

# Notes on the reproductive biology of the Mediterranean Peregrine Falcon *Falco peregrinus brookei* in South-Eastern Sicily (Italy)

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AN 0009-0003-9987-1892 MUV 0009-0002-8876-2044



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## Abstract

The Mediterranean Peregrine Falcon *Falco peregrinus brookei* was studied in the southern Iblei Mountains (Sicily, Italy) between 2023 and 2025. The survey was aimed at assessing the density, spatial distribution of nesting sites, and reproductive biology of the species in an area where this information was completely lacking. A density of 1.77 pairs/100 km<sup>2</sup> was recorded. The distribution of nesting sites in the study area was random. Nesting sites had a predominantly SE and SW exposure. The fledgling rate was 2.37 fledglings/nest. Fledging occurred between the second week of May and the first week of June, and therefore egg laying had occurred around the second week of March.

**Keywords:** Falco peregrinus brookei, density, dispersal, reproductive biology, Sicily

## INTRODUCTION

The Peregrine Falcon *Falco peregrinus*, a polytypic species with a Holarctic distribution, is present in Italy as a resident and breeder, migrant, and winter visitor (Brichetti & Fracasso 2003). Two subspecies breed in Italy, *F. p. peregrinus* and *F. p. brookei*, while *F. p. calidus* is a migrant and winter visitor, and *F. p. peregrinoides* is an occasional visitor (Sarà 2021). It breeds from the sea level to hilly elevation, and it is less common at higher altitudes, reaching altitudes up to 2,200–2,400 meters (Bacci & Brunelli 2022).

In Sicily, the *brookei* subspecies is sedentary and breeds throughout much of the region, with a minimum of 257 pairs (Sarà et al. 2021). The Iblei Mountains, located in southeastern Sicily, are one of the least studied areas of the region from an ornithological perspective, and no specific studies on the Peregrine Falcon have ever been performed in this area. This work aims to expand our knowledge of the reproductive biology and, more importantly, the population density of this falcon in the Iblei region.

## STUDY AREA AND METHODS

The study area (14°47' E – 36°52' N) covers a surface of 1,129.5 km<sup>2</sup> and is located in the southern sector of the Iblei Mountains, encompassing the territories of seven municipalities, six in the province of Ragusa and one in the province of Syracuse (Fig. 1). Morphologically, it is characterized by a vast, hilly plateau

of sedimentary limestone rocks reaching 600 m a.s.l. The area is affected by widespread karst; over millennia, fluvial erosion has created wide and deep grooves known as “cave” (canyon).

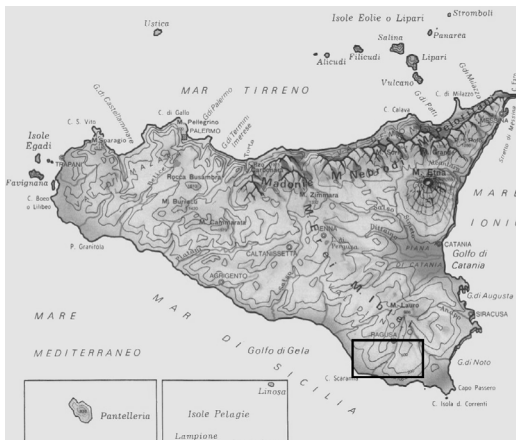
The plateau’s landscape mosaic is strongly influenced by human activity, with residential buildings, rural houses, and small, scattered patches cultivated primarily with cereals. Carob trees *Ceratonia siliqua*, and Olive trees *Olea europaea* are also present. Steppe grasslands and garrigues predominate on the slopes; canyons are covered with Mediterranean scrub, dominated by plants such as Tree Spurge *Euphorbia arborescens*, Wild Olive *Olea europaea* var. *sylvestris*, Holm Oak *Quercus ilex*, and Downy Oak *Quercus* cfr. *pubescens*. Some plantations of *Pinus* spp. are also present. Cattle grazing is widespread in the area.

Data collection took place between 2023 and 2025, from January to June, for a total of 39 field trips performed at different times of the day. Birds were directly observed and their nests/territories using a Bushnell 20-60x80 telescope and Nikon 10x42 binoculars. Where possible, observations were documented with telephoto lenses up to 800 mm. During the survey, all the canyons in the study area were visited. Each nesting site was georeferenced and mapped using Google Earth Pro. The collected data were archived and analysed using spreadsheets.

Peregrine Falcon density was calculated using the Nearest Neighbour Distance (NND) method (Newton 1976; Newton et al. 1977), as proposed by Penteriani

& Pinchera (1995) to standardise the research method. The density-determining area was obtained by drawing a circle around the outermost sites with a diameter equal to the mean Nearest Neighbour Distance (NND), then connecting them with a continuous line, thus delimiting the entire area actually occupied by breeding pairs. To make a realistic comparison of density with data known in the literature, we selected study areas larger than 1,000 km<sup>2</sup>, avoiding densities referring to entire regions since, in our opinion, the data are not comparable, especially without the details of the survey method applied.

Nest site dispersion was analysed using the G-test statistic, or GMASD (Brown 1975), calculated as the ratio of the geometric mean to the arithmetic mean of the squared Nearest Neighbour Distance (NND). The index ranges from 0 to 1; values close to 1 (>0.65) indicate a regular distribution of nests.



**Figure 1** – Location of the study area in Sicily, Italy (rectangle).

## RESULTS AND DISCUSSION

Twenty pairs of Peregrine Falcons (17 confirmed breeding pairs and 3 probable) were counted in the study area during the three years of research. Nesting sites averaged 263 m a.s.l. (SD = 141.01; N = 20; range = 11–551). This mean altitude was much lower than the regional average of 566 m a.s.l. reported by Sarà et al. (2021). In a sample of 19 sites, nesting cliffs were preferentially exposed to the S, SE, and SW (53%) and only in five cases (26%) to the N, NE, and NW; in three cases to the E (15.8%) and in one case to the W (5.3%). The southward prevalence of nesting locations is also mentioned for Sicily by Sarà et al. (2021). The mean distance between the nearest sites (NND) was 5.5 km (SD = 3.06; N = 14; range = 1.5 km–13.4 km). The G-test value was 0.58. The GMASD statistic (Brown, 1975) was compared with a CSR (Complete Spatial Randomness) null model using a Monte Carlo simulation (N = 14 and 100,000 simulations). The observed value ( $G = 0.58$ ,  $p \approx 0.42$ ) falls within the 95% acceptance interval (0.39–0.74), indicating the absence of a statistically significant deviation from spatial randomness. The irregular dispersion of sites is influenced by the particular topography of the study area, characterised by the discontinuous presence of deep canyons on whose rocky walls the Peregrine Falcon has suitable nesting sites. The density found in the study area was 1 pair/56.5 km<sup>2</sup>, or 1.77 pairs/100 km<sup>2</sup>. The mean distance to the nearest nest (NND) found in this study is

consistent with those already known in the literature for Sicily, while the density found in the southern Iblei Mountains was among the highest known in the literature at the national level (See Tab. 1 for a comparison). The high density of the

species found in the area could be due to the thriving livestock farming in this part of the region and the resulting concentration of feed producers, which favours the presence of Columbidae, the primary prey of the Peregrine Falcon.

**Table 1** – Comparison of breeding density of Peregrine Falcon *Falco peregrinus* in the study area with other areas of Sicily and other Italian regions. NND = mean Nearest Neighbour Distance between nesting sites in a sample area; prs./ter. = pairs / territories.

Area	km <sup>2</sup>	N. (prs./ter.)	NND (km)	Density (prs./ter./100km <sup>2</sup> )	Sources
<i>Southern Iblei (RG)</i>	1,129	20	5.5	1.77	<i>present study</i>
Provinces of Caltanissetta and Enna	4,229	55	5.4	1.30	Sarà et al. 2021
Madonie Mountains	1,090	20	5.1	1.83	Sarà et al. 2021
Provinces of Ragusa and Syracuse	2,552	20	5.1	0.78	Sarà et al. 2021
Province of Agrigento and other areas	5,994	60	nc	1.00	Sarà et al. 2021
<i>Sicilian areas (average)</i>			6.2	1.22	<i>from: Sarà et al. 2021, modified</i>
Lazio Apennines	11,873	158	4.7	1.35	Brunelli & Sarrocco 2021
Umbria	7,130	45	5.6	0.63	Magrini et al. 2021
Ligurian Appennines	3,000	23	//	0.77	Baghino & Cottalasso 2021
Ligurian Alps	1,885	21	//	1.17	Baghino & Cottalasso 2021
Western Lombard Prealps	3,500	//	//	1.34	Brambilla et al. 2021
Brescia Prealps	1,050	25	5.7	2.38	Brambilla et al. 2021
Extra-Alpine area of Cuneo	1,900	//	//	0.70	Beraudo et al. 2021
Trentino Prealps	3,570	42	5.1	1.18	Rizzolli et al. 2005

Peregrine Falcon pairs occupy nesting sites between January and February, nesting in old Common Raven *Corvus corax* nests (Fig. 2) or in natural cavities preferentially located on the upper third of the wall (100%; N = 13). Nesting areas are often shared with Common Raven (7) and with several raptor species, such as the Common Kestrel *Falco tinnunculus* (4), the Tawny Owl *Strix aluco* (2), and the Egyptian Vulture *Neophron percnopterus* (1).

Fledging took place between the second week of May and the first week of June. Considering that the incubation period for this species is 28–29 days and

the chick-rearing is 35–42 days (Cramp & Simmons 1980), egg laying should occur, on average, around the second week of March, confirming the postponement of the breeding season already observed in the rest of Sicily, where the laying date was delayed by one week between 1979 and 2019 (Sarà et al. 2022).

A mean fledging rate (fledglings/nests with fledging) of 2.37 was recorded (N = 8); 5 nests with two fledged chicks (62.5%) and 3 nests with 3 fledged chicks (37.5%). This fledging rate is in line with the average of 2.39 reported for Italy by Brunelli & Gustin (2021).



**Figure 2** – Nesting of the Mediterranean Peregrine Falcon *Falco peregrinus brookei* in an old Common Raven *Corvus corax* nest in the study area.

## CONCLUSIONS

Over a period of approximately 150 years, the Sicilian Peregrine Falcon population is considered to be increasing (Massa et al. 2021), but after a strong growth phase, the population has stabilised in recent decades (Sarà et al. 2021). Monitoring has been conducted almost annually in central and southern Sicily since 2010, and a 27% population decline has been recorded since 2017 (Mascara & Nardo 2023). There is no previous data available for the study area and, in general, for southeastern Sicily, to assess population trends, and therefore this study represents an initial contribution to our understanding of breeding size and biology of this population, on which to build long-term monitoring.

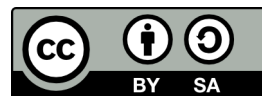
## Acknowledgements

We would like to thank Maurizio Sarà for his assistance with statistical analysis and critical reading, the Associate Editor Giacomo Assandri and two anonymous reviewers for their critical reading of the text and valuable suggestions, and Catriona Gillespie for her translation.

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Received: 01 November 2025

First Response: 06 November 2025

Final acceptance: 02 February 2026

Published online: 18 February 2026

Editor: Giacomo Assandri