

# Altitudinal distribution and source areas of Corsican Finches *Carduelis corsicanus* on several Mediterranean Islands

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## Introduction

The Corsican Finch *Carduelis corsicanus* was for long time treated as conspecific to the Citril Finch *Carduelis citrinella*, but its apparently independent evolutionary history has conferred it the status of an own species under the super-species *Carduelis [citrinella]* (Sangster *et al.* 2002, Förschler/Kalko 2007, Förschler *et al.* 2009). The world-wide range of the Corsican Finch is restricted to only five regularly settled Mediterranean islands (Tab. 1): Corsica, Sardinia, Capraia, Elba and Gorgona (Arcamone 1993, Cramp / Perrins 1994, Lambertini 2000, 2002, Moltoni 1975, Thibault / Bonaccorsi 1999, Whitehead 1885). Its population size is relatively small and estimated to range between 30,000 and 150,000 individuals (BirdLife International, 2007). The core population is located on Corsica, with at least 10,000 breeding pairs (Thibault / Bonaccorsi 1999).

According to the so-called insular syndrome (Blondel 2000) Corsican Finches, in contrast to mainland Citril Finches, show a niche expansion into more open habitats (Blondel *et al.* 1988; Förschler/Kalko 2006b, Martin 1992) and lower elevations (Marzocchi 1990, Thibault 1983, Thibault/Bonaccorsi 1999). In these areas, sometimes far away from conifer forest, Corsican Finches exploit herbs and grasses as alternative food sources to pine seeds (Förschler/Kalko 2006a). Tree Heath *Erica arborea* and other small bushes such as Broom *Genista salzmannii* and Bramble *Rubus ulmifolius* are used as nesting plants (Förschler/Kalko 2006b). Altogether, these ecological differences separate the Corsican Finch clearly from the Citril Finch, whose habitat selection is mainly restricted to higher elevated conifer forests of Mountain Pines *Pinus mugo*, Scot's Pines *Pinus sylvestris*, Black Pines *Pinus nigra* or Spruces *Picea abies* (Förschler/Kalko 2006a,b).

Corsican Finches settle five very distinct islands, which are all characterized by mountains. On Corsica the widest range of habitats is found reaching from warm Mediterranean coastal areas to truly alpine and steep mountain zones (Thibault/Bonaccorsi 1999). Sardinia has a similar variability of habitats, however the highest mountains are less cold than on Corsica and the lower regions are generally hotter. On the islands Elba, Capraia and Gorgona Mediterranean Macchia is dominating, but all these islands have prominent mountains with relatively cool climatic conditions.

Due to this variability in the habitat structure of the settled islands (Corsica, Sardinia, Capraia, Elba and Gorgona) we investigated the altitudinal distribution and abundance of Corsican Finches on Corsica and compared our data with observations obtained from Sardinia, Elba and Capraia. Our findings raise some questions on the status and population exchange of Corsican Finches on the distinct islands.

### Study areas

Corsican Finches were studied on the Corsican Island in different breeding seasons (April-June 2001 and May-June 2003; 50 excursion days). During daily full-time excursions we noted systematically the occurrence of birds at different elevations in order to determine their altitudinal distribution and abundance. Furthermore, we searched for breeding habitats and nesting sites to get an idea about the habitat selection of the spe-

cies on the island (see results summarized in Förschler/Kalko 2006b). For comparison we used unpublished data from several other Mediterranean islands: Elba (May 2000; 7 excursion days), Sardinia (April-June 2003; 30 excursion days) and Capraia (March-May 2003; 18 excursion days).

In total, 46 nests of Corsican Finches were found during the course of our study: 10 in Capraia, 12 in Sardinia and 24 in Corsica (Tab. 2, 3).

■ Tab. 1 Distribution of Corsican Finches in the Tuscan Archipelago, Sardinia and Corsica (adapted from Lambertini 2000, 2002) - Verbreitung des Korsenzeisigs auf dem Toskanischen Archipel, Sardinien und Korsika (verändert nach Lambertini 2000, 2002)

Island/Insel	Max. Height/ max. Höhe (in m)	Area/ Gebiet (in km <sup>2</sup> )	Distance to mainland/ Entfernung zum Festland (in km)	Corsican Finch occurrence/Korsen- zeisig Vorkommen
Corsica/ Korsika	2706	8722	83	very common/ sehr häufig
Capraia	447	19,5	54	common/häufig
Sardinia/ Sardinien	1834	24090	190	not common/ nicht häufig
Elba	1019	223,5	10	scarce/selten
Gorgona	255	2,2	34	scarce/selten
Giannutri	88	2,6	24	unsettled/unbesiedelt
Giglio	496	21,3	26	unsettled/unbesiedelt
Montecristo	645	10,4	65	unsettled/unbesiedelt
Pianosa	29	10,3	56	unsettled/unbesiedelt

■ Tab. 2: Occurrence of Corsican Finches during breeding season from April to June 2001/2003 at different elevations on Corsica - Vorkommen von Korsenzeisigen in unterschiedlichen Höhenstufen während der Brutzeit April bis Juni 2001/2003

Elevation (meters asl)	Time effort (minutes)	Number of observations	Observed birds	Birds per observation	Birds per time effort	Number of found nest
1-100	2320	3	7	2.3	0.003	0
101-200	1840	4	10	2.5	0.005	0
201-300	245	2	10	5	0.04	0
301-400	195	3	22	7.3	0.11	0
401-500	440	6	40	3.3	0.05	0

Elevation (meters asl)	Time effort (minutes)	Number of observations	Observed birds	Birds per observation	Birds per time effort	Number of found nest
501-600	495	7	44	6.3	0.08	0
601-700	855	7	83	11.9	0.1	0
701-800	490	14	114	8.14	0.23	0
<b>801-900</b>	<b>3995</b>	<b>43</b>	<b>1115</b>	<b>25.9</b>	<b>0.28</b>	<b>1</b>
<b>901-1000</b>	<b>1425</b>	<b>22</b>	<b>671</b>	<b>30.5</b>	<b>0.47</b>	<b>8</b>
<b>1001-1100</b>	<b>3065</b>	<b>23</b>	<b>252</b>	<b>11.0</b>	<b>0.08</b>	<b>15</b>
1101-1200	795	9	84	9.3	0.1	0
1201-1300	265	4	29	7.3	0.11	0
1301-1400	165	2	13	6.5	0.08	0
1401-1500	930	7	131	18.7	0.14	0

■ Tab. 3: Nesting plants of Corsican Finches found during our studies on Corsica (2001/2003), Sardinia (2003) and Capraia (2003) - Neststandorte des Korsenzeisiges während unserer Untersuchungen in Korsika (2001/2003), Sardinien (2003) und Capraia (2003)

Plant species/ Pflanzenart	Corsica/Korsika (n=24)	Sardinia/Sardinien (n=12)	Capraia (n=10)	Total (n=46)
Tree Heath/ Baumheide <i>Erica arborea</i>	16	9	10	35
Bramble/Brombeere <i>Rubus ulmifolius spec.</i>	2	1		3
Salzmann Broom/ Salzmann Ginster <i>Genista salzmanii</i>	2			2
Juniper/Gemeiner Wacholder <i>Juniperus communis ssp. nana</i>		2		2
Black Pine/ Schwarzkiefer <i>Pinus nigra ssp. laricio</i>	2			2
Maritime Pine/ Strandkiefer <i>Pinus pinaster</i>	1			1
Holm-oak/Steineiche <i>Quercus ilex</i>	1			1

## Results

Although Corsican Finches on Corsica were distributed from sea level up to the highest areas during the breeding season, most of the birds inhabited areas above 700 m a.s.l. The highest abundance of the species was found at elevations between 900-1000 m a.s.l. (Tab. 2). Here, the birds occupied mainly vast and rocky Tree Heath scrublands and semi-open conifer forests with Laricio Pines *Pinus (nigra) laricio*.

All the nests found during our study were located between 800 and 1100 m a.s.l. (Tab. 2) and were mainly built in Tree Heath vegetation (Tab. 3). Some nests were situated in Broom, Bramble, Stone Oaks *Quercus ilex*, Laricio Pine, and Maritime Pine *Pinus pinaster* (Tab. 3). In contrast to Corsica, Corsican Finches on Sardinia seem to be clearly restricted to higher elevations during the breeding season. In Northern and

Central Sardinia we found them in good numbers in the mountains of Monte Limbara above 900 m a.s.l., at Monte Masinniera and Monte Paidorzu above 900 m a.s.l. and in the massif de Gennargentu above 1400 m a.s.l.. Despite intensive search, we found only few birds below 900 m a.s.l., e.g. one individual close to the village of Tempio-Pausania (500 m a.s.l.), one at the pass between Calanganus and Berchidda (600 m a.s.l.), two at the pass of Scala Pedrosa (680 m a.s.l.) and one at very low elevation close to the Lago de Liscia (180 m a.s.l.). In North Sardinia, Corsican Finches settled mainly in habitats with Tree Heath and Maritime Pines whereas on the higher slopes of the central part of the island, they occupied alpine *Juniper* vegetation. The nests were mostly situated in Tree Heath vegetation, but also in Bramble and Juniper bushes (Tab. 3).



■ Abb. 1: Bruthabitat Cartalavonu Korsika (Bild: M. Förschler)

On the island of Elba we found indications of reproduction of the species (3-4 pairs with singing and song-flying males) exclusively along the western slopes of Monte Capanne (900 m a.s.l.), in rocky Tree Heath scrubland intermixed with some Maritime Pines. Our single observation in lower elevations was one over-flying individual in coastal Macchia close to the village of Fetovaia (100 m a.s.l.). In the time of our stay on Elba we were not able to discover nesting sites.

In our systematic search for Corsican Finches on Capraia from sea level to the highest mountain slopes (Monte Castello, 445 m a.s.l.) birds appeared mainly in vast Tree Heath Macchia above 200 m a.s.l. Here the species was rather abundant. The lowest localities with only few Corsican Finches were noted around 100 m a.s.l. We found 10 nests on the island, most of them at elevations between 200-400 m a.s.l. and all located in Tree Heath shrubs (Tab. 3). Interestingly, some pairs preferred – untypical for the species – Tree Heath bushes in totally inaccessible rocky cliffs (controlled only with binoculars) on the West and Northwest coast as nesting sites, which provided diversified microclimatic conditions on a small scale due to the exclusion of direct sunrays (pers. obs.).

### Discussion

The altitudinal occurrence of Corsican Finches during breeding season on the four studied islands differed considerably. Birds in Corsica were found from sea level up to the nearly treeless higher mountain slopes, although most of them occurred at higher altitudes (800-1500 m a.s.l.). This pattern confirms the remarks by Jourdain (1911) and contrasts the general view that Corsican Finches live and reproduce on Corsica equally in all elevations and all types of low vegetation habitats (Cramp/Perrins 1994, Thibault/Bonaccorsi 1999). Some arguments

could help us to explain these findings. We suppose that the Corsican Finches breeding at higher altitudes represent the reproductive basis of the population and that the observation of breeding pairs at lower elevations may be seen more as a kind of opportunistic behaviour under good weather and food conditions in early spring, a scenario which has also been described for Citril Finches (Borras/Senar 1991, Jouard 1930). The occurrence of birds in lower parts may be caused therefore by reproductive overspill of populations in high quality mountain areas (Blondel *et al.* 1988). This hypothesis is supported by the fact that most of the birds observed in lower elevations during the reproduction period were subadult (second calendar) birds. Inexperienced younger individuals of the closely related Citril Finch on the mainland are often ousted to low quality habitats (Förschler 2002) and are known to breed rather unsuccessful in their first year (Förschler/Kalko 2006c).

In the other studied islands, Corsican Finches showed very similar distribution pattern to that observed in their mainland counterpart, the Citril Finch. Contrary to Corsica, birds on Sardinia and Elba occurred exclusively in the highest mountains (Förschler/Kalko 2006b). Corsican Finches on Sardinia breed only in mountainous areas above 800 m a.s.l., where Black Pines, Juniper *Juniperus communis nana* and Tree Heath shrubs constitute the habitat. They are very rarely seen in lower areas, even in winter (S. Nissardi and N. Baccetti pers. comm.). Therefore Corsican Finches in Sardinia seem to be more or less restricted to the highest peaks of the island, especially the Gennargentu Massif in Central Sardinia and some isolated higher mountain ranges in the north (Monte Limbara) and the south (Monte Arcosu) of the island (S. Nissardi and N. Baccetti pers. comm. and pers. obs.). Accor-

ding to the observations in Sardinia, breeding of Corsican Finches on Elba is more or less restricted to the mountain peaks of Monte Capanne (800-1000 m a.s.l.), occupied with vast Tree Heath scrubland (Lambertini 2000, 2002, N. Baccetti pers. comm.). Conditions in the lower areas of Sardinia and Elba are presumably too hot and too dry for this mountain species and/or the population pressure of the reproductive areas in the mountains is much lower than on Corsica. According to the altitudinal distribution of Corsican Finches in the different islands during breeding season, we suppose that the main part of the population consists of "real" mountain birds. The case of Capraia is therefore of special interest, since here the individuals do not have the opportunity to settle in higher montane or subalpine areas. This fact could raise some questions about the way the birds cope with this totally different cli-

matic situation. One of the main questions is, if they are able to maintain their population size constant or whether they need continuous immigration of birds from Corsica. On Capraia (max. height: 447 m a.s.l.), we found Corsican Finches from nearly sea level up to the highest peaks during breeding season. However, the relative abundance of the species increases also with elevation and the main part of the breeding population occurred in areas above 200 m a.s.l.

Due to their "mountain nature", Corsican Finches on Capraia seem to avoid warm and unfavourable conditions alternating between the hot and sunny eastern and southern slopes and the shady and windy cliffs with lower temperatures of the western and northern coast of the island. This could explain why birds at the steep and mountainous islands of Capraia and Gorgona (see Tab. 1) are able to breed also at lower elevations,



■ Abb. 2: Bruthabitat Monte Limbara Sardinien (Bild: M. Förschler).

whereas conspicuously other close-by islands of the Tuscanian Archipelago with fewer mountainous structures (Giannutri, Giglio, Pianosa, Montechristo) are practically unsettled (Lambertini 2000, 2002, N. Baccetti pers. comm., Tab. 1).

### Conclusions

To discern population dynamics of Corsican Finches on the distinct islands, in future detailed “sink and source” studies between the different sub-populations living in distinct habitats and various elevations would be necessary. We may expect that the small populations on Elba, Capraia and Gorgona are lastly not self-preserving, but dependent on regular dispersion of juvenile birds from the core population of Corsica. Furthermore, all breeding attempts in lower areas could be mostly the result of a general overspill of the population at higher elevations.

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### Abstract

Despite being rather abundant on some Mediterranean Islands, the Corsican Finch has been only poorly studied. In comparison to its mainland counterpart, the Citril Finch, Corsican Finches are known to settle not

only in mountainous areas, but have expanded their habitat choice into low Macchia vegetation across all altitudes due to a general niche expansion (insular syndrome). We describe the altitudinal distribution pattern of Corsican Finches on the Corsican Island and compare it with observations for other islands settled by the species: Sardinia, Elba and Capraia. In Elba and Sardinia Corsican Finches appear to be restricted mainly to the highest elevations. In Corsica and Capraia they occur at all elevations, although the main part of the breeding population on Corsica is drawn as well to mountainous areas. These observations suggest that the high reproductive output in these zones (source areas) may support breeding areas in lower elevations (sink areas). Moreover, we suppose that the small populations on Elba and Capraia are probably not self-preserving, but might depend on regular immigration due to dispersion from the core population of Corsica. To discern the population mechanisms of Corsican Finches on the four islands, detailed studies on sink and source mechanisms of the various populations breeding in distinct habitats and on different elevations would be challenging.

### Zusammenfassung

*Höhenverbreitung und Quellgebiete des Korsenzeisigs (Carduelis corsicanus) auf verschiedenen Mittelmeerinseln. - Im Gegensatz zu seinem nahen Verwandten, dem Zitronenzeisig (Carduelis citrinella), besiedelt der Korsenzeisig nicht nur die höheren Gebirgslagen, sondern auch die niedriger gelegenen Macchia-Gebiete. Diese Nischenerweiterung in der Habitatwahl wird mit dem sogenannten Inselsyndrom erklärt. (Bei Inselpopulationen treten häufig komplexe Verhaltensänderungen im Vergleich zu benachbarten Festlandspopulationen*

auf). Im Frühjahr 2001 und 2003 untersuchten wir die Höhenverbreitung des Korsenzeisigs auf Korsika und auf den Nachbarinseln Sardinien, Elba und Capraia. Während wir auf Elba und Sardinien die Korsenzeisige überwiegend in den höchsten Lagen antrafen, sind die Vorkommen auf Korsika und Capraia über alle Höhenstufen verteilt. Allerdings liegt der Schwerpunkt der Verbreitung auf Korsika ebenfalls in den höheren Lagen. Wir vermuten, dass die bessere Fortpflanzungsrate in den Optimalhabitaten der Hochlagen (source area – Quellgebiet) zu einem Populationsüberschuss führt, der in die weniger geeigneten, tieferen Lagen (sink areas – Senken) ausweichen muss. Ferner ist anzunehmen, dass die kleinen Populationen auf Elba und Capraia sich nicht dauerhaft selbst erhalten können und eine regelmäßige Einwanderung von Jungvögeln (Dispersion) aus der Kernpopulation von Korsika stattfindet. Es wäre zweifellos lohnend, die Populationsmechanismen in den „source and sink areas“ auf den verschiedenen Inseln genauer zu untersuchen.

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