las perturbaciones de origen antrópico son un factor de amenaza común para especies vulnerables como el halcón de Eleonora. Este trabajo muestra que el incremento de la presencia humana en las islas Columbretes, durante el periodo 1992–2000, no ha afectado ni al número de parejas nidificantes ni a su productividad. Sin embargo, dicho incremento de la actividad turística ha coincidido con un cambio en el nivel de ocupación de dos islas del archipiélago, favoreciendo a la isla menos frecuentada por embarcaciones turísticas. Se sugieren algunas medidas de gestión que pueden servir para comprobar si las visitas turísticas pueden influir en el mantenimiento y crecimiento de la colonia a largo plazo, así como para prevenir estos posibles efectos.

Palabras clave: Halcón de Eleonora, Perturbaciones de origen antrópico, Embarcaciones turísticas, Columbretes, Conservación, Mediterráneo occidental.

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## Introduction

The Eleonora's Falcon (*Falco eleonora*) is a highly migratory species which breeds on Mediterranean islands and winters in the Indian Ocean (WALTER, 1979). It is presently considered to have an unfavourable conservation status in Europe (TUCKER & HEATH, 1994). This species has evolved a late breeding calendar as an adaptation to feeding chicks, taking advantage of the pulse of migrant birds moving southwards late in the summer over the Mediterranean basin (WALTER, 1979). Human disturbance is presently considered one of the major threats to birds and other vertebrates (TUCKER & HEATH, 1994; HILL et al., 1997; RISTOW, 1999). Hence, Eleonora's Falcons are prone to suffer from human presence since tourist visits to colonies commonly peak during the breeding period.

This paper presents the effects of the increasing number of tourist boats on Eleonora's Falcons breeding on a small archipelago of the western Mediterranean, following a long period of monitoring their breeding performance.

## Material and methods

The study took place on the Columbretes Islands (39°51'N 0°40'E), a 19 ha volcanic outcrop (comprising four major islet groups: Carallot, Ferrera, Foradada–Lobo and Grossa) located close to the wide continental shelf of Castellón, E Spain (fig. 1).

The Columbretes archipelago has been a nature reserve since 1988 and a marine reserve since 1990. The total area is 4,400 ha. Two of the islands (the largest and the smallest, Grossa and Carallot) have a special protection regime (integral reserve).

Our main prediction was that changes in distribution or number of breeding pairs on these two islands would be small whereas changes in both parameters on Ferrera and Foradada–Lobo would be larger.

Data regarding public use of the islands and breeding performance of Eleonora's Falcons was obtained from unpublished reports (Reserva Natural Islas Columbretes, 1988–2001) supplied by the regional government from 1988 to 2001.

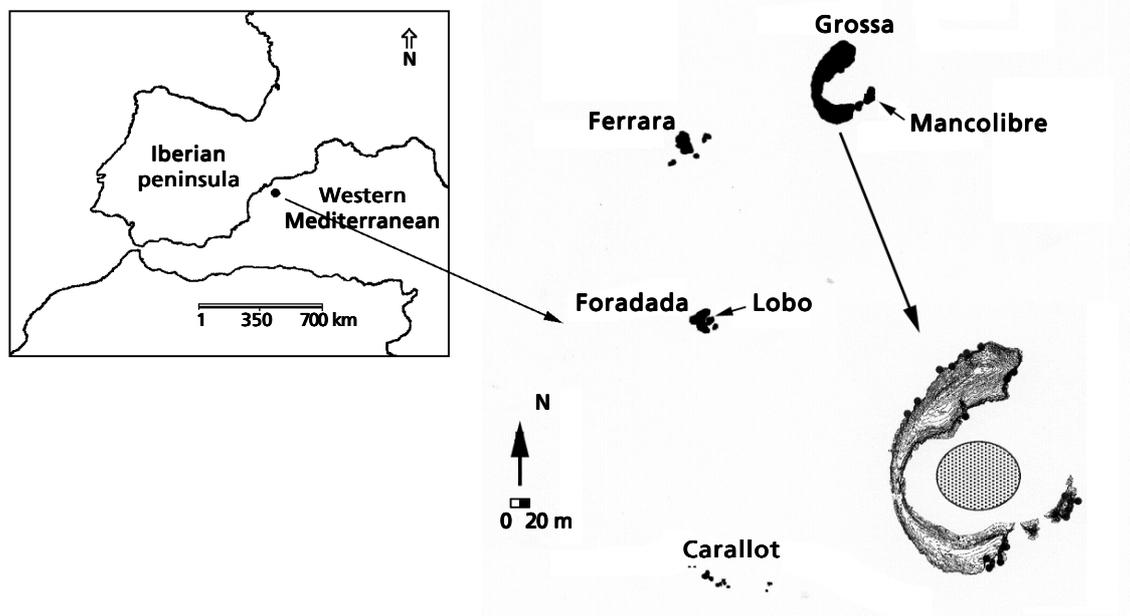


Fig. 1. Map of the study area showing the location of Eleonora's Falcons nests in 2001 and the approximate location of buoys for tourist boats in Grossa Island (dotted circle).

Fig. 1. Mapa de las islas Columbretes. Se muestra la localización aproximada de los nidos de halcón de Eleonora en la Isla Grossa en 2001 y la zona donde se localizan las boyas de amarre para embarcaciones turísticas (círculo con puntos).

Human presence was measured as the number of boat licenses-plates recorded daily (boats-day hereafter).

Boats were tied up to the buoys located around the islands and the team of three wardens living on the main island counted them daily by means of a terrestrial telescope.

The monitoring of boats was constant throughout the study period. The number of breeding pairs was also determined by knowledgeable wardens of the reserve by inspecting the islands from a boat early in the breeding season to locate and count breeding pairs and later by double-checking the existence of nests from the mainland.

Productivity (i.e. number of fledglings per nest) was estimated from the content of nests when visited for chick ringing in mid September, using field procedures developed by two members of the study team (AM, DO).

Monitoring and ringing of falcons was approximately constant throughout the study period. In 1999, the overall number of breeding pairs was not estimated due to lack of an appropriate boat to visit all the islands, but productivity was estimated from nests located on Grossa Island and Mancolibre (fig. 1).

## Results

Inter-annual variation in the number of boats-day is shown in table 1. The overall trend was a progressive increase in human presence on the islands ( $r_s = 0.97$ ,  $n = 13$ ,  $p < 0.001$ ). Monthly variations in the number of boats-day are shown in figure 2. Boats-day clearly peaked in July and August precisely the time when falcons were laying and incubating their eggs (DOLZ & DIES, 1987). However, the number of breeding pairs, remained approximately constant through the years ( $26 \pm 2.16$  pairs, mean  $\pm$  SD,  $n = 13$ ) as did their productivity ( $1.64 \pm 0.33$ , mean  $\pm$  SD,  $n = 13$ ) (table 1). In fact, correlations between years and number of pairs ( $r_s = 0.18$ ,  $n = 13$ ,  $p > 0.05$ ) and productivity ( $r_s = 0.50$ ,  $n = 13$ ,  $p > 0.05$ ) were not significant.

No significant correlation was found either between overall numbers of boats-day during the breeding period (July-September) and numbers of breeding pairs ( $r_s = -0.14$ ,  $n = 12$ ,  $p = 0.66$ ) or between overall number of boats-day during the breeding period and productivity ( $r_s = 0.23$ ,  $n = 12$ ,  $p = 0.46$ ). Inter-annual variation in the use of the various islands by breeding falcons and tourist boats is shown in table 1. The

Table 1. Number of nests and productivity of Eleonora's Falcons (*Falco eleonorae*) detected on each island of the Columbretes archipelago during the period 1988-2000 (source: Reserva Natural Islas Columbretes, 1988-2001): ND. No data available; In brackets number of boats-day.

Tabla 1. Número de nidos de halcón de Eleonora (*Falco eleonorae*) detectados en cada una de las islas del archipiélago de las Columbretes durante el periodo 1988-2000 (datos extraídos de: Reserva Natural Islas Columbretes, 1988-2001): ND. Información no disponible; entre paréntesis se indica el número de barcos-día.

Year	Carallot	Foradada-Lobo	Ferrera	Grossa	Productivity	Total
1988	1	6	5	11		23 (184)
1989	-	-	-	-	1.37	(242)
1990	-	-	-	-	1.73	(374)
1991	-	-	-	-	1.41	(509)
1992	0 (2)	8 (31)	4 (11)	15 (592)	1.53	27 (636)
1993	1 (12)	3 (65)	7 (31)	15 (537)	1.66	26 (645)
1994	1 (19)	4 (131)	5 (36)	14 (606)	1.0	24 (792)
1995	0 (33)	5 (86)	8 (40)	13 (493)	1.61	26 (652)
1996	1 (106)	3 (107)	6 (38)	13 (481)	1.89	23 (732)
1997	1 (0)	3 (94)	6 (66)	13 (695)	1.35	23 (855)
1998	1 (0)	3 (93)	8 (45)	15 (715)	2.0	27 (853)
1999	1 (0)	(75)	- (66)	12 (804)	2.0	- (945)
2000	1 (0)	1 (86)	9 (51)	14 (758)	1.6	25 (895)
2001	1 (-)	4 (-)	10 (-)	15 (-)		30 (-)

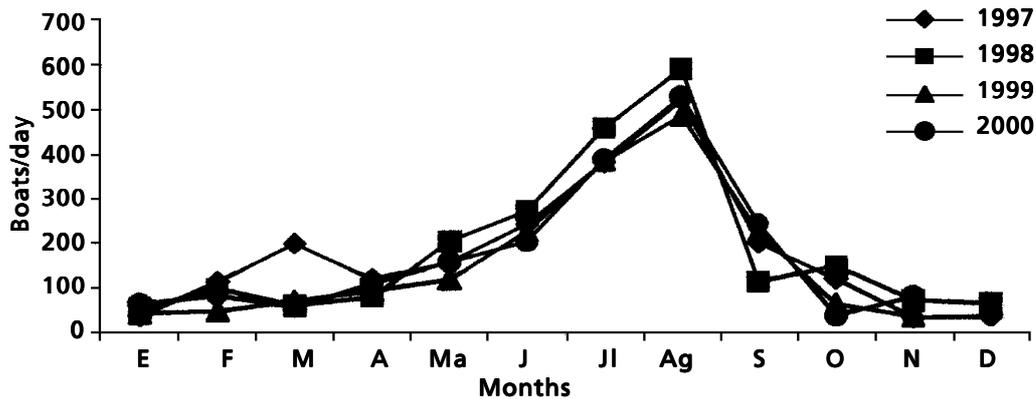


Fig. 2. Monthly variation in the number of boats-day at the Columbretes Islands during the period 1997–2000: E. January; F. February; M. March; A. April; Ma. May; J. June; Jl. July; Ag. August; S. September; O. October; N. November; D. December.

*Fig. 2. Variación mensual en el número de barcos-día en las islas Columbretes durante el periodo 1997–2000: E. Enero; F. Febrero; M. Marzo; A. Abril; Ma. Mayo; J. Junio; Jl. Julio; Ag. Agosto; S. Septiembre; O. Octubre; N. Noviembre; D. Diciembre.*

percentage of falcons breeding on Ferrera (in relation to the total breeding pairs of Ferrera + Foradada-Lobo) increased over time (table 1). Indeed, a non-parametric correlation run to check whether this percentage had changed overwith time showed a significant strong correlation ( $r_s = 0.78$ ,  $p = 0.014$ ), although, correlations between annual numbers of breeding pairs and annual numbers of boats aton Ferrera and Foradada were not significant.

## Discussion

Shifts in island use by Eleonora's falcons seem to have affected only the colonies on Ferrera and Foradada, the two islands with no special protection regime. Anchoring of boats around Carallot is not permitted as the distance from Grossa makes it difficult to keep activities carried out within the restricted area under control. Nevertheless, tourist activities such as scuba-diving are allowed on Grossa, where the island wardens, who have a permanent base on this island, can more easily monitor the activities of visitors; boats must be tied up to buoys in the bay, thereby remaining at a reasonable distance from most falcons nests (see fig. 1).

The fact that correlations between annual numbers of breeding pairs and annual numbers of boats on Ferrera and Foradada were not significant would be explained if the mean number of boats-day at Foradada-Lobo in 1997 acted as a threshold regarding falcon disturbance, finally forcing falcons

to migrate to a quieter island from 1998 onwards. We are not aware of any factor (e.g. food, nest-site availability, competing species, ectoparasites) other than human presence that may have influenced the change in the distribution of breeding pairs, albeit the exact way in which human presence may have affected falcons remains unknown. However, the fact that scuba-divers prefer Foradada as compared to Ferrera, because of the existence of submerged archs (S. Sales, pers. com.) may have played some role.

Hence, our data indicate that high tourist presence coincideds with a loss of pairs at Foradada-Lobo and that lower tourist presence coincided with an increase in the number of pairs at Ferrera, although there were no changes in the overall number of breeding pairs (i.e. the colony remains stable). However, only experimental manipulation of the number of boats-day could unequivocally demonstrate a cause-effect relationship.

These spatial changes may not be dangerous for short-term colony persistence. The clumping of breeding pairs in social species, such as the Eleonora's Falcon, can have positive consequences for breeding performance; one possible short-term conservation option would be to increase protection of Ferrera (where the level of human presence is quickly approaching that of Foradada-Lobo), allowing only Foradada-Lobo as a tourist destination. However, given the reduced size of the archipelago, high protection on Foradada-Lobo should also be attained in the future so as not to threaten long-term colony persistence

and growth (e.g. banning the presence of boats within a buffer zone around the island).

Tourism affecting Eleonora's Falcons in the Columbretes Islands was previously reported in 1997, when a marked decrease in breeding pairs occurred in a small rocky islet located beside the main island (Mancolibre, see fig. 1). This reduction was probably caused by excessive presence of scuba divers according to SÁNCHEZ (1997). The environmental authorities experimentally removed a buoy placed close to the isle, and banned the transit of boats around the islet. This sub-colony quickly recovered its usual number of breeding pairs in 1998. Hence, conservation measures addressed to reduce human presence around the colonies of Eleonora's Falcons can give positive results and should be further employed to determine the role of human presence on the patterns of island use by falcons.

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