

Habitat characteristics and seed crops used by Blue Chaffinches *Fringilla teydea* in winter: implications for conservation management

EDUARDO GARCIA-DEL-REY¹*, LUIS GIL², NIKOS NANOS², UNAI LÓPEZ-DE-HEREDIA², PASCUAL GIL MUÑOZ³ and JOSÉ MARÍA FERNÁNDEZ-PALACIOS¹

¹Departamento de Ecología, Facultad de Biología, Universidad de La Laguna, 38206 La Laguna, Tenerife, Canary Islands, Spain, ²Unidad de Anatomía, Fisiología y Genética, ETSIM-UPM, Ciudad Universitaria s/n, 28040 Madrid, Spain and ³Sección de Montes, Medio Ambiente, Cabildo Insular de Tenerife, Santa Cruz de Tenerife 38200, Canary Islands, Spain

Capsule Tree cover and seeds on the ground influence the occurrence of Blue Chaffinches during the non-breeding period.

Aims To study the feeding habitat selection of the common Tenerife Blue Chaffinch race during the nonbreeding period as a desperate measure to conserve the endangered Gran Canaria race, whose critical area was burnt in the summer of 2007.

Methods Basic statistics were used to test for differences between occupied sites (n = 35) and available representative sites (n = 35). Univariate classification tree models were applied to explore the relationship between a single response variable (presence-absence) and multiple explanatory variables and the relative importance of these. Pine seed availability was quantified on the trees (n = 70) and on the ground (n = 140; 1×1 m plots).

Results We found a non-random feeding habitat selection by Blue Chaffinches on Tenerife. During the non-breeding period Blue Chaffinches selected those areas for feeding on pine seeds where the tree cover was higher than 38% (mature areas with tall and thick trees with good crops). When the tree cover was lower than 38%, the mean number of seeds on the ground influenced the presence of this finch (> 0.05 seeds per m²).

Conclusions This study highlights that Blue Chaffinches primarily select sheltered sites for feeding during the non-breeding period. The selection of less sheltered sites seems to be mediated by pine seed availability. Therefore, in this endemic forest system, perceived predation risk, food abundance and availability, and overall availability of safe foraging options are all possibly determining the winter feeding habitat selection. We recommend selective cuts in high-density pine stands to recreate those conditions that allow the pine trees to set seed and management aimed at creating a structure of dispersed small-area compartments with mature trees that provide food and shelter. The installation of artificial feeders seems to be a post-fire priority action for the conservation of the Gran Canaria race.

A vast literature has been devoted to the study of habitat selection by both animals and plants (e.g. see references in Cody 1981) and finding why a particular animal or plant prefers one place as opposed to another has been a major topic in ecology (Wiens 1989). Conservation managers normally include this information in their management action plans to improve a particular habitat and therefore the animal or plant community in question (Sutherland 1998). Few biologists will question the importance of food

^{*}Correspondence author. Email: edugdr@ull.es

supply in influencing animal numbers and that resources also fluctuate spatially and temporally (Herrera 2004).

The endemic forest of the Canary Islands Pine Pinus canariensis is restricted to the central and western islands of Gran Canaria, Tenerife, La Gomera, El Hierro and La Palma (Ceballos & Ortuño 1951), although a small patch (c. 6 ha) has been planted on the semiarid island of Fuerteventura. This generalist tree occurs from 1200 to 1500 m up to 2000 m in the north and from 500-700 m to 2300 m in the south (Jiménez et al. 2005) and is well adapted to volcanism (Climent et al. 2004) and its consequences (Arévalo et al. 2001). Its needles exhibit morphological drought adaptations (Grill et al. 2004) and its cones and seeds vary in size with altitude (Gil et al. 2002). The effect of fire on the pine forest bird community is poorly understood and non-natural forest fires and their increased frequency are being considered by Canarian authorities as a major threat to this ecosystem because between 1986 and 2006 a total of 11 751 ha were burnt on the island of Tenerife alone. In July 2007 a total of 17 000 ha of pine forest were burnt on Tenerife and 7699 ha on Gran Canaria (Área de Incendios Forestales del Ministerio de Medio Ambiente). Very little is known about the phenology of the seed crop of this pine tree in quantitative terms (Ceballos & Ortuño 1951), a key aspect for the seed-feeding bird community of these forests.

Blue Chaffinches Fringilla teydea are pine seed feeding specialists (Snow & Perrins 1998) that occur on Tenerife and Gran Canaria (Bannerman 1963) and are sexually dimorphic in size (Garcia-del-Rey & Gosler 2005). Two endemic races have been described (nominate teydea, (Webb et al. 1842) on Tenerife and polatzeki (Hartert 1905) on Gran Canaria) which are taxonomically monophyletic, supporting their individual conservation (Pestano et al. 2000). On Tenerife Blue Chaffinches are considered common (Garcia-del-Rey 2001, 2002) and maintain a fairly high density (Garcia-del-Rey & Cresswell 2005). Their current conservation status in the Spanish Red Data Book is vulnerable (Varela 2007). During the breeding season Blue Chaffinches select territories with a good number of pine trees and a well developed shrub layer, particularly in the north slope of the island (Garciadel-Rey & Cresswell 2005). These authors also suggested that while breeding, males tend to forage mainly on open cones on the ground for their seeds, while females search for invertebrates on the needles.

During the last 15 years, the population of Gran Canaria's Blue Chaffinches has been considered at a national scale as endangered (Varela 2007) due to a

rapid population decline and a total population size of about 200 birds (Tucker & Heath 1994), restricted to the natural reserves of Inagua and Tamadaba. On 5 May 2005 a recuperation plan was officially approved (Boletin Oficial de Canarias 2005) which suggested a series of in situ and ex situ actions to be undertaken. After the extinction of Tamadaba's population (P. Calabuig in litt.) an intense fire burnt the entire critical area of this race in Inagua (7699 ha of pine forest) during the summer of 2007 before any of these actions could be undertaken properly. Therefore, the Tenerife subspecies of Blue Chaffinch provides a unique opportunity to study basic aspects of the biology and ecology of this endemic bird, as a desperate measure to predict what may be happening to the Gran Canaria pine forest dweller. No quantitative data are presently available for either of the two races of this finch outside the breeding season.

Two types of data can be used by policy-makers to develop management guidelines for population conservation: low-resolution (extensive) surveys covering large geographical areas, for example, full island surveys (Garcia-del-Rey & Cresswell 2005) and high-resolution (intensive) studies of small areas. We take an 'intensive' observational approach to investigate how pine forest vegetation structure and seed crop influence variation in the selection of feeding sites by endemic Blue Chaffinches during the winter non-breeding period. We predict that winter feeding habitat selection is mediated by the availability of pine seeds from the annual crop.

METHODS

This study was undertaken on the volcanic island of Tenerife, Canary Islands (Fig. 1), during the nonbreeding period, when birds were not attached to territories and well after the peak of pine seed dispersal (unpubl. data). Winters are mild in the Canary Islands (Marzol-Jaen 1984). The pine forest on this island ranges from 700 and 2300 m asl. The old pine trees are typically 15–25 m in height but sometimes can reach 40–60 m (Blanco *et al.* 1989).

Fieldwork was carried out during December 2007 at an unmanaged pine forest area near the town of Vilaflor (28° 11' 16.12" N–16° 39' 37.11" W), dominated by an understorey of two leguminous shrubs: *Chamaecytisus proliferus* and *Adenocarpus viscosus* (Ceballos & Ortuño 1951). A plot (1.5 × 1.5 km) was selected at random (Universal Transverse Mercator of southwest corner: 336000–3118000), 2225 m asl, from the stratum 'unmanaged pine forest' (see Fig. 1),



Figure 1. Distribution of different types of pine forest areas on the island of Tenerife. The arrow indicates the location of the study site.

which covers a total area of 23142 hectares. This sample area is representative of total pine forest of Tenerife that is inhabited by the relict Gran Canaria race of Blue Chaffinches.

Bird surveys

The study site was divided by a 250×250 m grid with the aid of geographic information system software (ARCVIEW 3.2). Birds were identified with binoculars (Zeiss 10×40) within 25 m-wide belts at either side of systematic located transects on each of these cells. The perpendicular distance from the bird to the observer was estimated by means of a laser rangefinder with a ± 1 m error. Four parallel transects (c. 62.5 m apart) were walked (west–east, 1 km/h) on each quadrat (the last one coinciding with the next cell edge) when the terrain was suitable for this. A survey transect (1.3 ha; 250×50 m) with a feeding bird or a pair of chaffinches feeding was the sample unit. If more birds were encountered they were only recorded if they could be classified in different age classes (i.e. adult *versus* second year, Garcia-del-Rey & Gosler 2005) or if they were individually colour-ringed. Special care was taken to avoid pseudoreplication through mapping of movements of previously observed individuals on 1:5000 maps. The effort was also standardized to 1 hour per cell. A single observer (first author) collected all the data from 3 to 18 December 2007. No surveys were done during rain or strong wind and fieldwork was only conducted between 07:30 (dawn) and 10:30 hours (local time) to maximize feeding observations.

Microhabitat structure

The microhabitat structure representative of the study site was characterized by measuring ten variables on 35 circular sample units of 25 m radius located at the intersections (nodes) of the gridlines of the 250 \times 250 m cells (Sutherland *et al.* 2004). One node was not surveyed due to inaccessibility on

Table 1. Predictor variables used to characterize the vegetationarchitecture and the availability of main food resource in each25 m radius circular plot.

Predictor	Description
TC	Cover of trees (%)
T1	Number of trees with dbh > 50 cm
T2	Number of tress with dbh < 50 cm
MTH	Mean tree height of the six closest trees (m) to the observation
OCT	Number of open cones on the six closest trees to the observation
SC	Cover of Chamaecytisus proliferus and Adenocarpus sp. (%)
MSH	Mean shrub height (m)
G	Grass cover (%)
OCG	Mean number of open cones on the ground $(2 \times 2 \text{ m}^2)$
MSG	Mean number of pine seeds on the ground $(2 \times 2 \text{ m}^2)$

foot. These habitat variables were selected based on the most important ecological requirements of the chaffinch genus *Fringilla* (Snow & Perrins 1998) (Table 1). The cover (%) predictors in the different strata (canopy, shrub and ground) and the number of trees of different dbh were measured visually. The average heights of trees and shrubs were estimated with a dendrometer (Haglöf Vertex IV).

The microhabitat occupied by Blue Chaffinches was also characterized (3–18 December 2007), by measuring the same ten variables, in circular sample units of 25 m radius, around each bird found eating pine seeds (n = 35).

Food availability

Three variables were used to measure food availability (i.e. number of open cones on the trees (OCT), mean number of open cones on the ground (OCG), average number of pine seeds on the ground per m² (MSG)). OCT were counted with binoculars (Zeiss 10 × 40). OCG and MSG were also counted, during 4 minutes and without disturbing the pine needles litter, on four (north, south, east and west) 1 × 1m plots located at 12.5 m from the centre of each 25 m radius circular sample unit (n = 140). Each seed was crushed to check that it contained endosperm (Sutherland *et al.* 2004). Blue Chaffinches do not scrape or dig on the ground while foraging (Garcia-del-Rey & Cresswell 2005).

Statistical analysis

The means of the predictor variables for occupied and available sites were compared using Student's *t*-test

after transforming some of them for normality, identified by Kolmogorov–Smirnov tests (i.e. arcsine of the square root for cover variables, natural logarithm for the rest). Potential inter-correlations between predictors were examined using Spearman's rank correlation tests. Occupied and available places were scored as a binary dependent variable and the habitat measures as independent explanatory variables (Manly *et al.* 1993).

Species occurrence (presence = 1; absence = 0) in all the plots sampled (35 available versus 35 occupied) was modelled introducing all the ten original descriptors as explanatory variables, and analyzed using classification trees (data were not transformed). This relatively new technique in ecology (Zuur et al. 2007) was used to analyze Blue Chaffinch occurrence in relation to environmental variables and explore the relationship between a single response variable and multiple explanatory variables (Chambers & Hastie 1992, De'Ath & Fabricus 2000). The response variable undergoes successive univariate splits, according to threshold values of the explanatory variables that maximize the differences between the two resulting groups of samples. Tree models deal better with non-linearity and interaction between explanatory variables than regression, generalized linear models (GLMS) and generalized additive models (GAMS): they can be used to find interactions missed by other methods in complex ecological studies, they indicate the relative importance of different explanatory variables, are not affected by transformation on the explanatory variables (Zuur *et al.* 2007) and minimize the problems of stepwise (forward or backward) procedures, which are becoming less popular among ecologists (see, for example, Whittingham et al. 2006b). The predictive power of the obtained classification tree was evaluated by means of crossvalidation procedure using ten random sampling iterations. This objectively allows selecting the optimal tree size and avoids complex suboptimal trees (for a full explanation of this process see Zuur et al. 2007). The minimum number of observations that must exist in a node, in order for a split to be attempted was set to five and the full tree was obtained with the default complexity parameter set to 0.001.

The non-parametric gam, with a Poisson distribution and a logistic link function, was used to relate Blue Chaffinch presence–absence data to the most important explanatory variable obtained by the tree model.

Basic statistical methods followed Zar (1998) and were implemented using SPSS 12.0. BRODGAR 2.5.6. (www.brodgar.com) was used for all univariate tree model analyses and the GAM.

RESULTS

Occupied versus available areas

Significant differences were found between occupied and available representative sites for the percentage tree cover (TC), the average height of the trees (MTH), OCG and MSG (see Table 2). For these, the values on the occupied sites were always greater than in the available sites, suggesting that Blue Chaffinches select areas with higher tree cover, taller pines and a relatively large number of cones and seeds on the ground. TC was significantly correlated with the number of trees with a dbh > 50 cm (T1) ($r_s = 0.45$, P = 0.001), MTH ($r_s = 0.53$, P = 0.001), OCT ($r_s = 0.24$, P = 0.04), OCG ($r_s = 0.52$, P =0.001), and MSG ($r_s = 0.31$, P = 0.01).

From the observations gathered (n = 35) it can be concluded that Blue Chaffinches spent more time feeding higher up in the canopy than on the ground (67.7% versus 32.3). Most birds were observed feeding on the left-over seeds of the open cones still hanging high up in the canopy (55.2%) (i.e. seeds that were left at the back of the cones and therefore not dispersed) and in 12.5% of the occasions the birds were exploiting seeds stuck on the needles. Only on 28.2% of the feeding observations were the Blue Chaffinches eating seeds on the ground and in only 4.1% of the observations were of birds feeding on seeds from the old pine cones that had fallen the year before.

Modelling of habitat preferences

Colinearity (i.e. significant correlation coefficient > 0.75) was not found between variables and all ten predictors were used for the univariate tree model

analysis. The full classification tree describing the pattern of winter feeding habitat selection of Blue Chaffinches can be seen in Fig. 2a and the pruning diagram resulting from ten cross-validations is also shown (Fig. 2b). This full classification tree indicates that TC is the most important explanatory variable. The classification tree correct prediction of presence–absence of this species was 91.4%.

The pruning diagram (Fig. 2b) indicates that the tree presented in Fig. 2a is suboptimal, and that a classification tree of size 5 would be optimal (Fig. 3), according to the one standard deviation rule that dictates to select the left-most tree for which the mean relative error is below the dotted line (Zuur *et al.* 2007). This classification tree showed a correct prediction of presence–absence of the species in 77% of the occasions.

Therefore, there is a high probability of finding Blue Chaffinches feeding on pine seed in locations with a pine tree cover higher than 38% (i.e. there is a significant and strong tree cover linear effect, GAM; s(TC): $\chi^2 = 8.48$, df = 1, *P* = 0.003; intercept: -4.31, *P* = 0.001) (see Fig. 4).

However, when the pine tree cover is lower than 38%, the probability of observing Blue Chaffinches feeding on pine seed drops and the MSG seems to become the second most important explanatory variable. The presence of Blue Chaffinches feeding on these sites was influenced by a MSG higher than 0.05 per m², which corresponds to the 5.9% of the total availability of pine seeds in the study site (as presented in Table 1).

In just 17% of the total observations Blue Chaffinches were observed feeding on locations with a TC smaller than 38%, a MSG smaller than 0.05 per m^2 , a MTH greater than 13.5 and a mean shrub height (MSH) less than (or equal to) 0.5 m.

Table 2. Mean \pm sd values (untransformed) for the microhabitat predictors (25 m radius circular plots) around each bird eating pine seeds (occupied) and around representative points of the study site (available). The total value and the results of *t*-test comparisons for each predictor are also shown.

Available (n = 35)	Occupied (n = 35)	t	Р	Total
10.53 ± 11.15	31.44 ± 23.09	-4.82	0.001***	20.99 ± 20.86
1.40 ± 1.64	2.63 ± 3.22	-1.93	0.06	2.01 ± 2.61
1.54 ± 1.84	2.87 ± 3.45	-1.94	0.06	2.21 ± 2.82
8.75 ± 5.37	12.85 ± 5.79	-3.07	0.01**	10.80 ± 5.92
0.65 ± 0.63	0.84 ± 0.74	-1.28	0.21	0.74 ± 0.69
1.24 ± 3.07	4.83 ± 8.65	-1.90	0.06	3.04 ± 6.70
0.28 ± 0.32	0.47 ± 0.57	-1.70	0.10	0.38 ± 0.46
1.68 ± 6.33	2.83 ± 15.20	0.11	0.92	2.25 ± 11.57
1.51 ± 3.63	3.16 ± 5.15	-2.12	0.04*	2.34 ± 4.49
0.49 ± 1.12	1.21 ± 1.46	-3.50	0.001***	0.85 ± 1.34
	Available $(n = 35)$ 10.53 ± 11.15 1.40 ± 1.64 1.54 ± 1.84 8.75 ± 5.37 0.65 ± 0.63 1.24 ± 3.07 0.28 ± 0.32 1.68 ± 6.33 1.51 ± 3.63 0.49 ± 1.12	Available $(n = 35)$ Occupied $(n = 35)$ 10.53 ± 11.15 31.44 ± 23.09 1.40 ± 1.64 2.63 ± 3.22 1.54 ± 1.84 2.87 ± 3.45 8.75 ± 5.37 12.85 ± 5.79 0.65 ± 0.63 0.84 ± 0.74 1.24 ± 3.07 4.83 ± 8.65 0.28 ± 0.32 0.47 ± 0.57 1.68 ± 6.33 2.83 ± 15.20 1.51 ± 3.63 3.16 ± 5.15 0.49 ± 1.12 1.21 ± 1.46	Available $(n = 35)$ Occupied $(n = 35)$ t 10.53 ± 11.15 31.44 ± 23.09 -4.82 1.40 ± 1.64 2.63 ± 3.22 -1.93 1.54 ± 1.84 2.87 ± 3.45 -1.94 8.75 ± 5.37 12.85 ± 5.79 -3.07 0.65 ± 0.63 0.84 ± 0.74 -1.28 1.24 ± 3.07 4.83 ± 8.65 -1.90 0.28 ± 0.32 0.47 ± 0.57 -1.70 1.68 ± 6.33 2.83 ± 15.20 0.11 1.51 ± 3.63 3.16 ± 5.15 -2.12 0.49 ± 1.12 1.21 ± 1.46 -3.50	Available $(n = 35)$ Occupied $(n = 35)$ tP 10.53 ± 11.15 31.44 ± 23.09 -4.82 0.001^{***} 1.40 ± 1.64 2.63 ± 3.22 -1.93 0.06 1.54 ± 1.84 2.87 ± 3.45 -1.94 0.06 8.75 ± 5.37 12.85 ± 5.79 -3.07 0.01^{***} 0.65 ± 0.63 0.84 ± 0.74 -1.28 0.21 1.24 ± 3.07 4.83 ± 8.65 -1.90 0.06 0.28 ± 0.32 0.47 ± 0.57 -1.70 0.10 1.68 ± 6.33 2.83 ± 15.20 0.11 0.92 1.51 ± 3.63 3.16 ± 5.15 -2.12 0.04^* 0.49 ± 1.12 1.21 ± 1.46 -3.50 0.001^{***}

*P < 0.05; **P < 0.01; ***P < 0.001.



Figure 2. (a) Full classification tree describing the pattern of winter feeding habitat selection of Blue Chaffinches *Fringilla teydea teydea* on Tenerife (Canary Islands). If a statement is true, follow the left branch. Branch lengths are proportional to deviance explained by each split criteria. Numbers at the end of a branch are the predicted group (1, presence; 0, absence) and classifications per group (errors/number of observations). Note that % tree cover (TC) is the most important explanatory variable. Correct prediction of presence–absence is 91.4%. MSG, mean pine seeds on the ground; MTH, mean tree height (m); MSH, mean shrub height (m); T2, number of tress with dbh < 50 cm. (b) Pruning diagram resulting from ten cross-validations. The dots are the averages of the cross-validations and the vertical lines the standard deviation. The one standard deviation rule dictates selection of the left-most tree for which the mean relative error is below the dotted line, which in this case is a tree of size 5. cp, complexity parameter. (See Fig. 3.)



Figure 3. Optimal classification tree (according to Fig. 2b) describing the pattern of winter feeding habitat selection of Blue Chaffinches *Fringilla teydea teydea*. Branch lengths are proportional to deviance explained by each split criteria. If a statement is true, follow the left branch. Numbers at the end of a branch are the predicted group (1, presence; 0, absence) and classifications per group (errors/number of observations). Correct prediction of presence-absence is 77%. TC, % tree cover; MSG, mean seeds on the ground; MTH, mean tree height (m); MSH, mean shrub height (m).

DISCUSSION

Overall, the pattern of the winter feeding habitat selection of Blue Chaffinches indicates a preference for sheltered areas, locations with a pine tree cover higher than 38%. A high percentage of TC is also related to well-developed canopies that produce high seed crops as TC was correlated with mature tall pine trees, OCT, OCG and MSG. In the Canary Islands mature trees usually produce the greatest seed crops, whereas in areas of high density of thin pine trees (such as pine plantations) the canopy cannot develop properly and seed crops are smaller or even non-existent (Ceballos & Ortuño 1951).

As in the other two closely related members of the genus *Fringilla*, Blue Chaffinches are mainly ground foragers (Snow & Perrins 1998), but during the nonbreeding period this finch prefers those sites where vegetation structure makes seeds accessible in sheltered places, high up in the crown of the trees. Birds were mainly feeding on seeds from the back of the open cones on the trees (55.2%), those that dispersed the majority of their seeds during the summer. However, chaffinches also exploited seeds stuck in the foliage that did not reach the ground (12.5%). Garcia-del-Rey & Cresswell (2005) suggested that males during the breeding season tend to forage mainly on the open cones left on the ground for their seeds. Eventually, all the open pine cones will fall to the ground and seeds will have to be searched for on the ground.

Food is widely considered the ultimate factor influencing the foraging behaviour of birds during the breeding and the non-breeding season (e.g. Buckingham & Peach 2006, Siriwardena et al. 2007). Recent experimental research has also shown that seed-eating birds alter their foraging behaviour in response to vegetation manipulation (Devereux et al. 2006, Whittingham et al. 2006a) and the perceived predation risk has been suggested as a key factor explaining why granivorous birds prefer areas with greater visibility for foraging and feeding on the ground. Our results do not depart from this pattern because the occurrence of Blue Chaffinches in less sheltered locations (TC < 38%) was influence by the availability of pine seeds on the ground. Habitat choice for non-breeding birds is driven by the starvation-predation risk trade-off (Lima 1986). In our forest system perceived predation risk, food abundance and availability, and overall availability of safe foraging options, are all possibly determining the winter feeding habitat selection of Blue Chaffinches.

Conservation implications

The Canary Islands Pine is considered a key element for ecosystem stability and conservation. According to Arco Aguilar *et al.* (1992) on Tenerife there were 30 000 ha of natural forest, and between 1945 and 1983, 10 000 ha were planted. Today, only 1.6% of the pines of the natural stands is over 180 years old (Climent *et al.* 2002), whereas in a primitive forest 800-year-old pine trees would be normal (Genova & Santana 2006). Stands of this pine in the Canary Islands are not managed for timber production at the present time, but selective cuts to reduce high-density areas (planted in the early 1960s) and fire restoration actions (cutting the affected shrubs) are taking place on the island of Tenerife.

For high-density pine stands, this study justifies selective cuts to recreate those conditions that allow the trees to set seed. Managing high-density pine forest stands towards a structure of dispersed small-area compartments with mature trees (dbh > 50 cm) that provide both food (pine seed crop) and shelter (TC > 38%) during the winter could be considered as a priority for the conservation of pine seed-eating birds and particularly the endemic Blue Chaffinches.



Figure 4. Partial fit of tree cover (TC) (GAM model with Poisson distribution and log-link function). The x-axis shows the TC gradient and the y-axis is the contribution of the smoothing function s(TC) in the model logit(Y) = intercept + s(TC).

The effect of fire on the pine forest bird community is not fully understood (Garcia-del-Rey 2007). However, this study highlights the importance of sheltered feeding places during the winter. Although the Canary Islands Pine does not die after a fire, an important proportion of the canopy, and therefore the year's crop, is destroyed by the flames (i.e. 70.9% by the July 2007 fire on Tenerife, Garcia-del-Rey 2007) and the fructification capacity of the trees in burnt areas will be affected for the next 30 years (unpubl. data). Assuming that it takes 2 years for a Canary pine cone to mature and disperse its seeds (Ceballos & Ortuño 1951), we also recommend, as a priority action for the endangered Gran Canaria race Fringilla teydea polatzeki, the installation of artificial feeders with pine seeds up in the canopy (at sites with a TC larger than 38%) of the greatest diameter trees (dbh > 50 cm), at

least during the second and third winters after the July 2007 fire (i.e. 2008/09 & 2009/10). Seeds become superabundant immediately after a fire (Saracino *et al.* 2004) and seed rain becomes insignificant until the third year after a fire (R. Otto *in litt.*). This action is justified because official estimates suggest that this finch will become extinct in 2025 (Boletin Oficial de Canaria 2005).

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