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## Second-calendar-year Eleonora's Falcons attending breeding colonies in Sicily

**Abstract** Surveys of breeding colonies of Eleonora's Falcons *Falco eleonorae* in the Aeolian and Pelagie Islands, Sicily, showed an unexpectedly high proportion of second-calendar-year (2CY) birds attending breeding colonies. On average, around 20% of all aged birds at breeding colonies were 2CYs. There is evidence that this proportion is increasing at one colony, which may be an early warning signal of colony decline. Some birds attempted to breed in their second-calendar-year; the outcome of these pairings is unknown.

The Eleonora's Falcon *Falco eleonorae* breeds on offshore islands throughout the Mediterranean basin, locally along the Atlantic coast of Morocco and in the Canary Islands (Cramp & Simmons 1980; Snow & Perrins 1998; Thévenot *et al.* 2003). More than 80% of the species' world population (of around 12,300 pairs) breeds in Greece (Dimalexis *et al.* 2008). In Italy it is a scarce breeding bird with an estimated population of 500–600 breeding pairs (Spina & Leonardi 2007). Around 150 pairs breed on islands off the coast of Sicily (e.g. Corso 2005, Corso & Gustin 2009a,b, Corso & Penna 2009), the majority in the Aeolian (Lipari) Islands. During observations of breeding colonies, we monitored the age profile of both breeding pairs and attendant non-breeders. The proportion of second-calendar-year (2CY) birds was much higher than expected, as was the number of such birds attempting to breed. If the proportion of adult and young birds at breeding colonies is changing over time, this may provide an early indication of population decline.

### Study area and methods

Breeding colonies on the islands of Salina, Alicudi, Panarea and Filicudi in the Aeolian archipelago were visited at least three times a year between August and October, the Salina colony over a 13-year period (1998–2010) and the other colonies over five years (2005 and 2007–10). A colony on Lampedusa (Pelagie Islands) was visited on three occasions in September and October in both 2005 and 2007, and on three occasions between July and October in the years 2008–10 (Corso & Gustin 2009a,b). The total number of birds was recorded during each visit and they were

aged whenever possible. Observations at all colonies were made from the coastline and from a small boat using 10x binoculars; a telescope was also used for land-based observations.

The data presented here are taken solely from counts in October, which is the end of the breeding season and when the total number of birds present is highest. The total number of birds and the maximum number of adult and 2CYs at each site was recorded. In the case of 2CYs, only those individuals seen well enough (in good light and at close range) to establish the age beyond doubt are included. Unmated 2CY birds are generally more active around colonies than breeders, and consequently are detected more readily. However, some 2CY birds do attempt to breed, often with older birds, making it difficult to establish the exact numbers present. The maximum count was taken as the highest number of birds observed simultaneously, usually before dusk or just after rain, when birds were hunting flying ants, dragonflies or migrating passerines.

### Ageing criteria

Until they moult, 2CY Eleonora's Falcons retain juvenile primaries, secondaries, tertials and rectrices; with good views they are readily recognised by the conspicuous dark banding on the underside of the flight feathers and the upper surface of the tail (Clark 1999; Forsman 1999; Corso 2004). Adult plumage is acquired during the first complete moult, which begins in the birds' second autumn (when they are 12+ months old). Birds in their third calendar-year differ from 2CY birds by their darker and unmarked tail and uniformly dark tertials, as

**Table 1.** Number of Eleonora's Falcons *Falco eleonora* at breeding colonies on Salina in October, 1998–2010. Numbers in parentheses show the estimated maximum number of breeding pairs present.

Year	No. breeding pairs	No. birds aged	No. adult birds ( $\geq 3$ CY)	No. 2CY birds	% 2CY
1998	25 (28)	42	39	3	7.1
1999	20 (25)	22	19	3	13.6
2000	25	37	33	4	10.8
2001	20	40	32	8	20.0
2002	19 (22)	29	22	7	24.1
2003	13 (15)	21	13	8	38.0
2004	9 (10)	20	14	6	30.0
2005	8 (10)	21	17	4	19.0
2006	7 (8)	14	9	5	35.7
2007	5	10	8	2	20.0
2008	4 (6)	8	7	1	12.5
2009	4 (6)	8	6	2	25
2010	5	10	7	3	30
mean	12.6	21.7	17.4	4.3	19.9

well as the extent of moult, wing- and tail-shape profiles, and structure (Conzemius 2000; Corso 2004; Ristow 2004).

## Results

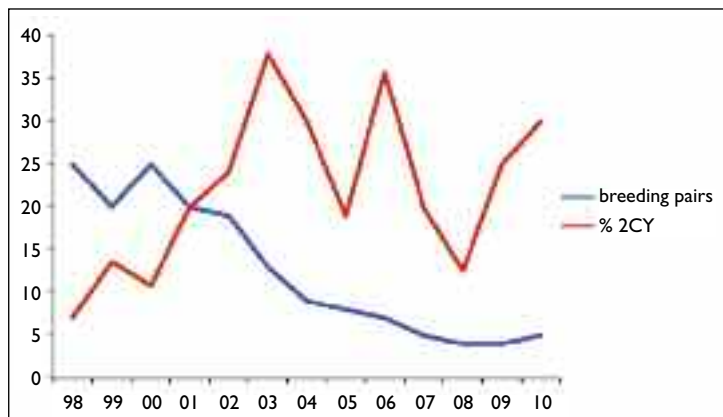
### Salina

The Salina colony was surveyed annually during 1998–2010 (table 1). During the study period the proportion of 2CY birds increased (fig. 1) while the number of breeding pairs declined. In total, 30 2CY birds were observed to be paired and involved in breeding activities over the 13 years; most (90%) were 2CY females paired with adult males. The breeding success of these younger birds is unknown. Overall breeding success at this colony has declined from 1.65 young fledged per breeding pair in 2000 to less than 0.40 in recent years (Corso & Gustin, 2009b, in prep.).

### Lampedusa

Numbers of Eleonora's Falcons on Lampedusa have been fairly stable for many years (Corso 2005; Corso & Gustin 2009a,b), although breeding success has generally been rather poor (ranging from 0.8

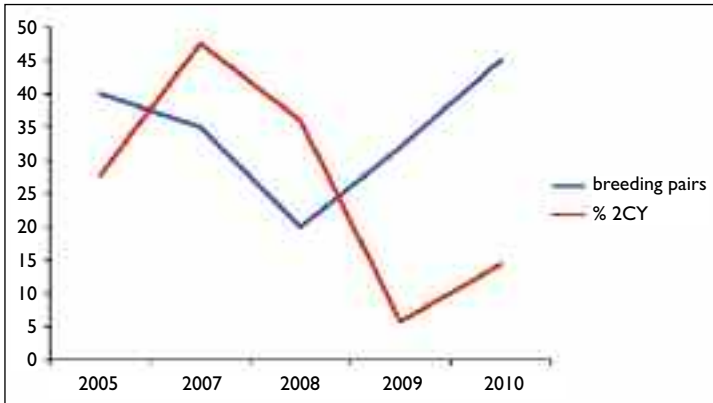
to 1.5 young fledged per breeding pair; Corso & Gustin 2009b). At this colony, 2CY birds comprised on average 22% of the total in the study years (table 2). At 47.6% in 2007, Lampedusa held the highest percentage of 2CYs recorded from any Sicilian breeding site. In contrast to the results from the Salina colony, the proportion of 2CYs attending the colony declined during the study period (fig. 2) as the number of breeding pairs rose, although the marked year-to-year variation obscures clear trends. In 2005, 19 2CYs were sexed as female and six as male; at least 14 were mated with adults and involved in breeding activities. Over five breeding seasons, no less than 45% of 2CYs were observed attending nests.



**Fig. 1.** The number of breeding pairs and percentage of 2CY Eleonora's Falcons at the Salina colony, 1998–2010.

**Table 2.** Number of Eleonora's Falcons *Falco eleonorae* recorded at Lampedusa during October visits in 2005 and 2007–10, together with the number of adult and 2CY birds recorded. Numbers in parentheses show the estimated maximum number of breeding pairs.

Year	No. breeding pairs	No. birds aged	No. adult birds ( $\geq 3$ CY)	No. 2CY birds	% 2CY
2005	40 (51)	90	65	25	27.8
2007	35 (44)	42	22	20	47.6
2008	20 (35)	25	16.9	36.0	
2009	32 (43)	86	81	5	5.8
2010	45 (50)	70	60	10	14.3
mean	34.4	62.6	48.8	13.8	22.0



**Fig. 2.** The number of breeding pairs and percentage of 2CY Eleonora's Falcons at the Lampedusa colony, 2005–10.

**Alicudi**

Alicudi holds the largest breeding colony of Eleonora's Falcons in the Aeolian archipelago. The number of breeding pairs increased from 1997 (25–28 pairs) to 2009 (40–50 pairs, where the range given shows first the number of pairs counted, and second the number of pairs estimated to be present), although during this time breeding success declined from 1.8 to 0.6 young per breeding pair, a similar pattern to that observed on Salina (Gustin *et al.* 2005; Corso & Gustin 2009a,b). Note that birds are difficult to age accurately at this colony, and thus the sample of aged birds varies (table 3) – but the proportion of 2CY birds increased between 2005 and 2009, coinciding with the continuing rise in number of pairs and the decline of the Salina colony. Disturbance from tourist activities may have prompted birds to relocate from Salina to Alicudi.

**Discussion**

At a breeding colony in the Aegean Sea, Wink *et al.* (1987) and Wink & Ristow (2000) aged

4.5% of birds as 2CY, while Ristow *et al.* (1989a) found that just 3% of birds were 2CY at a colony in this same region. They considered that the vast majority of 2CY birds in the Aegean colonies were not breeding, although Ristow *et al.* (1989b) reported that 3CYs comprised up to 30% of the breeding population. The proportion of 2CYs

attending Sicilian colonies is thus substantially higher than at those Aegean colonies, as is the number of such birds attempting to breed. Ristow & Wink (1985) and Wink & Ristow (2000) found that 2CY Eleonora's Falcons disperse widely during their first summer, often ranging far from breeding colonies, while 3CYs are faithful to their natal colony.

The age structure of a breeding population is likely to affect the overall reproductive success of a colony and Ferrer *et al.* (2003) suggested that changes in the age of first breeding can be used as an 'early warning signal' to detect possible changes in population trends in long-lived species – with an increase in immatures often preceding a population decline. This could be the case for Eleonora's Falcons on Sicily. At least on Salina, at the most thoroughly surveyed colony, the proportion of immatures is rising, while the number of breeding pairs and average breeding success are in decline (table 1).

**Table 3.** Maximum number of Eleonora's Falcons *Falco eleonorae* recorded at five Sicilian breeding colonies during October visits in 2005 and 2007–09, together with a breakdown of the number of adult and 2CY birds recorded.

Breeding site	Year	No. birds aged	No. adults ( $\geq 3$ CY)	No. 2CYs %	2CY
Panarea	2005	6	6	0	0
Panarea	2007	15	10	5	33.3
Panarea	2008	15	10	5	33.3
Panarea	2009	20	17	3	15
Filicudi	2005	11	11	0	0
Filicudi	2007	27	21	6	22.2
Filicudi	2008	10	7	3	30
Filicudi	2009	25	21	4	16
Alicudi	2005	80	75	5	6.3
Alicudi	2007	57	48	9	15.8
Alicudi	2008	20	16	4	20
Alicudi	2009	30	21	9	30
<b>Total</b>	<b>2005</b>	<b>208</b>	<b>174</b>	<b>34</b>	<b>16.3</b>
<b>Total</b>	<b>2007</b>	<b>151</b>	<b>109</b>	<b>42</b>	<b>27.8</b>
<b>Total</b>	<b>2008</b>	<b>78</b>	<b>56</b>	<b>22</b>	<b>28.2</b>
<b>Total</b>	<b>2009</b>	<b>169</b>	<b>146</b>	<b>23</b>	<b>13.6</b>

Since breeding success in the Aeolian colonies has been quite low in recent years, some (perhaps many) of the 2CYs may originate from other colonies. The proportion of 2CYs also suggests relatively high adult mortality; certainly this seems to be higher at Sicilian than in Aegean colonies, perhaps due to factors such as increased hunting pressure in the central Mediterranean basin or longer sea/desert crossings (Walter 1979). The population of Eleonora's Falcons in Sicily is in decline and we consider it important to raise awareness of potential problems and stress the need for conservation measures at breeding sites, especially the prevention of unnecessary disturbance. We hope that this short paper will highlight these concerns, and reinforce the need for continued monitoring.

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