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INTER-LOCALITY VARIATION IN BREEDING PHENOLOGY AND NESTING HABITAT OF THE CITRIL FINCH *CARDUELIS CITRINELLA* IN THE CATALONIAN PRE-PYRENEES

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SUMMARY.—*Inter-locality variation in breeding phenology and nesting habitat of the citril finch* Carduelis citrinella *in the Catalonian Pre-Pyrenees.*
Aims: Considerable variations have been found amongst several citril finch sub-populations at Port del Comte mountain in the Catalonian Pre-Pyrenees in reproductive success, body mass, fat score, diet, survival rate and speed of moult due to different habitat quality and different slope exposition. In line with these studies, the aim of this study was to investigate variations in breeding phenology and nesting habitat between north-facing high quality areas (Vansa) and south-facing low quality areas (Bofia) as well as east-facing areas of intermediate quality (Port Comte / Sucre). Since the species habitat requirements have been little studied before, another aim of this study was the recording of some basic data on the phenology of this species and its nesting habitat in Spain.
Location: The slopes of Port del Comte mountain (Catalonian Pre-Pyrenees).
Results and Conclusions: As expected, variations were found in breeding phenology and nesting habitat. Birds on the moister and cooler north-and east-facing slopes (Vansa, Port Comte) started breeding earlier than did birds from the drier and sunnier south-facing slopes (Bofia). All nests at the slightly more elevated locality of Bofia were built in mountain pines *Pinus mugo*, while at the other two study sites a small proportion of the nests were also situated in scots pines *Pinus sylvestris*. Nests were built mainly in the top of the trees or in large side branches at a similar height above ground. At Bofia solitary trees were more often used instead of tree groups or forest than at the other sites. Furthermore, nests were situated at greater distance from each other and the proportion of subadult birds with breeding activity was higher at Bofia.

Key words: Citril finch, *Carduelis citrinella*, breeding phenology, nesting habitat, inter-locality variation.

RESUMEN.—*Variación entre localidades en la fenología reproductiva y en el hábitat de nidificación en el verderón serrano* Carduelis citrinella *en los pre-pirinéos catalanes.*

Objetivos: Con anterioridad, se han encontrado considerables variaciones entre distintas subpoblaciones de verderón serrano en el Port del Compte (pre-pirinéos catalanes), en éxito reproductor, peso corporal, grasa corporal, dieta, probabilidad de supervivencia y en la velocidad de muda. Estas diferencias se deben por una lado a diferencias en la calidad del hábitat, y por otro a diferencias en la exposición de la ladera de la montaña. En línea con estos resultados previos, el primer objetivo de este estudio fue estudiar las variaciones en la fenología reproductiva y en el hábitat de nidificación entre la pendiente norte que representa un hábitat de alta calidad (Vansa) y la pendiente sur que representa un hábitat de baja calidad (Bofia), teniendo como población intermedia una población localizada en la ladera este de la mon-

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taña (Port Comte / Sucre). Debido a que los requerimientos de hábitat han sido poco estudiadas, el segundo objetivo del presente estudio fue el registrar los datos básicos de la fenología reproductora y el hábitat de nidificación de esta especie en España.

Localidad: Las laderas del Port del Comte (pre-pirinéos catalanes).

Resultados y Conclusiones: Como era esperado, se encontraron diferencias en la fenología reproductora y el hábitat de nidificación entre las distintas poblaciones estudiadas. Las parejas que se reproducen en la ladera norte y este, que presentaban un mayor grado de humedad y una temperatura menor (Vansa, Port Comte) iniciaban su reproducción antes que las parejas situadas en la ladera sur (Bofia) que es más seca y soleada. Todos los nidos de Bofia se encontraron en *Pinus mugo*, mientras que en las otras localidades hubo un porcentaje de nidos tambien situados en *Pinus sylvestris*. Los nidos se situaron principalmente en la parte alta de los árboles o en las ramas laterales grandes a una altura similar. En Bofia, en comparación con las otras localidades, se utilizaron más frecuentemente los árboles solitarios que los grupos de árboles. Además, en esta localidad, los nidos se encontraron a mayor distancia entre sí y el porcentaje de subadultos reproductores fue mayor que en las otras poblaciones estudiadas.

Palabras clave: Verderón serrano, *Carduelis citrinella*, fenología reproductora, habitat de nidificación, variación entre localidades.

INTRODUCTION

The distribution of the citril finch *Carduelis citrinella* is in the boreal mountain zones of western temperate Europe (Cramp and Perrins, 1994). Some of the highest breeding densities are found in the Pyrenees (Baccetti and Märki, 1997). Most birds nest in loose breeding groups of 5 to 25 pairs. Characteristically, there are often unoccupied areas between breeding spots of the species, which are in potentially suitable habitats (Förschler, 2002a; Dorka, 1986; Glutz von Blotzheim and Bauer, 1997). The population of the Port del Comte mountain in the Catalonian Pre-Pyrenees was estimated in 2002 to be about 1200 to 2400 citril finch pairs, based on estimates of settlement densities in sample areas. This makes it one of the most densely settled areas of the species in Spain (Borras and Senar, 2002; Borras *et al.*, 2005).

The slopes of Port del Comte mountain show an important bioclimatical contrast between hygrophilous and cooler north-facing, and more xerophyllous and sunnier south-facing facing slopes (Gutiérrez, 1991; Borras and Junyent, 1993). In over 10 years of capture-recapture studies at Port del Comte mountain, Senar *et al.* (2002) and Borras *et al.* (2004) found notable differences in the speed of moult, body condition, survival rate and wing morphology, as well as asymmetric population exchange between the two subpopulations located on the same mountain at a distance of only 5 km (Senar *et al.*, 2002). Furthermore, birds at the north-facing locality (Vansa) were found recently to rely more on mountain pine seeds *Pinus uncinata* than birds on the south-facing locality (Bofia), which feed more on a series of herb seeds (Borras *et al.*, 2003). Finally, these differences in inter-locality variation manifest themselves also in significant variations in reproductive success between the breeding groups of north-facing Vansa with high success, and south-facing Bofia with low breeding success (Förschler *et al.*, 2005).

Since habitat quality is known to differ considerably between the various areas at Port del Comte mountain (Gutiérrez, 1991; Borras and Junyent, 1993; Senar *et al.*, 2002; Borras *et al.*, 2003), it may be supposed that those environmental conditions may also have effects on breeding phenology and nest habitat of the species. Furthermore, up to now, the nesting habits of citril finches have been rarely studied. Therefore, analysis was carried out of data on the breeding phenology and nesting habitat of citril finches, these data obtained during a study on reproductive success (Förschler *et al.*, 2005) at the three localities of Port del Comte mountain: Vansa (north-facing slope), Bofia (south-facing slope) and Port Comte / Sucre (east-facing slope).

MATERIAL AND METHODS

Searching for nests

Between April and June 2002, citril finch nests were searched for systematically during nest building time on three localities of Port del Comte mountain. These comprised the north-facing slope at the skiing resort Vansa / Prat Llong, a high-quality locality (Senar *et al.*, 2002), the south-facing slope of Bofia, a low-quality locality (Senar *et al.*, 2002) and the east-facing slope of Port Comte as well as the skiing area Sucre, areas of intermediate quality for citril finches (Förschler *et al.*, 2005). Most nests were found by following the females that were engaged in nest building.

Nest parameters

When a nest was found, the following parameters were noted: slope inclination, elevation, tree species, height, shape of tree, position and structure of nest, nest height, distance of nest to main trunk and to end of nest branch, exposition of nest and nesting tree, slope inclination at the nesting site, beginning of nest building (pentad), first, second or repeat clutch, and age of nesting birds. For each nesting site the following parameters of the nest surrounding were documented as well: distance of the nest to permanent water resources, salt uptake places and important food sources, distance to open space, to tracks and forest edges, as well as distance to simultaneously used nests of neighbouring pairs.

Age combination of nesting pairs

Whenever possible, the age of nesting birds was determined, especially during nest building, by means of typical plumage marks. Subadult birds (2nd calendar year) can be distinguished under good observation conditions from adult birds (3rd calendar year or older) by the whitish coloration of some greater wing coverts (Jenni and Winkler, 1994; Glutz von Blotzheim and Bauer, 1997).

Statistical analysis

Statistical comparison was carried out between the three study sites. If the data was distributed parametrically, ANOVA was used. If the data showed no parametric distribution, Kruskal Wallis Anova was used and Dunn's pairwise multiple comparison procedure carried out to detect statistical differences between groups.

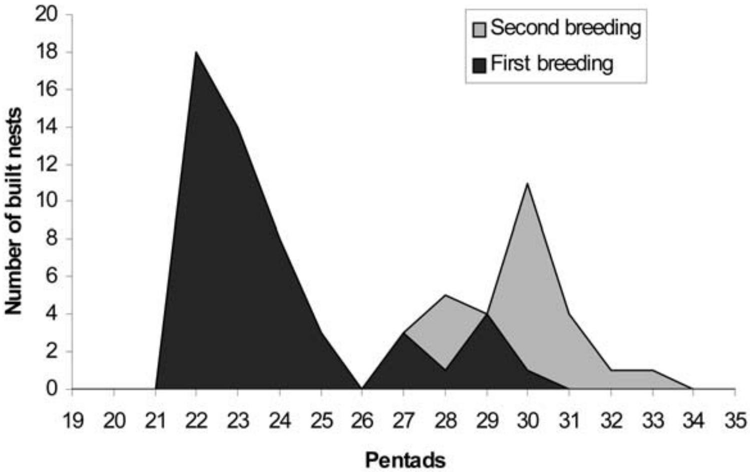
RESULTS

A total of 72 nests was found on the three slopes of Port del Comte mountain, including 14 nests on the south-facing slopes of Bofia (Refugi, Canalda), 24 nests on the north-facing slopes of the skiing resort Vansa (L'Arp, Prat Llong) and 34 nests on the east-facing slope of the skiing resort Porte del Comte / Sucre (Forat de Bofia, Prat de Botons, Rasa de Bofia, golfing area and around the hotels).

Nest building activity showed two peaks, with a first maximum in pentad 22 (first breeding; 16.04.-20.04.) and a second maximum in pentad 30 (second and repeat breeding; 26.05.-30.05.) (Fig. 1). The proportion of second and repeat clutches was with more than 40 % at the south-facing slope (Bofia), nearly twice as high as on north- and east facing slopes (Fig. 3).

Mountain Pine was the tree species mainly selected where citril finch nests were built.

FIG. 1.—Nest building activities (*n* = 72) of citril finches *Serinus citrinella* in 22nd (16.04.-20.04.) to the 33th (10.06-14.06.) pentad at Port del Comte mountain. From pentad 30 (26.05.-30.05.) there was a clear second peak due to new nest buildings after the main part of the juveniles of the early nests have fledged out. The allocation of nest building activities to the second breeding mentioned between pentad 27 and 29 in the figure are the result of direct observation of nest building females which alternated between feeding young birds of the first breeding and, at the same time, building a new nest for the second breeding close to the first nest (see also Förschler, 2001).
*[Distribución de fechas de inicio de la construcción del nido en primeras y segundas puestas de verderón serrano en el Port del Comte (*n *= 72). Las segundas puestas a partir del 26 de mayo se asignaron por observación directa de hembras que construían nidos a la vez que cebaban pollos en otro nido o por nidos construidos muy cerca de nidos en donde ya habían volado los pollos.]*



However a small number of nests were found in scots pine as well, at Vansa (4 %) and at Port Comte (15 %). Nesting sites were allocated to four groups concerning position of nesting tree from single trees to closed forest. Bofia had a much higher percentage of nests in single trees than did Vansa and Port Comte (Fig. 4). Port Comte nests were situated more often in tree groups than were nests in the other two areas. In Vansa half of all nests were situated at forest edges and in forests. Furthermore, Vansa had a higher percentage of nests located in trees with a single trunk than nests in the other two areas (Fig. 5).

Several nest parameters were obtained, including time of nest building, slope inclination, nest height, nesting tree height, distance to permanent water and food resources, to open space, to human trails, to forest edge, as well as the distance to simultaneously used nests of neighbouring pairs. Data of statistical comparisons are summarised in Table 1.

There was a significant difference in time of first nest building between south-facing (Bofia) and north-facing (Vansa) localities, but no significant differences between north- and east-facing (Port Comte) localities. Nests at the south-facing locality were built at higher elevations than nests at north- and east-facing slopes in Vansa and Port Comte. Inversely, nests at east-facing Port Comte were built in an area with a much steeper slope (inclination) than were nests in areas of Vansa and Bofia. Differences, however, were not significant. Nearly

FIG. 2.—Nest building activities (n = 72) of citril finches *Serinus citrinella* in pentads at three slopes of Port del Comte mountain.
[Distribución de las fechas de inicio del nido en el verderón serrano Serinus citrinella *en las tres laderas del Port del Comte (*n *= 72).]*

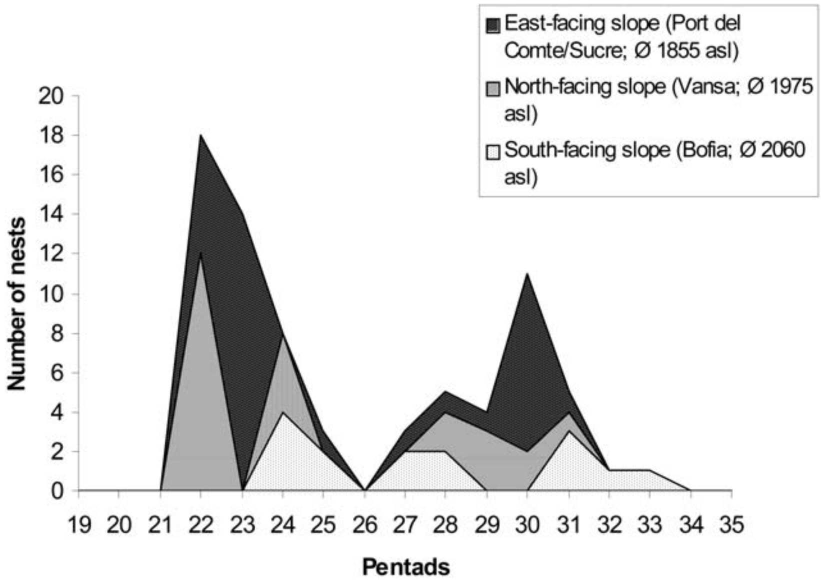


FIG. 3.—Proportion of first and second/replacement nest building (n = 72) of citril finches *Serinus citrinella* at Port del Comte mountain.
[Proporción de primeras y segundas puestas (o puestas de reposición) del verderón serrano Serinus citrinella *en las tres laderas estudiadas en el Port del Comte (*n *= 72).]*

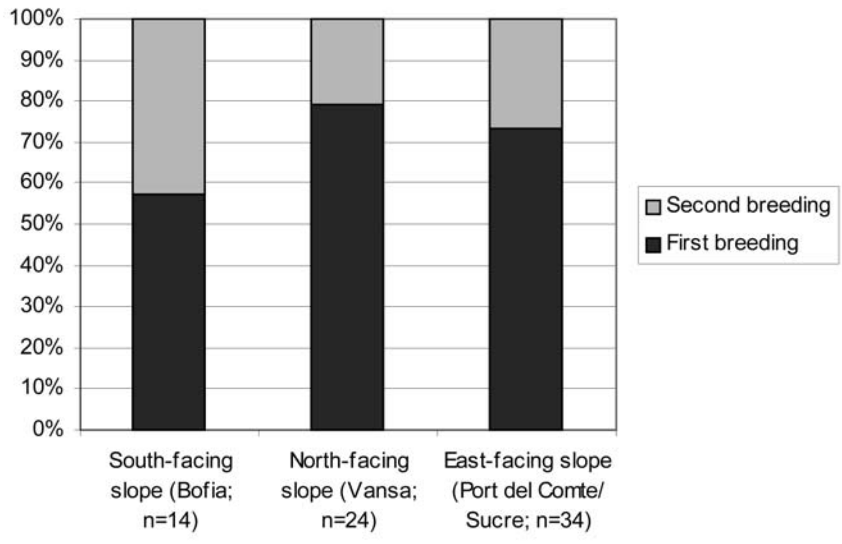


FIG. 4.—Proportion of nesting positions in citril finches *Serinus citrinella* (n = 72) with regard to habitat type and tree grouping on three slopes of Port del Comte mountain.
[Localización de los nidos (porcentaje) de verderón serrano Serinus citrinella *(*n *= 72) en relación al tipo de hábitat (interior de bosque, límite del bosque) y de la agrupación del arbolado (arboles solitarios o en grupo) en las tres laderas estudiadas en el Port del Comte.]*

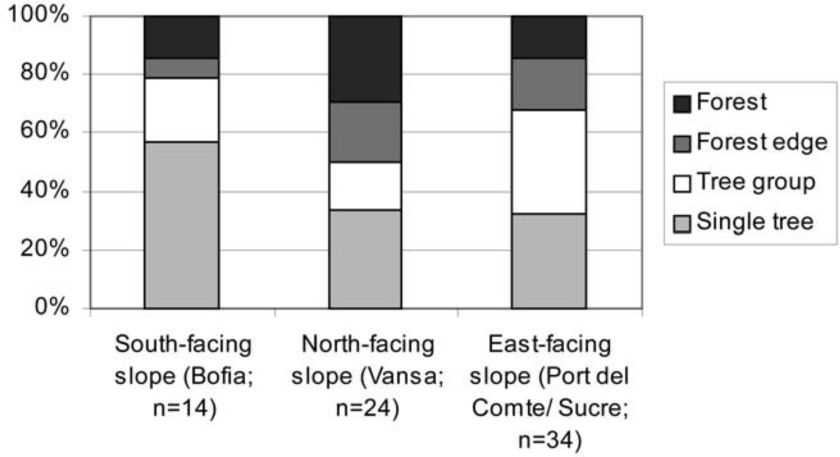


FIG. 5.—Allocation of citril finch *Serinus citrinella* nests (n = 72) to nesting tree type on three slopes of Port del Comte mountain.
[Localización de los nidos (porcentaje) de verderón serrano Serinus citrinella *(*n *= 72) en relación al tipo de troncos (sencillos, dobles o múltiples) en las tres laderas estudiadas en el Port del Comte.]*

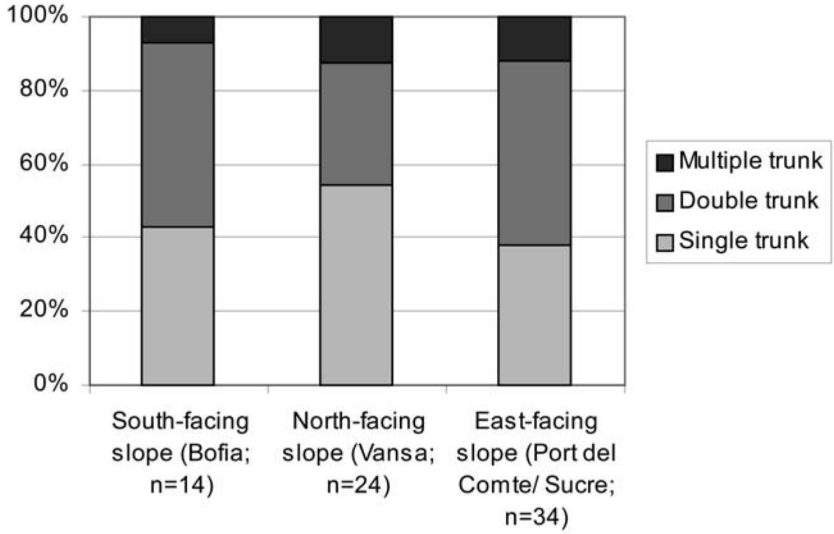


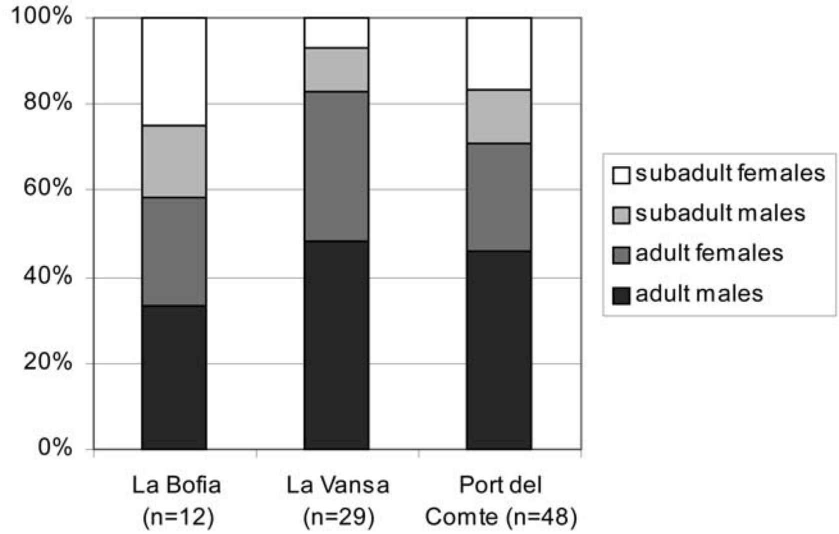
TABLE 1

Comparative characterization of breeding phenology and habitat selection of the three slopes at Port del Comte mountain in 2002 (mean ± SD). ANOVA (*F*) is used for comparison of parametric distributed and Kruskal-Wallis-Anova (*H*) and Dunn's pairwise multiple comparison procedure (Dunn) for non-parametric distributed data. *n* = Sample size.

*[Comparación de variables que caracterizan la fenología reproductora y del hábitat en las tres laderas estudiadas en el año 2002 en el Port del Comte (media ± DT). Se uso un ANOVA (*F*), una prueba de Kruskal-Wallis (*H*) o una prueba a posteriori de Dunn dependiendo de la distribución normal o no de las variables.* n = *tamaño de muestra.]*

Variable	**Vansa** north-facing	**Bofia** south-facing	**Port Comte** east-facing	Statistical comparison
First nest (start date) *[Inicio del primer nido]*	24.8 ± 3.5	27.2 ± 3.1	25.4 ± 3.5	*H* = 42.52, df = 2, *P* < 0.001 Dunn: *P* < 0.05 for Bofia *vs.* Port Comte, and Vansa *vs.* Port Comte
Elevation (m a.s.l.) *[Altitud (m s.n.m)]*	1975 ± 64 *n* = 24	2060 ± 23 *n* = 14	1855 ± 37 *n* = 34	*H* = 9.03, df = 2, *P* = 0.01 Dunn: *P* < 0.05 for Bofia *vs.* Port Comte, and Vansa *vs.* Port Comte
Slope inclination (degrees) *[Pendiente (grados)]*	13.1 ± 5.8 *n* = 24	10.6 ± 4.5 *n* = 14	15.3 ± 6.9 *n* = 34	*H* = 9.03, df = 2, *P* = 0.06
Nesting tree height (m) *[Altura del árbol (m)]*	8.2 ± 2.4 *n* = 24	7.4 ± 2.8 *n* = 14	6.8 ± 2.0 *n* = 34	*F* = 2.66, df = 2, *P* = 0.08
Nest height (m) *[Altura del nido (m)]*	5.9 ± 3.3 *n* = 24	4.8± 2.9 *n* = 13	4.6 ± 2.3 *n* = 34	*H* = 2.25, df = 2, *P* = 0.33
Vertical position (%) *[Posición vertical (%)]*	40 ± 10 *n* = 24	39 ± 11 *n* = 13	40 ± 9 *n* = 34	*H* = 0.92, df = 2, *P* = 0.96
Horizontal position (%) *[Posición horizontal (%)]*	61 ± 37 *n* = 22	59 ± 40 *n* = 14	55 ± 38 *n* = 33	*H* = 0.02, df = 2, *P* = 0.99
Nearest closed forest (m) *[Bosque más cercano (m)]*	18 ± 26 *n* = 24	90 ± 149 *n* = 14	64 ± 74 *n* = 34	*H* = 6.39, df = 2, *P* = 0.04 Dunn: no sign.
Nearest human trails (m) *[Sendero más cercano (m)]*	25 ± 25 *n* = 24	71 ± 51 *n* = 14	22 ± 29 *n* = 34	*H* = 11.38, df = 2, *P* = 0.003 Dunn: *P* < 0.05 for Bofia *vs.* Port Comte
Nearest Dandelion site (m) *[Distancia al más cercano* Taraxacum *(m)]*	33 ± 25 *n* = 24	45 ±45 *n* = 14	43 ± 37 *n* = 34	*H* = 0.48, df = 2, *P* = 0.79
Nearest water source (m) *[Distancia al punto más cercano de agua (m)]*	352 ± 308 *n* = 24	288 ± 318 *n* = 14	525 ± 332 *n* = 34	*H* = 9.11, df = 2, *P* = 0.01 Dunn: *P* < 0.05 for Bofia *vs.* Port Comte
Nearest salt place (in m) *[Punto con sal más cercano (m)]*	491 ± 288 *n* = 24	483 ± 684 *n* = 14	1264 ± 590 *n* = 34	*H* = 26.60, df = 2, *P* < 0.001 Dunn: *P* < 0.05 for Bofia *vs.* Port Comte and Vansa *vs.* Port Comte
Nearest neighbour (m) *[Vecino más cercano (m)]*	44 ± 20 *n* = 14	60 ± 19 *n* = 9	58 ± 30 *n* = 22	*F* = 1.64, df = 2, *P* = 0.20

FIG. 6.—Age of breeding citril finches *Serinus citrinella* (n = 89) on three slopes of Port del Comte mountain (adult: 3rd calendar year or older; subadult: 2nd calendar year).
[Composición de edades de los adultos reproductores de verderón serrano Serinus citrinella *(*n *= 89) en las tres laderas estudiadas en el Port del Comte.]*

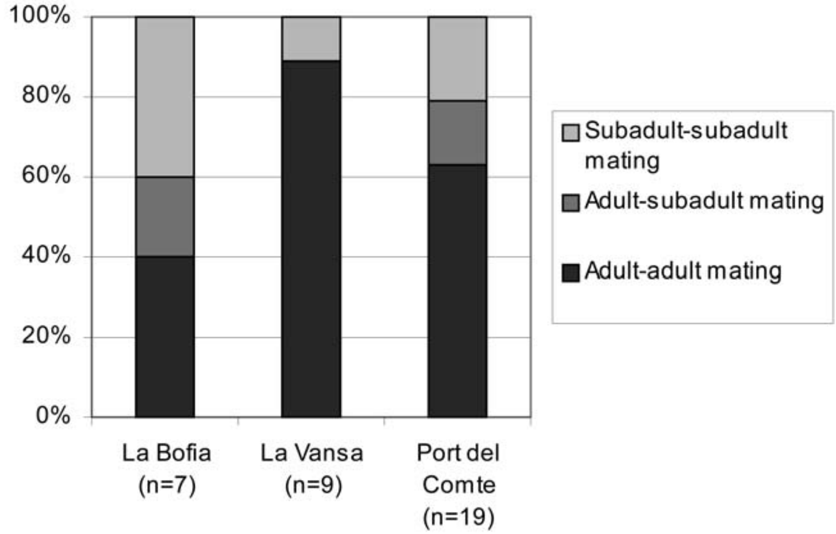


significant results were obtained concerning the height of nesting trees with slightly higher nesting trees in north-facing Vansa than in the other areas. No significant differences were found concerning height of nests above ground as well as in the vertical and horizontal position of the nests in the trees.

A significant difference was detected for birds in Vansa that nested closer to forest structures than did birds at Bofia and Port Comte. Furthermore, birds at Bofia nested significantly further away from the nearest human trails than did the birds at the other two localities. There was no significant difference among sites regarding distance of nesting sites to important food resources such as dandelion *Taraxacum officinale*, mountain pines and other herbs and grasses. Citril finches at east-facing Port Comte had to fly further to the nearest source of permanent water and salt uptake sites in comparison with the other two sites. Finally, there was no significant difference in distance to the nearest nest of a neighbouring pair, although birds at north-facing Vansa tended to nest somewhat closer to their nearest neighbours than did birds at south-facing Bofia and east-facing Port Comte.

In total more than two thirds of all age-determined nesting birds were adults. The proportion of birds in adult plumage was highest in north-facing Vansa with more than 80 % and lowest in south-facing Bofia with less than 60 % birds with adult plumage. At Port Comte 70 % of all birds were adults (Fig. 6). Regarding mating of age-determined breeding pairs (Fig. 7), in 66 % of all cases both partners were adults, in 22 % both partners were subadults. In 12 % an adult male mated with a subadult female. No mating was observed between a subadult male and an adult female. In Vansa, an extraordinarily high proportion of adult-adult mating occurred with more than 90 %, whereas in Bofia only 40 % of all age-determined pairs were adult-adult pairs. Port Comte was intermediate between Vansa and Bofia with 60 % adult-adult matings.

FIG. 7.—Age-determined pairs of citril finch *Serinus citrinella* (*n* = 33) at three slopes of Port del Comte mountain (adult: 3rd calendar year or older; subadult: 2nd calendar year).
[Tipos de emparejamientos por el tipo de edad de los adultos reproductores de verderón serrano Serinus citrinella *(*n *= 33) en las tres laderas estudiadas en el Port del Comte.]*



Discussion

As previously expected, some variations were found in breeding phenology and nesting habitat between north-, east- and south-facing breeding sites of citril finches at Port del Comte mountain in the Catalonian Pre-Pyrenees, probably due to different bioclimatic conditions and habitat qualities (Gutiérrez, 1991; Borras and Junyent, 1993; Borras *et al.*, 2003).

Nest building activity took place between the 22nd and the 33rd pentad with two peaks, a higher one in the 22nd pentad (first brood) and a smaller one in the 30th pentad (second brood). A major part of all nests was built during a few days. This pattern can be explained by the strong influence of weather conditions on nest building. Citril finches started nest building synchronously during the first warm days. Similar observations have been made for populations of citril finches in the Black Forest (Förschler, 2002a). Synchronous nest building behaviour may help the birds to diminish predation rate and enable them to exploit good food conditions optimally within the breeding groups (Newton, 1972). Birds of neighbouring nests often use good food sources in the surrounding collectively and synchronously.

Whereas birds in the high quality areas (Senar *et al.*, 2002) on north- and east-facing slopes (Vansa, Port del Comte) started nest building earlier, birds of the south-facing slope (Bofia) showed a delay of two pentads. It is supposed that citril finches are able to adapt the nest building time to food availability. On the north- and east-facing slopes finches are known to feed mostly on nutritious pine seeds (Borras *et al.*, 2003), that are available earlier. In contrast, birds at Bofia had to wait until a sufficiently large supply of herb seeds was available to rear their young (Borras *et al.*, 2003). Other factors for a later start of nesting activity at Bofia may be found in the difference of elevation, and a higher portion of inexperienced subadult birds involved in breeding at south-facing Bofia (see evidence for this in Senar *et al.*, 2002).

Pine trees were used exclusively for nesting at the study sites. At south-facing Bofia, all nests were built in mountain pines, whereas in the lower areas of the two other study slopes also scots pine was included in some cases. This pattern reflects the natural limitation of the two pine species at Port del Comte mountain. Above 1900 meters, the mountain pine is almost the only tree species, whereas in lower areas the slopes are dominated by scots pine. However, it is obvious that the main population of citril finches breeds in the mountain pine at greater altitude instead of in the scots pine zone. This obvious preference for mountain pines also fits the close similarity in distributional pattern between this tree species and citril finches in central Europe (Cramp and Perrins, 1994; Glutz von Blotzheim and Bauer, 1997; Förschler, 2002a).

The highest proportion of second breeding was observed at the south-facing slope (Bofia). This was likely caused by the early loss of many nests due to a late onset of spring during incubation, with snow covering areas above 2000 meters for several days. Bad weather conditions during the breeding period, such as in this case, may be a reason for low breeding success as well as higher predation rates due to higher predator vulnerability. Additionally, due to the lower habitat quality of Bofia, it is also supposed that there is a larger portion of less fit birds which inhabits these areas, which confirms such indications given by Senar *et al.* (2002).

Nest height as well as vertical and horizontal nest position were similar in all areas. The observation of slightly higher nesting trees in Vansa compared to the other two areas, may be mainly explained by generally larger tree heights on the north-facing slope. It is presumed that birds in the other areas were limited to lower trees due to lesser availability of higher trees, but there is a lack of more exact data on the variation of vegetation height in the distinct areas to confirm this assumption. In general, two types or even strategies of nest position choice in pines may be distinguished. Nests were either built close to the trunk in the tree crown, or nests were located on outer parts of solid lateral branches at lower parts of tall trees. Both positions may be well suited to avoid predation by abundant predators in the study area such as jays *Glandiarius garrulus* (Förschler, 2002b) and probably *Formica* ants (Förschler *et al.*, 2001).

Citril finches nested at Bofia predominantly in solitary trees, whereas at Port del Comte more nests were found in tree groups, which was caused by the more scattered habitat structures with single pines at Bofia. At Vansa, most nests were built at forest edges and within pine forest. These observations manifest themselves also concerning the distance of nests to the nearest closed forest, with birds of the north-facing slopes nesting significantly nearer to closed pine forest. This pattern reflects obvious habitat differences with more open landscape on south- and east-facing slopes and generally more wooded areas on north-facing slopes (see indications for this in Senar *et al.*, 2002; Borras *et al.*, 2003; Borras *et al.*, 2004).

Human trails may be of special interest for citril finches, because as edge habitats they often harbour particularly good food conditions with larger diversity of distinct herbs and grass seeds (Förschler and Kalko, 2006). In this study, citril finches at Bofia were nesting significantly further away from human trails than did birds in the other two areas. This might reduce the quality status of south-facing Bofia versus the other areas. Dandelion is one of the food plants often associated to edges of tracks, which has a special importance for citril finches as food plant (Borras *et al.*, 2003). However, it may also be due to Bofia represents a more open habitat, so human trails are not that important as in a closed forest.

Furthermore, water plays an important role for finches in general (Newton, 1972). Birds of the east-facing slope had to fly greater distances to the nearest source with permanent water. However, the quality of water resources can be very different and birds at Bofia depend only on a few water sites provided mainly by human actvities. In contrast, birds at Vansa can use the largest variety of fresh water sources. Besides water, citril finches may be observed frequently during the uptake of salt, presumably for additional minerals (Borras *et al.*, 2003), a behaviour which is especially typical for conifer seed eating birds such as crossbills *Loxia curvirostra* and siskins *Carduelis spinus* (Glutz von Blotzheim and Bauer, 1997). In all study areas, traditional salt places were frequently used, and it is supposed that birds sometimes have to fly over large distances to get to these salt places (*e.g.* one morning in five hours, nearly 100 individuals were caught visiting the same salt place). In this study, birds of Port Comte / Sucre had to undertake the longest flight distance to reach such a salt place.

The distance to the nearest nest of another citril finch pair was greatest at Bofia. The increasing distance between the nests fits observations of different settlement structures and population densities due to distinct habitat quality. Thus, in 2002 fewer breeding pairs and lower population densities were observed at Bofia and higher population densities in the other study areas. However, this observation may be biased by the more scattered structure at Bofia, so not only nests but also trees are at larger distances.

Finally, the highest proportion of 2nd calendar year birds (subadults) involved in breeding was also found at south-facing Bofia. It is assumed that low quality areas such as Bofia are mainly settled by low quality individuals (subadult birds), which has been previously supported by long-term ringing studies of the species (Senar *et al.*, 2002).

To summarise, several variations were found in nesting habitat and phenology between the three study sites. However, differences are small and may be explained mainly by ecological variation of living conditions in the distinct localities. Nonetheless these data are of interest in the context of inter-local variation at Sierra de Port del Comte, as indicated by other studies (Senar *et al.*, 2002; Borras *et al.*, 2003, 2004; Förschler *et al.*, 2005)

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