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The Golden Eagle *Aquila chrysaetos* in the northern Marches Apennines (Central Italy). Long-term monitoring (1983-2023) in the mountains of Pesaro-Urbino

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Abstract - This study describes the monitoring work related to the nesting of the Golden Eagle *Aquila chrysaetos* in Northern Marches Apennines (Central Italy), in province of Pesaro-Urbino. Monitoring took place between 1983-2023, when a minimum of 1 and a maximum of 5 breeding pairs nested in the research area. The 16 nesting sites used by the Golden Eagle were located on cliffs with niches, ledges and high shallow caves, at an average height of 744.43 m (±249.7 m) a.s.l. The average number of nests per territory was 3.2 (±2.28 SD). The exposure of nest sites was heterogeneous. The maximum density for the species was 0.60 pairs/100 km^2 and the Nearest Neighbor Distance was 8.84 km ±2.5. Most of the first incubations occurred in March and within the study period, at least one incubation was always observed. Incubation and fledging periods lasted on average 44.70 days (±1.78 d) and 81.76 days (±6.45 d), respectively. Over the study period, the breeding pairs raised a total of 98 chicks, of which 75 fledged successfully. Across the 41 years of monitoring, the productivity rate recorded was 0.65 (N. fledglings /N. pairs), the reproductive success 0.94 (N. fledglings /N. pairs with confirmed incubation), the fledging success 1.14 (fledglings/N. success pairs) and the nestling mortality was 23.5%. In 13.6% of the total successful breeding events, two fledglings were raised per nest. Only in three years of monitoring, no fledgling was raised.

Keywords*: Aquila chrysaetos,* Breeding biology, Central Italy, Golden Eagle, Marches, Nesting sites, Raptors.

INTRODUCTION

The Golden Eagle *Aquila chrysaetos* is one of the most intensively monitored species in Italy and a recent update of the national breeding population has led to an estimation of 630-729 breeding pairs, of which 52-62 are in the central Apennines (Fasce & Fasce 2017). The monitoring of the Golden Eagle population in the Umbria-Marches mountain range began in 1979 (Magrini et al. 2001, Perna et al. 2004) and the area's current population is estimated around 18-20 pairs, with over an 80% increase compared to the period 1979-1990 (Angelini et al. 2017). In 2014, 18 breeding pairs were counted in Umbria-Marches Apennines (Angelini et al. 2017) and the present

study aims to update and increase the data relative to the northern Marches.

Generally, in the Marches region the species is considered sedentary-nesting, irregularly migrating and irregularly wintering (Giacchini 2003), but in the province of Pesaro-Urbino, in the northernmost part of Marches region, it is considered sedentary-nesting and irregularly migrating (Pantalone et al. 2022), thus essentially sedentary (Pandolfi & Giacchini 1995). In the latter province, the Golden Eagle was certainly already nesting in the 16th century on M. Nerone (Felici 1982, Pandolfi & Zanazzo 1993, Pandolfi & Giuliani 1993) and in 1753 in the Sasso Simone-Simoncello as well as on M. Carpegna (Loppi 1753).

In the 19th century the species has been reported nesting in Furlo Gorge, on M. Catria and M. Nerone (Matterrozzi Brancaleoni 1808-1812, Salvadori 1872, Falconeri di Carpegna 1892, Gasparini 1894). Chiavetta (1981) indicates a general population increase in the post-war period and a subsequent decrease until the end of the 1970s. This decrease also affected the province of Pesaro-Urbino, where, in the same years, no breeding pairs were detected (Pandolfi 1975). It is likely that poaching played an important role in this demographic collapse and hindered the colonization of new territories by the Golden Eagles even after 1979, the year of its return to M. Catria as a nesting species (Pandolfi & Giacchini 1995).

The improvement in the species' demographic status in the Umbria-Marches sector in the last twenty-five years has been associated with a more stringent protection regime through the establishment of numerous protected areas (Magrini et al. 2013). Indeed, the number of breeding pairs on the provincial territory increased from two-three in the period 1990-95 (Pandolfi & Giacchini 1995) to four in 2013 and then five in 2022. In order to contribute to a more complete and up-to-date understanding of the presence of the Golden Eagle in the Marches Apennines, this work presents the results from the continuous long-term monitoring of nesting pairs in the province of Pesaro Urbino between 1983 and 2023 (i.e. Fasce & Fasce 2004).

MATERIALS AND METHODS

Study area

The study area includes the Apennine mountainous areas falling within the borders of the province of Pesaro-Urbino (Marches region, Fig. 1): M. Catria (1701 m a.s.l.), M. Nerone (1525 m a.s.l.), Furlo Gorge (between the M. Paganuccio and the M. Pietralata, respectively 976 m and 889 m a.s.l.), M. Petrano (1162 m a.s.l.) and Sasso Simone-Simoncello (1221 m a.s.l.). The provincial territory considered suitable for the Golden Eagle was identified considering all the areas falling within the main mountainous prominences, with a minimum altitudinal limit corresponding to 400 m a.s.l., which is the lowest value of the range in the central southern Apennines (Borlenghi et al. 2014; Brichetti & Fracasso 2018). The calculation of the surface to measure the breeding density was made using TINITALY (Tarquini et al. 2007), a digital elevation model of Italy with 10 m cells-grid (Version 1.0). The study area extends over 828 km^2 and includes mostly calcareous or calcareous-marly environments. The lithology and tectonics favour the presence of extensive rocky areas, gorges (Furlo and Burano) and limestone blocks rising from the reliefs (Sasso Simone and Simoncello). The vegetal landscape has extensive forest formations on the slopes (oak forests, beech forests, ilex forests, etc.) and large secondary grasslands in the summit areas (Ballelli & Pedrotti 1992, Barbadoro & Barbadoro 1997, Biondi 2007, Biondi et al., 2007, Saltarelli & Pantalone 2023), the latter being fundamental hunting sites for the Golden Eagle (Ragni 2004). Average annual precipitation is between 1100 (M. Nerone and M. Petrano) and 1300 mm (M. Catria), while average temperatures range between 10° (M. Catria) and 12° C (M. Nerone, M. Paganuccio and M. Petrano) (Crescentini & Klaver 1997). The vast majority of the study area includes protected areas, where many of the Golden Eagle's usual preys are present (Pedrini & Sergio 2001; Poggiani & Dionisi 2015).

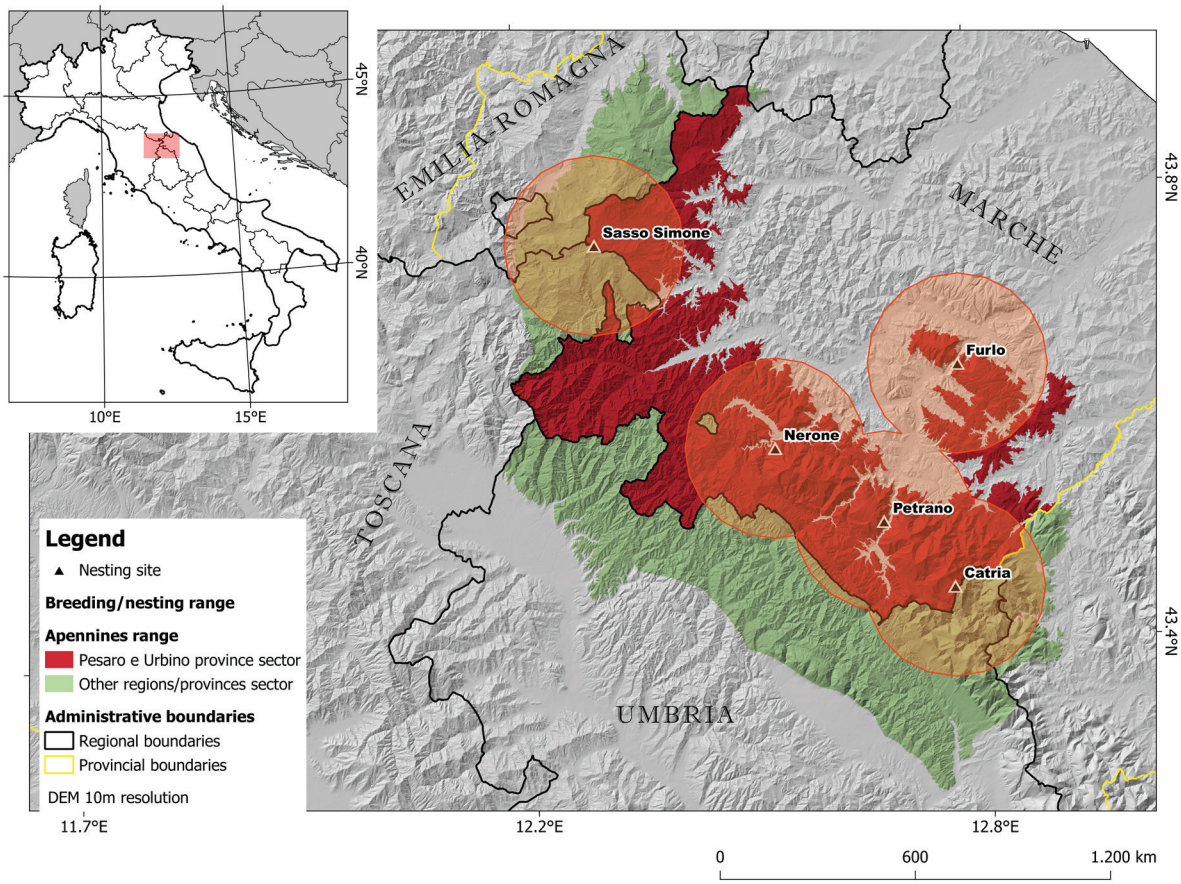

Figure 1. Study area (red), mountainous areas above 400 metres in other neighbouring regions (green). Background DEM, downloaded from TinITaly (Tarquini et al. 2007).

Data collection

The data here presented was collected during continuous weekly surveys (in many periods daily), from 1988 to 2023. About 4,000 days and more than 22,000 hours were dedicated to observations, which were all carried out in the mountainous areas suitable for Golden Eagle nesting in the province of Pesaro-Urbino. Since 1983 information on the nesting and flight of the raptor was also collected with interviews (Pesaro-Urbino Provincial Police, local observers) and consultation of official documents. The continuous field surveys began in 1985 (Giacchini 2019). Stakeouts were used at a safe distance (average distance between the observation points and the nest: 586.57±162.43 m, range 433-1047 m), to not disturb breeding activity. For visual observations, 8x42 and 10x42 binoculars were used, as well as spotting scopes with 20-60x80 magnifications, including digiscoping. For monitoring purposes, pairs observed in territorial display or reproductive activity (copulation, incubating and chick rearing, Brunelli et al. 2004) were considered. For the definition of the monitoring effort and reproductive parameters, we largely used Andreotti & Leonardi 2007 as a reference. The protocol, used since 1988, required a minimum of 4 annual visits to the nesting areas (Fasce 1988) and each survey required at least 4 consecutive hours of observation (Artese et al. 2017). In the event of known vacant nests, three prolonged observations of the adults were carried out (between mid-August and October) to rule out the presence of youngs in that year (Fasce 1988), a circumstance

indicating a reproduction event at unknow sites. On occasions when the exact day of laying could not be ascertained, hatching dates were estimated from the development of the chicks' plumage (Cramp & Simmons 1980, Mathieu 1985). In order to measure the elevation of the nesting sites, we used the software Google Earth Pro, using three-dimensional processing of the rocky ridges and ledges (tolerance of 10-15m). The distance to the nearest neighbour (NND) was calculated as the distance from the nest's barycentre of a pair and that of the nearest pair (Tjernberg 1985). This calculation does not take into account the nesting event that took place in Sasso Simone and Simoncello, a site used only once in 2022.

For the population study, the following demographic parameters were calculated: percentage of laying pairs ([N. of laying pairs /N. of total pairs] x 100); percentage of pairs with success ([N. of successful pairs/total pairs] x 100, Craig & Enderson 2004); the reproductive success (N. fledglings / N. pairs with confirmed incubation; Cheylan 1981); the fledging rate (N. of fledglings /N. of successful pairs; Craig & Enderson 20004); the productivity (N. of fledglings / N. of checked pairs; Craig & Enderson 2004); the percentage of chick mortality ([N. dead chicks / N. total chicks] x 100; Whitlock & Schluter 2014).

We further report information on the diet of the Golden Eagle and on the feeding of the chicks, exclusively based on visual observations of prey items delivered to the nest (a method already used by Borgo & Genero 2017) and assumes a purely qualitative character.

RESULTS

During the study period we detected five territories occupied by breeding pairs of Golden Eagles, identifiable by the following toponyms: M. Catria (C), M. Nerone (N), Gola del Furlo (F), M. Petrano (P), Sasso Simone (SS). A sixth territory was recently occupied by a territorial pair in the Tuscan-Marches ridge (Alpe della Luna) and in the valleys between the upper Urbino and Montefeltro, but reproduction has not yet been verified (Ricci & Manganelli 2024, *pers. comm*.), and has therefore not been considered in the present work. Regarding the nesting pair in the Furlo Gorge, we are certain that the territory was occupied by the same individuals (identifiable by specific characteristics of the plumage) from 1990 until 2016.

In the study area, 16 nesting sites (average 3.2 nests/territory, 2.28 SD) were found: three on M. Catria (nests C1, C2 and C3), six on M. Nerone (N1, N2, N3, N4, N5 and N6), five in the Furlo Gorge (F1, F2, F3, F4 and F5), one on M. Petrano (P1) and one in Sasso Simone (SS1). At the beginning of this study, the structures of 13 of the sites were at least in place**.** Additionally, during the study period, the N6, F4 and SS1 nests were built from scratch, although they were all used only once. The exposure of the nests is heterogeneous (Table 1): five were exposed to SE (31.2%), five to SW (31.2%), three to NW (18.7%), two to NE (12.5%) and one to E (6.2%). The nesting site were mostly located on ledges (75%, N=12). The presence of Holm Oak plants *Quercus ilex* near three nests (F4, N4 and N5), especially for the two with a SW exposure, can be interpreted as a way to mitigate the impact of atmospheric agents on the nest (mainly on the part of sun and wind). In one case (N5) the tree performed a real support function for the outer part of the nest.

The nests were located at an average elevation of 744.43 m a.s.l. (±249.7 SD, range 518-1190), while the height of the walls used for nesting was on average 123 m (±51.6 SD, range 52-257). During the study period, the two most used nesting sites were F5 and C1 (Table 1); F5 was the nest used most consistently (3 consecutive years in 3 different periods), followed by the P1, consecutively used in 2013-2016 and 2019-2021. The nest that was abandoned for the longest period was N6, used only once in 2003, the structure of which still exists. The only nest site whose future reuse appears problematic is F1, due to the rock collapse that has almost entirely covered the niche. Regarding nest size, nest F5, located inside a cavern about 9 m high, is particularly noteworthy. The

Table 1. Environmental characteristics of nesting sites (Ledge = flat ledge on steep rock face; Niche= indentation of rock face; Small terrace= large rocky ledge on wall).

Nest	Characteristics of nesting sites	Mountain	Exposition	Altitude (a.s.l.) m	Wall height (m)	Number of years user
C1	Ledge	M. Catria	SE	1146	135	15
C2	Ledge	M. Catria	SE	1170	160	7
C3	Ledge	M. Catria	SE	1190	180	3
F1	Ledge	Furlo Gorge	S-SE	597	106	6
F2	Niche	Furlo Gorge	NE	534	52	5
F3	Ledge	Furlo Gorge	NW	560	110	2
F4	Ledge	Furlo Gorge	NW	590	140	1
F5	Cave with large cavity	Furlo Gorge	NW	550	100	17
N1	Ledge	M. Nerone	SW	540	187	1
N2	Niche	M. Nerone	SW	710	110	7
N3	Ledge	M. Nerone	SW	770	86	2
N4	Ledge	M. Nerone	SW	753	74	2
N5	Small terrace with *Quercus ilex*	M. Nerone	SW	645	85	1
N6	Ledge	M. Nerone	E	518	93	1
P1	Ledge	M. Petrano	SE	577	257	9
SS1	Ledge	Sasso Simone	NE	1061	100	1

structure is ca. 6.5-7 m high and 4-4.5 m wide and has been reported by local inhabitants to already exist in the mid-19th century. The simultaneous nesting of the present pairs was an infrequent event during the period 1988-2012 (three established pairs), having occurred in only 2 out of 25 breeding seasons, while in the period 2013-2022 (four established pairs) it was recorded in 5 out of 10 breeding seasons.

The distances between the different nests of the same pairs were on average 53 m ±SD= 6.10 (M. Catria), 532 m ±SD= 441 (M. Nerone) and 505 m ±SD= 307 (Furlo). The maximum relative density of the species in the study area was 0.60 pairs/100km^2 (5 pairs in 828 km^2), while the distance to the nearest neighbour (NND) was on average 8.84 km ± 2.5 (range: 5.4 - 11).

Out of a total of 127 breeding seasons, 115 were monitored. In the 35 cases in which the pairs did not nest, equalling 30.4% of the total, we observed mating in 8 cases, while in 2 cases the reproductive failure was associated with the replacement of one of the two partners. In 58 broods it was possible to date the laying of the first egg (Fig. 2), which mostly occurred in March. In the Furlo Gorge, the start of hatching appears earlier than that of the other three pairs, where the earliest laying date was 22nd of February (in 5 consecutive years, 2019-2023) while the latest was 30th of March (nest C1 in 1999 and nest P1in 2014). The average duration of the hatching period was 44.70 days (±SD=1.78; range: 40-48 d; N=51), in line with what is known in the literature (Brichetti & Fracasso 2013, Cauli & Genero 2017, Katzner et al. 2020). In the case of 18 broods, it was possible to determine by direct observation the exact number of eggs laid. In four deposition events the failure to hatch eggs was ascertained, while on two occasions, both in the Furlo Gorge, the presence of three eggs in the same nest was detected. Singular was the episode of the failure of a clutch of two eggs (2001), which sunk in the very high litter of the nest after 30 days of brooding, followed by the vain attempt by the female to continue the brooding and to remove, during the following month, the layer of branches that separated her from the eggs.

The mortality rate of the chicks in the nest was 23.5%. Only two cases of cainism were observed, one

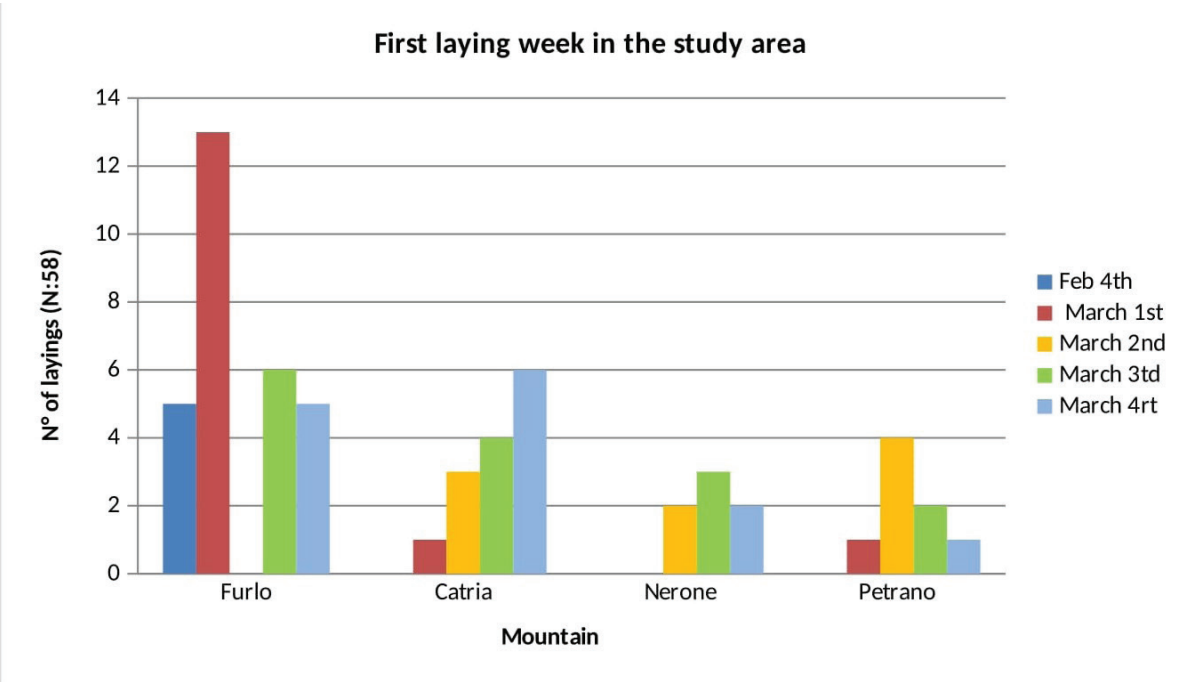

Figure 2. Frequency of the first egg laying between February and April in 4 of the study sites investigated.

in 1997 (a brood of three chicks) and one in 2023 (a brood of two chicks). Both took place in Furlo Gorge, and the two chicks both died within the first week of life. In one case (M. Nerone, 1988) the death of the chick, after the disappearance of its father, has been attributed to the female's difficulty in carrying out the breeding on her own. In 1991, the death of the chicks from Furlo Gorge has been associated with the temporary abandonment of the nest by the parents, maybe caused by the presence of tourists on the crags near the nesting site.

Out of 80 breeding seasons (69.6% of the total) in which laying was attempted, 66 (82.5%) had successful breeding and 98 chicks were produced, of which 75 fledged (summarised per monitoring location in Table 2; Table 3). The pairs' productivity during the study period was 0.65 chicks/pair, the reproductive success is 0.94 chicks/laying pair, and the fledgling success is 1.14 chicks/successful pair. Compared to the total number of pairs with ascertained chicks (N=76), 72.3% (N=55) had one chick, 26.3% (N=20) had two chicks, while only in one case (1.3%) three chicks were observed (Fig. 3).

The percentage of double fledgling correspond to 13.6% of the total of successful nesting events. The percentage of pairs with fledglings compared to the total checked pairs is 57.5%. There were three years without any fledglings produced (1991, 1992 and 2012). For 17 of the nesting events in the Furlo Gorge it was possible to determine the date of fledgling: 81.76 days (±6.45 SD; range 72-96 days), in line with data from the literature (Brichetti & Fracasso 2013, Cauli & Genero 2017, Katzner et al. 2020). The highest fledging age recorded was 96 days (nest F4, year 2010).

During the rearing of the youngs, nine prey species could be identified: among mammals the Wild Boar *Sus scrofa*, the Common Hare *Lepus Europaeus,* the Fox *Vulpes vulpes*, the Badger *Meles meles*, the Common Squirrel *Sciurus vulgaris* and the Weasel *Martes foina*; among birds the wild Pigeon *Columba livia f. domestica* and the common Pheasant *Phasianus colchicus* while among reptiles the Aesculapian snake *Zamenis longissimus*. In addition to the wild species, there were also some domestic animals such as the Turkey *Meleagris gallopavo f.*

Figure 3. Brood with three chicks (Furlo Gorge, 1997).

Table 2. Raw breeding values of Golden Eagles throughout the study period (1983-2023) for each monitored area.

	M. Catria	M. Nerone	Furlo Gorge	M. Petrano	Sasso Simone
Year of monitoring	40	29	34	11	2
No data years	1	7	3	0	0
Territorial pairs but not breeding	7	9	3	2	1
Territorial mated pairs but not breeding	2	4	2	0	0
Total fledglings (N=75)	26	12	27	9	1
Total fledglings mean	0.65	0.41	0.79	0.81	0.5

Table 3. Summary of breeding information across all sites within the study area during the monitored period (1983-2023) (e.g. Fasce & Fasce 2017).

Total checked breeding seasons	115
Reproductive events with laying	80 (69.6%)
Average breeding territories per pair	3.2 (n. 16; range 1-6)
Average elevation of nest	744 (n.16; range 518-1190 m)
Total fledged young	75
Productivity	0.65
Reproductive success	0.94
Fledging rate	1.14

domestica, the Cockerel *Gallus gallus f. domestica* and the domestic cat *Felis catus*.

DISCUSSION

The present work on the breeding behaviour of the Golden Eagle represents the first study at a provincial scale to span over a 40-year time (1983-2023). The study showed that the longest-established pairs occupied almost all the main provincial mountain areas characterised by morphologically optimal territories for the species (presence of incised valleys, accentuated slopes and differences in height, high availability of cliffs, presence of large cacuminal meadows). The detected pairs show a tendency to optimise reproduction by nesting in the same locations as in previous years, probably also because these locations offer a wide choice of suitable or ideal nesting sites. This results in a low average distance between breeding sites within the same pair across breeding seasons.

Our observations confirmed the preference of the species for nesting on rocky walls with ledges, niches and terraces, as in the rest of the national territory (Pandolfi & Giacchini 1995; Angelini & Giuliani 2001; Pedrini & Sergio 2001, Brichetti & Fracasso 2018). The infrequency of cave nesting (only 1 case in our study) probably correlates to the scarce availability of this type of habitat in the study area, whose use is common especially in Veneto region (Tormen & De Col 2017). The abundance of walls in the study area and the absence of old-growth forests make tree nesting unlikely, and this is an uncommon occurrence even in the Central Apennines (where plants of considerable height are used; Ceccarelli & Agostini 2017).

The range of the number of nests used per pair is entirely comparable to the one found by Angelini & Giuliani 2001 e Bionda 2017. The use of the nest N2 for several consecutive years and at various times is in apparent contradiction with the species' tendency to alternate nests (Fasce 1988, Brichetti & Fracasso 2013, Katzner et al. 2020), interpreted as a defensive behaviour against parasitosis (Newton 1997, Watson 2010). The continuous use of this nest could be explained by the low sun exposure, as the nest is located in a very sheltered niche. The occurrence of several alternative nests is an important visual sign of territory occupation (Watson 2010), which is even more accentuated by a particularly voluminous secular nest (F5) in the Furlo Gorge. This nest is the largest and most well-known in the study area (Fig. 4). Its size, when compared with that of other nests described in the literature (5.2 m height of the tallest Scottish nest; Brown 1976; 6.0 m of two nests in British Columbia, Canada, and Wyoming, USA, Bent 1937, Ellis 1986); 7.0 m of a nest in Montana, USA, Ellis et al. 2009), make it one of the largest at national and European level, as well as one of the oldest: the nest has in fact been standing for at least a century and a half, therefore for longer than the 48 years of nest use cited by Katzner et al. 2020 for Scotland.

The density of the species in the study area is 6 pairs/1000 km^2, higher than the density found for Abruzzo region (3.5 pairs/1000 Km^2, Artese et al. 2017) and for the Northern Apennines (2.5-4.6 pairs/1000 Km^2; Schiassi et al. 2013, Nardelli 2017). Although such studies used different methodologies to calculate the total area on which to estimate pair density, the area we calculated on the isohypsa 400 m a.s.l. may be overestimation, supporting the indication that the pair density may actually higher than in other Apennine areas. These differences in reproductive values between other Apennines areas and the ones monitored in this study, which are relatively close to one another, and belong to the same mountain range seem to reflect an uneven distribution of resources (e.g. better trophic and orographic conditions, and greater availability of suitable habitats our monitored areas). This is also the case in the Alpine and pre-Alpine areas in the central-eastern Alps (Pedrini & Sergio 2002). The high density in Pesaro-Urbino can be explained by a favourable territory quality for the Golden Eagles (Fasce & Fasce 2004), characterised by a good and stable availability of prey, supported by the fact that there was not a single year without egg laying within the study period. Additionally, in this

Figure 4. Furlo Gorge (M. Paganuccio), historical nest-F5 (2014 and 2007).

region numerous suitable nesting sites are present, which can allow to cope with the different weather conditions across years (Dunk et al. 2019).

The average elevation of the nests is similar to that found in other areas of the Apennines (860 m a.s.l. in the Umbrian-Marche Apennines, Angelini & Giuliani 2001; 868 m a.s.l. in Sicily, Brichetti & Fracasso 2018; 755 m a.s.l. in Aspromonte, Martino et al. 2017), suggesting that the nest height is stable in relation to the elevation of the mountain peaks above them (i.e. Borlenghi et al. 2014). Indeed, the vertical development of this chain is modest if compared to the Alps, where the breeding sites are located on average at higher elevations (Tormen & De Col 2017; Pedrini & Sergio 2001).

Several breeding sites are located on slopes exposed to the SE and SW, unlike what has been found by other authors in the central Apennines (Armentano & Ragni 1981, Ragni et al. 1986), which have shown preference for shaded exposures (N, N, N, NE and E); shelter from prolonged sunlight is considered a positive factor, especially during the rearing of chicks (Watson 2010). However, in majority of cases, the shading of the nests was ensured by the vegetation or by the morphology of the territory. In the monitoring location of M. Petrano, for example, the nest is sheltered from the sun by the trees and vegetation that grow higher up on the top of the ridge, while the nests of the Furlo Gorge are in the shade for most of the day, apart from a nest very sun-exposed, that had been abandoned. We hypothesize that the earlier egg laying date observed in this site compared to other, more inland territories, can be linked to the greater proximity to the sea and lower elevation.

Both reproductive success (0.94 chicks/laying pair) and productivity (0.65 chicks/pair) show values that are among the highest when compared with those found in other works, in particular within the Apennine range (for the northern Apennines: reproductive success 0.76, productivity 0.51, Nardelli 2017; for the Umbria-Marches Apennines: productivity 0.55, Angelini et al. 2017; reproductive success 0.82, productivity 0.58, Borlenghi 2017). The high percentage of occurrences with two fledged chicks (13.6% of successful nesting, N = 9) contributed to such high values. Moreover, out of 23 chicks that died before fledging (23.5% of the hatched chicks born) only two died from cainism (both in two nests in the Furlo Gorge and within the first 20 days of age, as described by Watson 2010). Taken together, these data can be interpreted as an indication of good trophic capacity of the territory (Newton 1997, Watson, 2010, Clouet et al. 2017). In this regard, the observations of prey deliveries to the nest confirmed the species reported by Angelini & Giuliani 2001 and Pandolfi et al. 1996.

The long-term monitoring of the Golden Eagle in the province of Pesaro-Urbino, although limited to a small population, has allowed to acquire the main reproductive biology parameters and shown an increase in the breeding pairs and the colonisation of new territories. This increase is also confirmed in Apennine regions in close geographical continuity with our study area (Angelini et al. 2017; Nardelli 2017; Artese et al. 2017). Important changes in national legislation on fauna and the establishment of protected areas have led to a stricter regime for the protection of these raptors, their prey and the mountain habitats in which the species concentrates its vital activities. This has probably contributed to an improvement of the demographic state, since its dramatic status at the end of the 70s of the last century due to illegal killings. We believe that the significant attenuation of this conflict is largely attributable to the depopulation of the mountains, which has been followed by the gradual increase of available habitats for wild animal populations, and therefore also for the Golden Eagle's prey species (Borlenghi et al., 2014).

The data collected indicate that the settled territories, which have occupied many of the mountain sectors suitable for the species, currently ensure the breeding population positive reproductive outputs, despite the most common threats for this species persist in the area: the ingestion of prey poisoned by rodenticides and lead, electrocution and disturbance - caused by hikers, rock climbers and photographers - which can lead to the abandonment of nests (Viggiani 2001), to a less frequent use of them (Borgo 2001) or to a decrease in parental care (Steidl & Anthony 2000, Arroyo & Razin 2006, González et al. 2006). In the study area, in addition to these factors, there is the deterioration of the summit meadows (M. Catria and M. Petrano), due to, among other things, tourism infrastructure (M. Petrano, M. Catria and M. Nerone) and noise pollution from motor vehicles (Furlo Gorge). The return of the species to the northern range of our study area (M. Carpegna-Sasso Simone and Simoncello, an area with documented historical presence of the raptor), and the frequentation of the Tuscany-Marches ridge by a young territorial pair, indicate that the process of recolonization of the Apennines is still ongoing. Therefore, we believe it is essential to enhance monitoring of Golden Eagle breeding activity and human disturbance in this area to obtain an accurate picture of the Golden Eagle distribution in the Marches Apennines and the challenges they may be facing.

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