Estimating Black Francolin *Francolinus francolinus* numbers in western Cyprus

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The Black Francolin *Francolinus francolinus* is widespread and relatively common in western Cyprus, particularly so in cereal-growing areas and at lower altitudes. In Pafos District it is virtually absent from natural vegetation and its numbers are therefore heavily dependent upon agricultural practices. By recording calling males in a 2.4 km^2 farmed valley near Polis, and also along a series of foot transects across a much wider area, both counted over a six-year period, numbers of Black Francolins were estimated at between 344 and 500 pairs in Pafos District, although this figure needs to be used with caution; the Cyprus Game and Fauna Service figures are much higher. There is some evidence of a slow decline during the years 2006–2011, though the species may be spreading into more upland areas, especially where cereals are grown or hay is cut, both of which have become more common recently. Methods of estimating the species' numbers are discussed; since these depend largely upon calling males and there is evidence that only a fairly small proportion of males can be heard calling at any one time, a number of repeat counts are needed for territorial mapping to prevent under-estimating actual numbers.

INTRODUCTION

The Black Francolin *Francolinus francolinus* occurs east to northeast India, with only a small proportion of the total population being found in Europe, where Cyprus is one of only four European countries with a population of the species, the others being Turkey, Azerbaijan and Georgia. Internationally, its conservation status is least concern (BirdLife International 2013), but within Europe it is regarded as SPEC 3 (declining: moderate continuing decline, BirdLife International 2004). Within the western Palearctic it occurs in a wide variety of habitats, including thickets and thorn, vineyards and orchards (Snow & Perrins 1998). However, it rarely occurred in any of these habitats during my Cyprus surveys. Snow & Perrins (1998) also listed "fields of barley and wheat flanked by bushes", which is much more typical of the bird's habitat in western Cyprus.

In western Cyprus, the Black Francolin is widely distributed, but almost entirely in man-modified habitats and only rarely in the more natural scrub areas (phrygana, machis *etc*) and never in my experience in pine forest, although it has been recorded twice in forests in the north of the island by Peter Flint (pers comm) and it also occurs there in dense juniper scrub (Flint & Stewart 1992). It is most numerous in cultivated areas, especially cereals (barley and wheat). Flint & Stewart (1992) noted that it is particularly common in coastal areas but does occur up to 400 m asl; records in recent years have increased the altitudinal range to 1000 m (Whaley & Dawes 2003). It was apparently very common prior to the 1980s, but then declined in most areas due to excessive hunting (Flint & Stewart 1992 and references therein). Snow & Perrins (1998) gave a figure of 350–450 pairs for the whole island, which seems likely to be too low. Improved control of hunting has led to increasing numbers and distribution in the last two or three decades. Recent annual reports from BirdLife Cyprus confirm that the species is now widely distributed across the whole island, and the estimate by BirdLife International (2004) of 2000–5000 pairs for Cyprus seems much more likely. This represents about a third of their estimate for Black Francolins in Europe. Here I am concerned both with the methods of obtaining population estimates for this sometimes noisy but otherwise elusive species, as well as its actual numbers. The Cyprus Game and Fauna Service (formerly the Game Fund) make periodic counts of Black Francolins, by driving along minor roads (Hadjigerou *et al* 2004, N Kassinis pers comm). Their data help to inform the annual quotas for hunters. The present study extends and complements that work.

METHODS

I made counts of all landbird species from 2006–2011 by walking along 38 transects in western Cyprus, predominantly in Pafos administrative district (Pafos District). In most years, each transect was counted twice, but in some years three times and occasionally only once, with a few routes being missed in two of the years. All counts were made in the breeding season, mostly between mid April and late May. Transect lengths varied, but most were from 1–2 km long, and each was sited in a particular land-use type of which there were six: forest, uncultivated, grass/phrygana, arable, permanent crops and built-up. The distance of each bird from the transect line was also recorded. Using the software DISTANCE (Buckland *et al* 1993, Thomas *et al* 2010), the density of Black Francolins at each site was calculated. Black Francolins were only recorded along ten of these transects, all in Pafos District, and only at the four low-to-mid altitude arable sites were they at all common (see Appendix 1).

A second breeding season method, again in Pafos District, consisted of plotting calling males in a section of the Chrysochou valley, from just south of Chrysochou village to the outskirts of Prodromi and Polis town in the north. This encompassed an area of *c*2.4 km^2, throughout which Black Francolins can frequently be heard in the spring. This area was surveyed from a slow-moving car, using farm tracks with little or no traffic. I made from 10–18 counts per season, which varied from 20–70 minutes and were between 07.00–19.00 h. The average ambient shade temperature during counts was recorded from an electronic thermometer. Any one count only covered part of the area but collectively the set of counts for each year covered every part of the area several times. Additional observations were made from a raised listening point on the road from Tera to Chrysochou. Birds were plotted on a large-scale map of the area, using a different symbol for each visit. Alongside each symbol, the land-use was noted, except where the bird was near a boundary between two or more types, and I could not be sure from which the bird was calling (almost all records were of birds calling).

At the end of each season, the number of territorial males was estimated from the maps (Bibby *et al* 2000). Most records formed clusters of from two to five symbols close together, although sometimes one or two were less close and a decision based upon experience had to be made as to whether one bird was involved or two. This was helped in about half of such cases when the two symbols were from the same visit: clearly that had to be two birds. Occasional symbols were isolated—less than 5% of them—and these birds were also counted, for two reasons. Firstly, as will be seen, only about 20% of the birds finally recorded were heard calling on any one visit, so isolated birds may simply have been missed by chance on some visits. Secondly, birds closer together (*eg* 200–300 m apart) called more often than birds towards the edge of the area, where most of the isolated records occurred.

In 1994, the Government of Cyprus published a *Census of Agriculture*, which gave the areas of land under different forms of land use (Census of Agriculture 1994). These data were, however, incomplete and Pomeroy and Walsh (2006) used them as a basis to estimate total areas for the whole of Pafos District at that time; these are the figures used in this paper (Appendix 2). Since then, one change that may have favoured Black Francolins has been the penning of livestock rather than having them graze on the hills. This has resulted in two important changes. Firstly, the total amount of vegetation has increased, being ungrazed, at least until it is cut for hay or silage. Secondly, some former grasslands are now growing cereals; altogether, however, these areas of cut vegetation are not extensive. Nevertheless, the presence of Black Francolins around Kritou Terra, Arodhes and Drinia (Table 1) may be a result of these changes.

RESULTS

Over six years, 85 birds were recorded during 112 transect counts (see Table 1 and Appendix 1), and 164 were plotted in the Chrysochou valley (not all were different individuals, as both transects, and especially valley counts, were repeated within each year). It is clear that, in this part of Cyprus, the Black Francolin is predominantly a bird of arable land, with 81 of 85 records from that habitat, and all but seven of those from low and mid altitudes (Table 1). Both methods showed a probable gradual decline in numbers 2006–2011. For the Chrysochou valley (Figure 1a), the decline was statistically significant ($P < 0.02$), whilst for the transects (Figure 1 b) the decline, although suggestive, was not significant.

Data collected from Chrysochou valley provide some indications of how best to plan such counts. Thus, the average numbers recorded as calling showed a gradual increase from mid April to early June (Table 2, note that the sample for late May/early June is only four visits). The time of day during which the visits took place did not have a big effect on the results (Table 3) but it does seem better to make counts before 10.00 h in the morning, when it is also likely to be cooler: counts were lower when the temperature was above 25°C (Table 4). The number of calling birds on any one visit to the Chrysochou valley was typically 3 or 4 (range 0–12), and the number of presumed territories that were recorded thus increased with successive visits, so that it took a number of visits to accumulate the positions of all (or at least most) of the males in the area. Figure 2 shows this as examples for two years. In both cases it seems likely that one or two more territories would have been located by continuing with visits for a further week or so. Thus the numbers of territories that I report here are minima. Cereals covered nearly half of the Chrysochou valley study area in 2011 (Figure 3b), but this was only one of five main forms of land use that year, and indeed all years during the period of study. The figure also shows (averaged over several years) the proportions of birds recorded from each type—in fact, where it was possible to determine where the bird was with some certainty, most were in cereals and the rest in fallow areas (which included a few small hay fields).

DISTANCE analysis showed that the effective width (ESW) counted in transects was from 97–99 m on either side of the transect line, but with fairly wide confidence limits. Appendix 2 gives total transect lengths for each type of land use; hence the effective area counted for each transect could be calculated, and when multiplied by the numbers of birds, yielded an estimate of density (Appendix 2). This was highest in the low-to-mid altitude arable areas, where it averaged *c*4.5 birds per km^2, compared to just over one bird

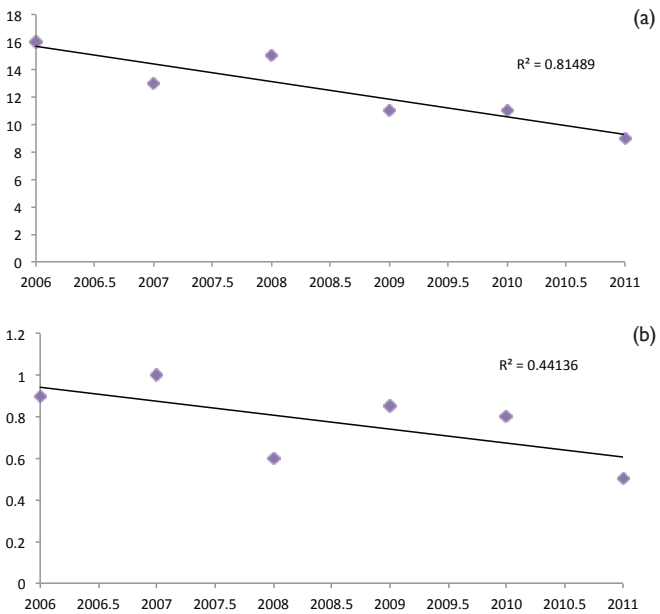

Figure 1. The estimated numbers of birds (a) in the Chrysochou valley and (b) per kilometre of transect. The latter is an average from the 8 transects along which the species was recorded.

Table 1. Details of the foot transects along which Black Francolins were recorded and estimates of the density of calling males.

Land use (number of transects)	Transect name	Length (m)	Altitude (m)	Numbers of birds			Mean density (birds km^{-2})
				total birds	no. of counts	average no. of birds	
Uncultivated (9)	Lara juniper	1680	50	1	11	0.09	0.05
Grass/phrygana (8)	Kritou Terra	930	490	1	9	0.11	0
Low–mid altitude arable (4)	Limui	1180	80	21	14	1.50	4.54
	Latchi	1200	30	22	13	1.69	
	Nata	2150	120	11	12	0.92	
	Terra	2100	350	22	14	1.57	
Higher altitude arable (4)	Arodhes[a]	800	620	5	12	0.42	0.87
	Drinia[a]	550	550	2	9	0.22	
Permanent	Ghoudhi	830	60	1	0	0.10	0.20
Crops (7)	Neo Chorio	910	220	1	10	0.10	

[a] sections of longer transects, the remaining parts being grass/phrygana

Table 2. Average number of Black Francolins recorded in four ten-day and a final three-day period at Chrysochou valley. Data are from 2006–2011 combined.

Period		Number of visits	Number of birds	Average no. of birds
April	21–30	18	42	2.33
May	01–10	18	41	2.28
	11–20	9	30	3.11
	21–30	7	28	4.00
May 31–June 02		4	23	5.75

Table 3. Average number of Black Francolins recorded in Chrysochou valley at various times of day.

Time period	Number of visits	Number of birds	Average no. of birds
07.00–10.00 h	28	92	3.29
10.00–16.00 h	17	32	1.88
16.00–19.00 h	11	25	2.27

Table 4. Average number of Black Francolins recorded in Chrysochou valley at different temperatures.

Temperature (°C)	Number of visits	Number of birds	Average no. of birds
11–15	4	9	2.25
16–20	10	25	2.50
21–25	26	64	2.45
26–30	3	5	1.67
31–35	2	3	1.50

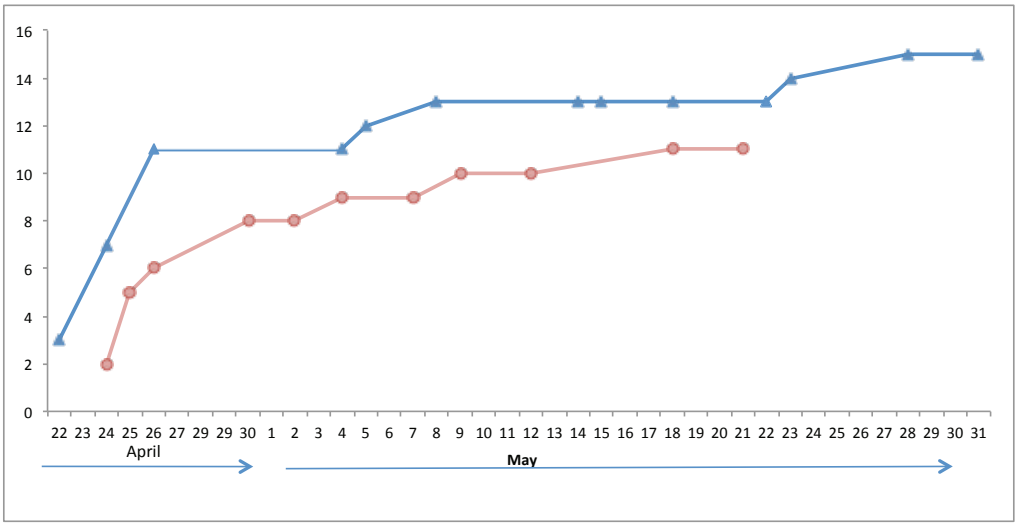

Figure 2. Cumulative totals of calling Black Francolins in Chrysochou valley over several weeks, April/May, in 2008 (triangles) and 2010 (circles).

per km^2 in the upland areas and far fewer in the only other sites where the species was recorded. The average density of calling birds in the Chrysochou valley was 5.21 km^{-2} over the six years, a little higher than for the foot transects in the comparable low to mid altitude arable areas, and also comparable to the figure of one male per 15–30 ha in parts of Turkey (Kirwan *et al* 2008). The density estimates given in Appendix 2 can form the basis of an estimate of the total population of Black Francolins in Pafos District. Using the estimates for the area of each main land use type in the district (as described in Methods), the figures in Appendix 2 were obtained. Altogether, these figures probably underestimate the numbers of males (or pairs since the species is monogamous, Snow & Perrins 1998), because, as suggested by Figure 2, making more counts would probably have added a few more birds to the Chrysochou counts, and in the same way the transect counts, although they typically lasted for about an hour, will almost inevitably have missed any birds not calling (sight records were rare). Further, birds in the grassland and uncultivated areas were sparsely distributed and probably called less as a result.

DISCUSSION

There is evidence that Black Francolin numbers have changed considerably in the past, and in 1989 were estimated to be as low as 150 birds in western Cyprus (Flint & Stewart 1992). The Cyprus Game and Fauna Service have used transect counts along minor roads to make counts of calling males (Hadjigerou *et al* 2004) and they estimated that in 2004 there were 36 000 birds in Pafos District which, even allowing for the release of captive-bred birds, seems to represent a remarkable increase. Their total of 36 000 in fact represented an estimated 6000 pairs, with each pair having produced four surviving young before the start of the hunting season in November. Even so, their figure is more than six times higher than my upper confidence limit for the period 2006–2011. And although my figures clearly suggest a declining trend in the past few years, the hunters themselves claimed to have shot 11 336 birds in the 2011–2012 season (N Kassinis pers comm). Other estimates include the figure of 2000–5000 pairs for the whole island by BirdLife International (2004). If the species now occurs in all parts of the island, as suggested by the BirdLife Cyprus

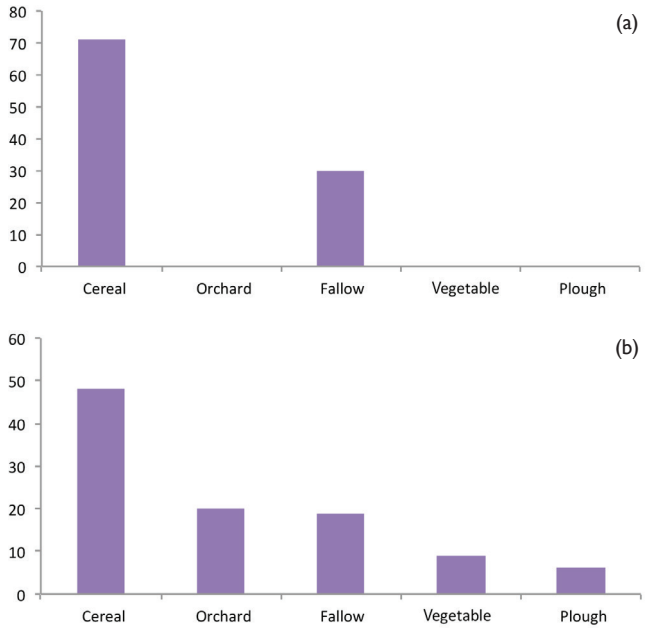

Figure 3. (a) Numbers of calling Black Francolins (expressed as percentages) in different land-use types in Chrysochou valley (n = 79), compared to the percentage frequency with which each land-use type occurred there in 2011(n = 100), as shown in (b).

annual reports for recent years, and Pafos District is 15% of Cyprus by area, this would give a figure of 300–750 pairs for Pafos District, fairly consistent with my estimates of 344–500 pairs. Both methods used in this study suggest an overall decline in numbers of Black Francolins over a period of five years. The final year, 2011, showed the biggest declines, possibly due to a shorter recording period than previous years, although the ten counts at Chrysochou should have been adequate. Agricultural intensification (Panayides *et al* 2011, Shirihai 1996) and too much hunting are possible reasons for declining populations of birds in farmland, but further studies are clearly needed to clarify this situation.

Both methods are relatively time consuming in relation to the amounts of data collected, meaning that Black Francolins are not easy to monitor. This is further complicated by the probability that birds at low density, receiving no answers to their calls, may call less frequently than those in areas of high density, such as the Chrysochou valley. If that is the case, then birds in areas of lower density are more likely to be missed, and their populations under-estimated, especially in vehicle counts, where a calling bird could only be heard for a few minutes (foot transects were compact in shape, and a calling bird would usually have been in range for at least half-an-hour). But the importance of Black Francolins to the hunting community necessitates a rigorous monitoring programme. The mapping of calling males, or the use of transect counting on foot, are likely to be the best methods.

As with many species it is usually best to make counts before 10.00 h and when the temperature is below 25°C. Surprisingly, counts were higher during the later periods of this study (Table 1), and presumably could have been higher still at even later dates. Small young of this species are observed late April–late August (BirdLife Cyprus annual bird reports) so egg-laying must begin by early April. Since many cereal fields have been cut by mid May, successful breeding presumably has either to be early, or in uncut fallow areas. The species is described by Snow & Perrins (1998) as omnivorous so the fact that many herbaceous plants are dry by May will not necessarily reduce the food supply available for both adults and young. Most species are more vocal when courting and earlier, rather than later, in the breeding season. From the evidence of this study, early morning counts in June may be the best, although this conclusion is only provisional. The evidence of Figure 2 indicates that most, though not all, birds had been recorded after *c*6–8 visits; perhaps fewer visits would be needed if counts were made later in the season. It is clear that, in western Cyprus at least, Black Francolins are heavily dependent on man-made habitats,

with cereal crops being particularly important, and other forms of land use holding far fewer (and none in some, Appendix 2).

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Appendix 1. Numbers of Black Francolins counted in the ten transects listed in Table 1 where they were recorded. Thus 2/1/1 means that 2, 1 and 1 birds respectively were recorded in three counts for that transect in that year. A blank indicates no counts.

	2006	2007	2008	2009	2010	2011
UNCULTIVATED						
Lara juniper	0	0	0/0/0	0/0	0/1	0/0
GRASS/PHRYGANA						
Kritou Terra	0/1	0	0/0	0	0/0	0
ARABLE						
low/mid-altitude						
Limni	3/2	2/0/2	2/1/0	1/2	2/1	2/1
Latchi	2/1	3/2/4	2/1/1	1/0	2/1	1
Nata		0/1/0	0/1/0	5/1	1/1	0/1
Terra	1/2	2/2/1	1/3/3	0/2	2/1	1/1
higher altitude[a]						
Drinia	0/1	0/1/0	0/0	0	0	
Arodhes	1/1	1/0/1	0/0	0	0/1	0/0
PERMANENT CROPS						
Ghoudhi: citrus/olive	0/1	0	1/0/0	0		

Neo Chorio: carob/olive	0	0	0/0	0	1/0	0/0
Total birds	16	22	16	12	14	7
Number of counts	18	22	26	15	17	14
Average number of birds per count[b]	0.89	1.00	0.62	0.80	0.82	0.50

[a] see text.

[b] strictly speaking, the averages are not quite comparable because of differences in numbers of counts per site between years.

Appendix 2. The population of Black Francolins in Pafos District calculated from transect data using DISTANCE. ESW = estimated strip width. LCL, UCL = lower, upper 95% confidence limits.

		Area (km^2)[a] of land-use type	**No. counts 2007–10**	**Length (km)**	**ESW (n = 127)**	**LCL**	**UCL**	**Total birds counted**
Forest		328	10	11.28				0
Uncultivated		345	10	9.90	97.0	80.8	116.6	1
Grass/phrygana		475	8	6.05				
Arable	Low	80	10	6.49	98.8	81.6	119.7	57
	Up	21	8	2.90				4
Permanent Crops		107	8	6.41	97.0	80.8	116.6	2
Built-up		40	9	7.14				0
Total		1396	63	50.13				

		Area surveyed (km^2)[b]		**Density (birds km^{-2})[c]**		**Total population[d]**	
		LCL	UCL	LCL	UCL	LCL	UCL
Forest							0
Uncultivated		16.00	23.08	0.0434	0.0625	15	22
Grass/phrygana							0
Arable	Low	10.59	15.41	3.70	5.38	296	431
	Up	3.79	5.51	0.725	1.06	15	22
Permanent Crops		8.287	11.938	0.168	0.241	18	25
Built-up						0	0
TOTAL						344	500

[a] from Pomeroy & Walsh (2006), with their 101 km^2 of arable divided into 80 for lowland (to 400 m asl) and 21 km^2 for upland (formerly grass/phrygana), this division being based upon field observation

[b] total transect length × no. of counts × LCL/UCL [in km^2] × 2. [× 2 because LCL/UCL apply to both sides of route]

[c] number of birds counted/area surveyed (= [b])

[d] density × area of land use type