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The breeding biology of Dupont's Lark, *Chersophilus duponti*, in Europe

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Abstract - Very little published information exists concerning the reproductive biology of Dupont's Lark, *Chersophilus duponti*, and what is available largely refers to the North African population. Here we present data from 33 nests found in southeastern (n=15) and central (n=16) Spain between 1989 and 1993.
The reproductive period extended from mid March to early July, a month longer than the North African populations. The laying period in SE Spain started more than a month earlier than in central Spain. Nests were placed on the ground, nearly always partially covered by shrubs (88 %), and oriented to the NW, N or NE (84%) of the closest plant. In SE Spain, this species appears to select nest site positions covered by shrubs 7-12 cm in height. No selection was evident in central Spain, where shrub height may be closer to the optimum required. Mean clutch size (3.6±0.6 sd) was larger than that reported for North Africa, but no differences were found between the two areas in Spain. Indications of asynchronous hatching were found, and appear to depend on clutch size. Mean egg length and width were 0.5 mm greater than those reported previously. The incubation period was 12-13 days. Nestling period was very short (8 days). Nest mortality was extremely high (84%), but egg hatchability was high (95.7%), and no nestlings starved (n=32). Coleopteran and lepidopteran larvae form 50% of nestling diet, but araneids (especially Lycosidae) are particularly important early in the nestling period.

Introduction

The basic aspects of the breeding biology of most European passerines are relatively well known (Cramp 1988). Dupont's Lark *Chersophilus duponti* is one exception in this respect. Due to its secretive behaviour, low population density and difficulty of finding nests, existing information concerning its reproductive biology is extremely limited (e.g. Cramp 1988).

Information on the breeding biology of this species refers largely to the Maghreb, North Africa, and large gaps exist in our knowledge of the species (Cramp 1988, Wunderlich 1987). Cañadas *et al.* (1988) provided data concerning the European population, but from a very small sample size (4 nests). Similarly, Herranz *et al.* (1993) presented information on the diet of nestlings based on a relatively small number of prey items (103) and nests (6).

The objectives of this note are (a) to contribute additional information concerning the reproductive biology of Dupont's Lark and (b) to compare data obtained in this study of the Iberian population with those obtained by Heim de Balsac and Mayaud (1962) in North Africa.

Methods

The major part of this study took place in two localities: Níjar, SE Spain (36°50' N, 2°25' W, 50 m asl) and Layna, in central Spain (41°05' N, 1°50' W, 1100 m). Both possess communities of birds representative of the two principal types of Spanish shrub-steppe habitats: the semi-arid in the first case and the "páramo" in the second (Suárez 1981, Tellería *et al.* 1988).

During an intensive study of reproduction in other lark species in both localities during 1989-93, 15 nests of Dupont's Lark were found in Níjar and 16 in Layna. Also included in the data on phenology and clutch size are records of two additional nests found in the localities of Baza (37°33'N, 2°42'W, 800 m) and Tobarra (38°29'N, 1°37'W, 500 m).

Nests were monitored almost every two days in Níjar (mean = 2.1 ± 1.1 sd days) and daily in Layna. Measurements of eggs (length and width) were made with calipers (accuracy ±0.05 mm). Weights of nestlings were determined using a spring balance (accuracy ±0.1 g). Nestling mortality was calculated using the method of Mayfield (Mayfield 1961, 1975) with modifications by Johnson (1979) and Hensler and Nichols (1981).

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Samples of nestling diet (159 prey items from 19 samples and 4 nests) were obtained using the "ligature" method (Johnson *et al.* 1980) in Layna during 1993. Prey were identified to the level of family whenever possible. Size of prey was considered as length of specimen without appendages; biomass (dry weight) was determined by drying in an oven for 3 hours at 90 °C (Quinney and Ankney 1985) and subsequently weighing with a precision balance (±0.1 mg).

Sample sizes used in the analyses of results varied considerably and are indicated in the text and tables whenever relevant. Furthermore, in determining phenology and clutch size, additional data from Cañadas *et al.* (1988) (n=4) obtained from the same area (Níjar), but in a different year (1986), are also included.

Results and Discussion

Breeding season

The laying period for this species appears to be relatively long, starting in the middle of March with the first egg recorded on 18 March and continuing until the beginning of July with the first egg of the last nest found on 3 July. The laying period is one month longer than in North Africa (Heim de Balsac and Mayaud 1962). Significant differences existed between the laying period in SE and central Spain, with first clutches appearing more than a month earlier in the former (mean dates of all clutches: 18 April and 5 May, n 14 and 15, SE and central Spain, respectively; Mann Whitney U test, U=4.5; $p<0.05$). This difference is presumably due to the warmer climate in the SE which has a much higher mean temperature in the first months of the breeding season. The last nests found in both localities appeared to be a result of secondary or substitution clutches, as is common for other lark species in Spain (Yanes and Herranz, unpublished).

Nest site selection

Nests (n=28) were situated on the ground and covered either partially by a shrub (89.3%) or a tussock of grass (7.1%); only one completely exposed nest was found (3.6%).

Shrubs covering the nests were generally less than 20 cm in height (mean=6.8±12.3 sd and 13.4±7.5; n=10 and 8 in Níjar and Layna, respectively). Comparison of the height of shrubs in which nests were found with the height of shrubs on a random sample (mean=26.0±14.5 in Níjar and 18.3±13.2 in Layna, n=60 in both cases), suggests that Dupont's Lark tended to select lower shrubs than those available in Níjar (Mann-Whitney U test; U=443, $p<0.05$), while in Layna there was no evidence of selection (U=184.5, $p>0.05$). Although the number of nests used in the analysis is low, the lack of apparent selection in Layna may be explained by the fact that the vegetation height of this shrub-steppe habitat is more similar to the optimum shrub height required for nesting sites by this species.

Positioning of nests in relation to shrub cover is remarkably constant. Most of the nests found (n 27) were oriented towards the NE (33.3%), N (25.9.%) or NW (22.2%). The proportion of nests with other orientations was small (7.4%, 3.7%, 0%, 3.7%, and 3.7% facing E, SE, S, SW and W, respectively). In the areas occupied by this species solar radiation and diurnal temperatures are extremely high (mean maximum temperatures during the breeding season: 25.4, 27.1, 31.1 and 34.2 °C in March, April, May and June, respctively, in Níjar, 27.1, 31.5 and 34.4 °C in May, June and July, in Layna) and nests appear to be orientated to gain shade and thereby avoid excessive heat.

In general, positioning of the nest is apparently similar to that of other larks found in Spanish shrub-steppe habitats (Cañadas *et al.* 1982).

Clutch and egg size

The clutch, as is common among passerines, was laid at a rate of one egg per day. A suggestion of asynchronous hatching was found, which appeared to depend on clutch size (i.e. synchronous hatching in two clutches of three eggs and asynchrony of one day in three clutches of four eggs).

Clutches size varied from three to five eggs (3, 40.0%; 4, 57.1%; 5, 2.9%; n=35). The mean clutch size of 3.6±0.6 sd was significantly larger than that found in North Africa (3.2±0.4, n=75) by Heim de Balsac and Mayaud (1962) ($X^2=9.21$, df=1, $p<0.05$). However, no differences were found between the two Spanish sites (3.7±0.6 and 3.6±0.5, n=17 and 16, respectively; $X^2=0.02$, df=1, $p>0.05$).

By dividing the data into two groups before and after the mean date of clutches in each locality, mean clutch size in Níjar was 3.7±0.8 for the earlier and 3.6±0.5 for the later period (n=7 and 8 nests). In Layna means for the two periods were 3.7±0.5 and 3.7±0.5 (n=10 and 6). Differences were not statistically significant in either case (Mann-Whitney U test; U=29 and 31, respectively, $p>0.1$). Thus, clutch size appeared to remain constant, or to decrease slightly, during the length of the breeding season.

Mean, standard deviation, maximum and minimum egg dimensions were as follows: length, 24.1±0.9, 25.9 and 22.3 mm; width, 17.7±0.5, 19.0 and 16.8 (n=48 eggs in 14 nests). Mean length and width of eggs was 0.5 mm greater than reported by Cramp (1988) for this subspecies (n= 14 eggs).

Incubation and nestling periods

The incubation period for one nest was 12-13 days, as reported by Cañadas *et al.* (1988). The nestling period was extremely short and the nest was always abandoned some days before the young were capable of flight (8 days, n=3 nests). The brevity of this period is typical among Palearctic ground-nesting species which suffer high mortality rates in the nest (Ricklefs 1969).

Weight increase of nestlings was extremely rapid (Fig. 1), reaching 20-23 g on leaving the nest. This weight increases after leaving the nest to approximately 30 g (n=6), when they were capable of taking their first flight. The young emit a short single syllable to attract the attention of the parents, similar to the last motif of the adult song.

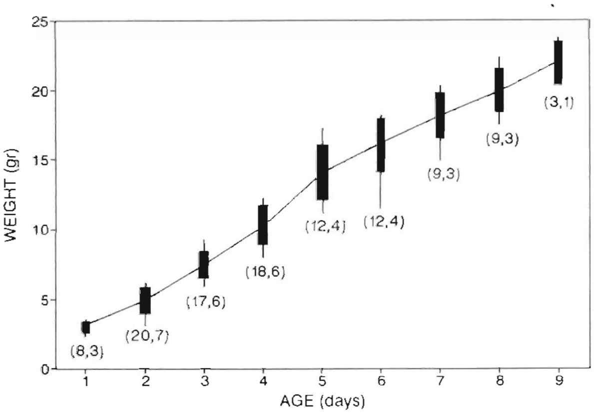

Figure 1. Mean, standard deviation, maximum and minimum values of nestling weight increase of Dupont's Lark (number of nestlings and nest in parentheses). Line shown point mean values.

Nestling mortality

Total nest failure (all eggs or chicks lost) was found to be very high (84%), and similar to that found in other passerines in Spanish steppes (Suárez and Manrique 1992, Suárez *et al.* 1993). Total nest failure during incubation was 51.7% (18 nests, 102 nest-days of observation, nest loss rate=0.059 nests/day). This value rose to 79.5% during the nestling period (18 nests, 79.5 nest-days observation, mortality rate 0.126 nests/day).

Egg hatchability was very high, 95.7% of the total of 69 eggs from 19 nests. No evidence of death by starvation was found in 32 chicks monitored in 9 nests.

Nestling diet

The taxonomic composition of the chick diet was characterised by the high frequency of spiders, especially Lycosidae, together with Orthoptera and larvae of Lepidoptera and tenebrionid Coleoptera, not only in abundance but also in frequency of occurrence in samples (Table 1). In terms of prey biomass, larvae of Lepidoptera and Coleoptera together comprised aproximately50% of the diet, followed by Aranea and Orthoptera.

By including the data of Herranz *et al.* (1993) gathered in Layna in 1992, and grouping the prey items into two periods (before and after 1 July, date of mean hatching period; n=173 and 77 prey items respectively), a significant variation in taxonomic composition of the diet was found (χ^2=25.9, df=11, $p<0.05$). In the later period the importance of araneids decreased, together with that of coleopteran larvae (χ^2=10.4 and 5.77, respectively, df=1, $p<0.05$), while the relative importance of Acrididae increases (Table 1; χ^2=15.5, df=1, $p<0.05$). The numerical importance of lepidopteran larvae remains constant (χ^2=0.03, df=1, $p>0.05$).

The relative importance of araneids in the nestling diet during the first period is particularly interesting. Although other larks also consume this type of prey, the proportion in the diet is notably smaller (e.g. Cramp 1988). Furthermore, most of these prey belonged to the family Lycosidae, suggesting a

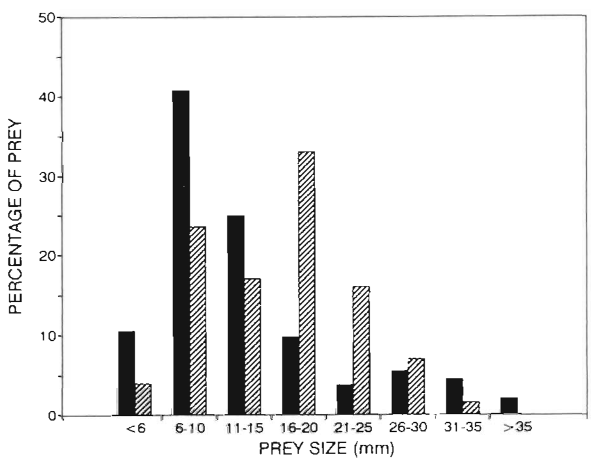

Figure 2. Prey size in the diet of Dupont's Lark nestlings in the locality of Layna, central Spain. Results are divided into two periods; before (filled, n=173) and after 1 July (striped, n= 77). Data of Herranz *et al.* (1993) are included.

Table 1. Taxonomic composition of the diet of Dupont's Lark nestlings. The results are divided into two periods, before and after 1 July, and are expressed as percentages of total prey items (N), total biomass (B) and frequency of appearance of taxa in total samples (F). Data of Herranz *et al.* (1993) are also included.

	Before 1 July			After 1 July		
	N(%)	B(%)	F(%)	N(%)	B(%)	F(%)
Mollusca. Gastropoda	1.2	1.0	10.5	2.6	1.7	15.4
Arthropoda						
Arachnida						
Araneae						
Ctenizidae	1.2	1.6	10.5	-	-	-
Eresidae	1.2	1.7	10.5	-	-	-
Araneidae	0.6	0.6	5.3	1.3	2.3	7.7
Lycosidae	23.1	17.8	78.9	7.8	27.3	38.5
Agelenidae	0.6	0.2	5.3	-	-	-
Salticidae	1.7	0.6	10.5	-	-	-
Drassidae	1.2	0.9	10.5	-	-	-
Thomisidae	4.0	4.6	26.3	-	-	-
Clutch bag	3.5	1.3	31.6	2.6	2.1	7.7
Araneae total	37.0	29.4	-	11.7	31.7	-
Insecta						
Thysanura						
Machilidae	0.6	0.1	5.3			
Hymenoptera						
Formicidae	5.2	0.1	10.5	1.3	0.01	7.7
Andrenidae	0.6	0.7	5.3	-	-	-
Larvae	0.6	0.1	5.3	-	-	-
Hymenoptera total	6.4	0.9	-	1.3	0.01	-
Orthopter						
Acrididae	6.9	3.0	31.6	33.8	31.1	84.6
Tettigonidae	0.6	0.4	5.3	7.8	6.9	46.0
Orthoptera total	7.5	3.4	-	41.6	38.0	-
Dictyoptera						
Mantidae	0.6	0.4	5.3	1.3	1.9	7.7
Phasmida						
Phillidae	-	-	-	1.3	1.2	7.7
Dipter						
Tipulidae	5.2	3.3	10.5	-	-	-
Syrphidae	-	-	-	2.6	0.5	15.4
Bombyliidae	-	-	-	3.9	0.8	7.7
Larvae	-	-	-	1.3	0.1	7.7
Diptera total	5.2	3.3	-	7.8	1.4	-
Hemiptera						
Cicadidae	-	-	-	1.3	2.6	7.7
Lepidopter						
Imagos	1.2	0.4	10.5	1.3	0.1	7.7
Larvas	16.8	17.0	78.9	22.1	14.2	92.3
Crisálidas	0.6	1.3	5.3	1.3	0.4	7.7
Lepidoptera total	18.5	18.8	-	24.7	14.7	-
Coleoptera						
Malachidae	0.6	0.1	5.3	-	-	-

	N(%)	B(%)	F(%)	N(%)	B(%)	F(%)
Apionidae	0.6	0.1	5.3	-	-	-
Carabidae	1.7	1.4	15.8	-	-	-
Scarabaeidae	3.5	4.9	21.1	2.6	3.6	15.4
Tenebrionidae	0.6	2.2	5.3	-	-	-
Chrysomelidae	0.6	0.2	5.3	-	-	-
Staphylinidae	-	-	-	1.3	1.8	7.7
Carabidae larvae	-	-	-	1.3	0.6	7.7
Scarabeidae larvae	0.6	0.8	5.3	-	-	-
Tenebrionidae larvae	12.7	26.6	47.4	1.3	0.8	7.7
Cerambycidae larvae	1.7	5.5	15.8	-	-	-
Coleoptera total	22.5	41.9	-	6.5	5.8	-
Vertebrata						
Scincidae (tail)	0.6	0.9	5.3	-	-	-
Prey items, biomass (mg), and samples number	173	3570	19	77	2038	13

positive selection for this taxon, which is not particularly frequent in Layna. During the second period the importance of araneids declined in favour of Orthoptera, a general phenomenon in the provisioning of nestlings in the majority of steppe bird species in Spain (unpublished data).

The length of prey varied from 3 to 40 mm (Figure 2), with almost 50% between 6 and 12 mm, similar to that reported by Herranz *et al.* (1993). Prey size varied between the two time periods, with a significant increase in size of prey items from a mean of 12.9±8.1 mm in the first period to 15.9±6.4 mm in the second ($n=173$ and 77 respectively; $U=4437$, $p<0.05$). This difference is probably a consequence of the mentioned shift in taxonomic composition of prey, but also due to the increase in the available size of grasshoppers, which were the principal prey items.

Concluding remarks

Although the results of this study are based on a relatively small number of nests, they present new information, and provide a better understanding of the breeding biology of Dupont's Lark, a rare and little-known European passerine.

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Resumen - La información publicada sobre la biología de reproducción de la Alondra de Dupont, *Chersophilus duponti*, es muy escasa y se refiere fundamentalmente a las poblaciones norteafricanas. En este artículo se presentan los resultados de 33 nidos encontrados en el sureste (n=15) y centro (n= 16) de la Península Iberica, correspondientes a los años 1989-93. El periodo de reproducción se extendió desde mediados de marzo hasta principios de julio, prolongándose un mes más que en las poblaciones del Magreb. El periodo de puesta comoenzó un mes antes en el SE que en el centro de España. Los nidos se situaron en el suelo, casi siempre cubiertos parcialmente por un caméfito (88 %), y orientados preferentemente hacia el NO, N y NE (84%). En el SE de Iberia la especie selecionó para ubicar el nido matorrales de altura comprendida entre 7-12 cm, mientras que en el centro peninsular no se encontró ninguna selección. El tamaño medio de puesta fué superior en la península que en el Norte de Africa, no encontrándose diferencias entre las dos localidades ibéricas. Existen indicios de eclosión asincrónica, que parece dependiente del tamaño de puesta. La longitud y anchura de los huevos fué 0.5 mm mayor que la publicada anteriormente. La duración de la incubación fué 12-13 días. El periodo de estancia de pollos en el nido fué muy corto, 8 días. La mortalidad de nidos fué extremadamente alta (84%), al igual que la fertilidad de los huevos (96%); no se registró ninguna muerte de pollos por inanición (n=32). Las larvas de coleópteros y lepidópteros comprendieron el 50% de la dieta de los pollos. Las arañas (especialmente Lycosidae) fueron también importantes al comienzo del período reproductor.

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