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DESKTOP ECOLOGY: SABOTA LARK *CALENDULAUDA SABOTA*

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Introduction

Observations by citizen scientists have advanced scientific knowledge in many fields of biology including the impacts of global climate change and invasive species, breeding phenology of animals, monitoring species or populations, landscape ecology, macro-ecology, disease, ecosystem functioning, and even the discovery of species new to science (Dickinson *et al.* 2012). One of its main advantages is using the collective interest and effort of a dispersed team of observers to obtain data on spatial and temporal scales not possible with more conventional field-based ecological studies.

In southern Africa, there is a considerable amount of data available in museums and various citizen science databases, e.g. the Southern African Bird Atlas Projects (SABAP), bird ringing (SAFRING) and the Birds in Reserves Project (BIRP), which may shed some light on a species ecology without the time constraints and expenses of field-based studies. A classic example using this approach is Tjørve's (2007) study of the Cape Sugarbird *Promerops*



Fig 1 - Representatives of the thick- (left) and slender-billed (right) groups within the Sabota Lark *Calendulauda sabota* complex.

cafer using Nest Record Card Scheme (NERCS) data to gain insight into its breeding phenology and breeding success.

Our aim was to perform a desktop study of the ecology of the Sabota Lark by collating data from various databases and collections. The Sabota Lark *Calendulauda sabota* is a southern African near-endemic with the largest distribution range of any southern African lark (*cf.* Dean 1997). It also exhibits considerable phenotypic variation across its range, particularly with regard to overall body size, bill size and shape, plumage colouration and behaviour (Clancey 1966; Engelbrecht 2012). This has led to the recognition of nine subspecies (Clancey 1966) which are usually divided into two groups, namely a thick- and a slender-billed group (Fig 1). The slender-billed group inhabits the more mesic eastern parts of southern Africa whereas the thick-billed group occupies the arid, western parts of the subcontinent. The results of this study will serve



as a base for a field-based study on the breeding ecology of the species and will reveal to what extent these databases corroborate data obtained from field studies.

Methods

Data from the NERCS, SAFRING and SABAP1 databases were obtained from the ADU. The following information was captured from NERCS records (where provided): breeding seasonality (backdated when possible), habitat and nest site characteristics, clutch size, egg dimensions and descriptions, duration of the incubation and nestling periods and any relevant additional notes on the cards. The approximate laying date, expressed as the month in which laying commenced, was estimated assuming a 12-day incubation and 11-day nestling period which seems to be the norm for similar sized southern African larks (*cf.* Hockey *et al.* 2005). NERCS breeding data was supplemented with data in the SABAP1 database. In all instances, locality data was used to assign a record to either the slender- or thick-billed group in order to determine if there is geographical variation in any of the parameters analysed in this study. The majority of cards represented a single visit and therefore it was not possible to calculate certain parameters such as breeding success.

For analysis of diet, stomach contents were obtained from the National Museum, Bloemfontein. A Leica EZ4 stereo-microscope was used to sort stomach contents into three categories, namely grit, plant or animal matter. Plant material included seeds or the remains of leaves or flowers. Seeds showed varying degrees of resistance to digestion and it was often impossible to distinguish partially digested seeds from other soft parts of a plant. Invertebrates were classified to order level using keys in Scholtz and Holm (1986).

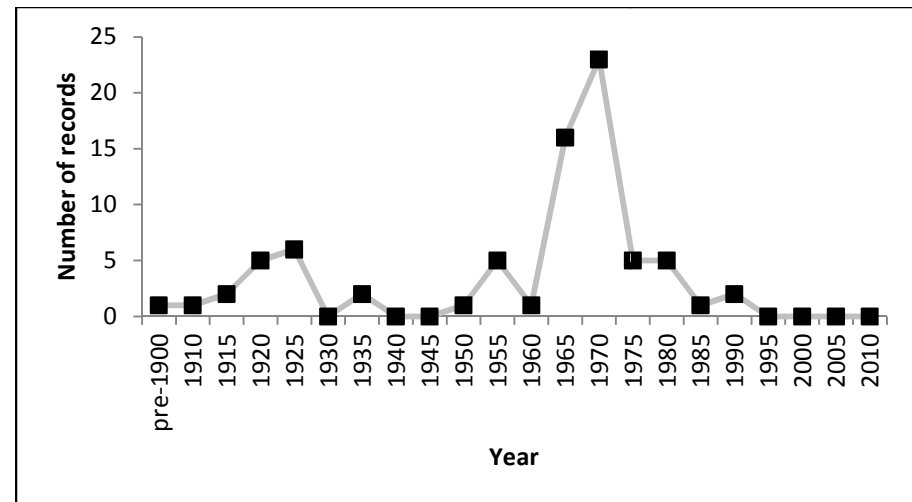


Fig 2 - Temporal distribution of NERCS records for the Sabota Lark *Calendulauda sabota* from 1886–2010 (n = 76).

SAFRING data was used to determine the timing of primary moult. The results were analysed using SPSS version 22 and Microsoft Excel. All results are reported as mean \pm SD.

Results and discussion

The NERCS database had a total of 76 nest record cards dating from 1886 to 1992 and represented records from throughout the species' range. There were interesting fluxes in records over the years, often coinciding with periods of global and national instability (Fig 2). For example, there were no records in the 1930s which coincided with the Great Depression of the early 1930s or during the period 1940–1945 which coincided with World War II. The majority of NERCS records (63.2%, n = 48) date from the mid-1960s to mid-1970s when there was a resurgence in interest in natural history studies. The last record for the Sabota Lark in the NERCS database was in 1992.

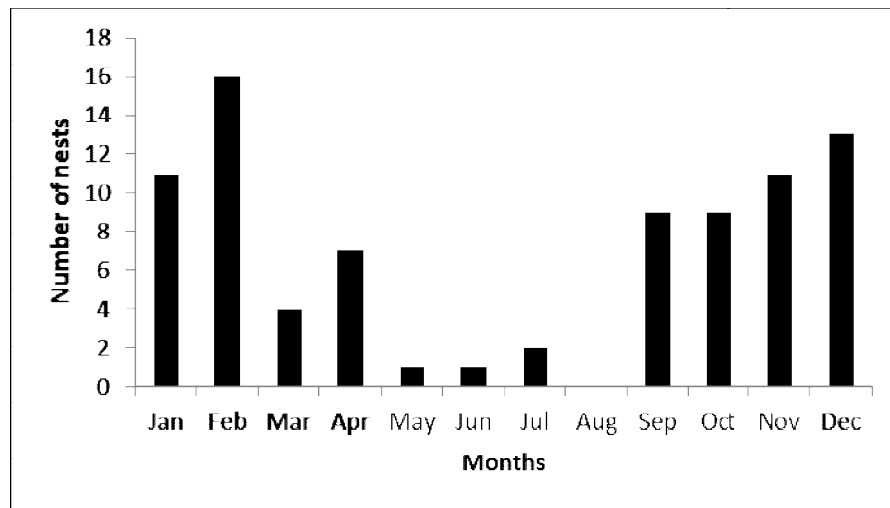


Fig 3 - Number of Sabota Lark *Calendulauda sabota* nests reported with eggs or nestlings from 1886–1992 (n = 76) as obtained from the NERCS database.

Breeding seasonality

The results of the analyses of NERCS and SABAP1 breeding records support Dean's (1997) finding that breeding in both groups coincides with the wet season (Fig 3). This is also the general pattern for most southern African passerines and in particular the mirafriid larks (*cf.* Hockey *et al.* 2005). However, the results showed geographical variation in the peak of breeding between the two groups: November to January (slender-billed group) and February to April (thick-billed group) (Fig 4). Both peaks in breeding coincide with the peak of the wet season in the mesic east and arid north-west of the subregion respectively. Most records from the extremes of the breeding seasons were single records and may represent opportunistic breeding attempts in response to erratic rainfall in the arid areas this group generally inhabits (Fig 5). However, it is also possible that observer effort is lower during the colder, winter

months, resulting in fewer records during this period.

Habitat and nest site characteristics

Fifty four (71.1%) of the NERCS cards provided information about the species preferred habitat and nest site characteristics. The majority of records described the macro-habitat as open *Acacia* savannah with sparse vegetation cover which is similar to the habitat preference described by Dean (2005). Other habitat types mentioned included *Burkea*, *Commiphora* and *Colophospermum mopane* woodland. Several records indicate nests situated on stony slopes or hillsides. They prefer nesting in open areas or clearings in savannah with sparse grass cover as this enables the incubating bird a good view to see potential predators from a distance away, yet provide sufficient cover to conceal the nest and to create a favourable micro-climate. Approximately half of all nests (51.3%, n = 39) were built at the base of a grass tuft, e.g. *Brachiaria* spp., *Stipagrostis uniplumis*, *Stipagrostis hochstetteriana* and *Enneapogon cenchroides*. Thirteen nests (17.1%) were situated adjacent to a forb, e.g. a "composite", a "small succulent plant", *Rhigozum* shrub, small *Aloe* species such as *A. davyana* and *A. transvaalensis*, and saplings of *Vachellia* spp. or *Colophospermum mopane*. One nest was placed underneath a rock and another beneath a dry cowpat.

NERCS nest entrance records (n = 12) revealed a preference for nests entrances facing in a southerly direction with 41.7% of the nests facing south, 16.7% south-west and 8.3% south-east. Two nests faced north (16.7%) and another two faced east (16.7%). This suggests a possible thermoregulatory adaptation to shield the nest during the hottest parts of the day. Several southern African larks' nest entrances face in a southerly direction (Boyer 1988; de Juana *et al.* 2004; Engelbrecht and Mathonsi 2012; Engelbrecht and Dikgale 2014).

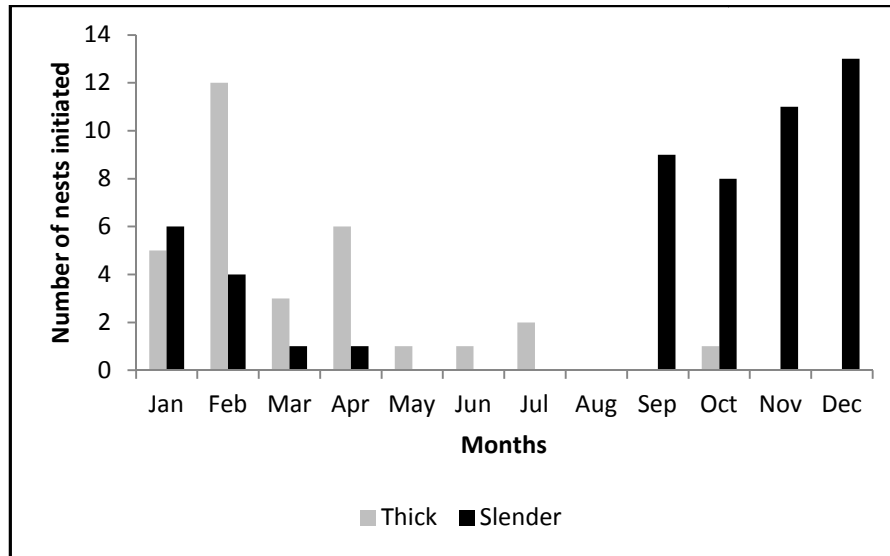


Fig 4 - Seasonal and geographical variation in the onset of breeding of the slender- and thick-billed groups of the Sabota Lark *Calendulauda sabota* from across the species range. Data obtained from the NERCS database.

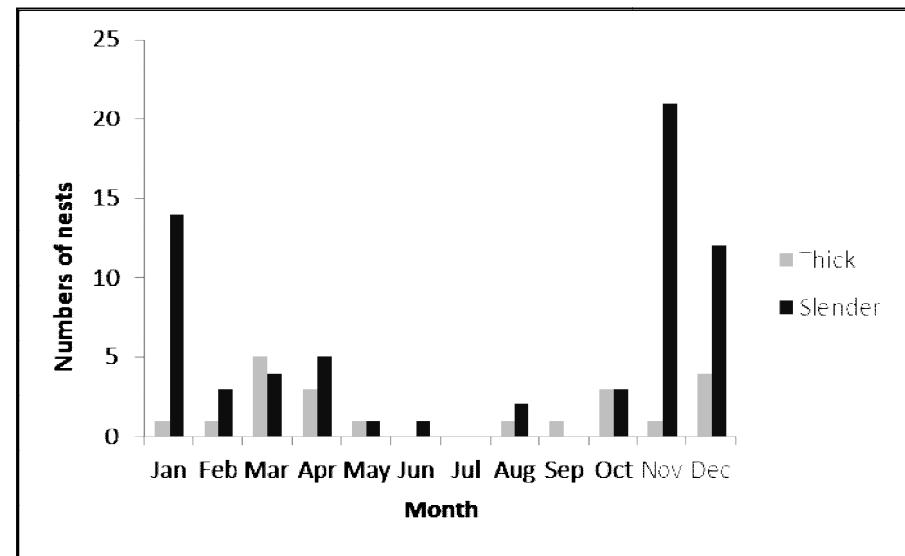


Fig 5 - Records of the breeding activities of the thick- and slender-billed groups of the Sabota Lark *Calendulauda sabota* across its range. Data obtained from the SABAP1 database.

Nest description

Most records described the typical domed nests of the genus, but there appears to be considerable variation with regard to how well the dome is developed. Descriptions of the dome varied from "flimsy" and "partial" to "thick" and "well developed covering the entrance". Variation in the quality of lark nests has been reported by several authors (Boyer 1988; de Juana *et al.* 2004; Engelbrecht 2005; Engelbrecht and Mathonsi 2012; Engelbrecht and Dikgale 2014) although the reasons underlying the variation are not always obvious. Interestingly, two records explicitly mentioned the absence of a dome. Boyer (1988) also reported an undomed nest of the Dune Lark *Calendulauda erythrochlamys*. According to Keith *et al.* (1992), nests tend to be undomed when it is already shielded by vegetation,

but Boyer (1988) suggested that experience may also play a role with first breeding females constructing nests with partial or flimsy domes. Two records included descriptions of an apron, i.e. an extension of the nest entrance. In both instances the material used for the apron was dead grass. There is much speculation about the functional significance of an apron and hypotheses suggest improving camouflage, thermoregulation and experience (Orr 1970; Afik *et al.* 1991; de Juana *et al.* 2004; Engelbrecht 2005; Engelbrecht and Dikgale 2014).

Description of the eggs, their dimensions and clutch size

All records described the eggs as having a white base with brown and grey speckles concentrated at the obtuse end which is the same



as described by Dean and Keith (1992). A summary of the egg dimensions and clutch sizes for the thick- and slender-billed groups reported on NERCS cards are presented in Table 1. Once again the results showed evidence of geographical variation in egg dimensions and clutch size. Not surprisingly, eggs of the thick-billed group tended to be larger than those of the slender-billed group although the difference was not statistically significant (Mann-Whitney U test, $P > 0.05$). The mean clutch size was 2.6 ± 0.7 (range: 1–5, $n = 67$) and compares well with the mean clutch size of 2.3 reported by Dean and Keith (1992). However, the mean clutch size of the thick-billed group was significantly larger compared to the slender-billed group (T-test, $P < 0.001$) (Table 1). This is unusual as other studies of larks found a general tendency for clutch sizes to decrease with an increase in aridity (Tieleman *et al.* 2004). An alternative explanation could be that the erratic rainfall patterns in the arid western regions may result in opportunistic breeding when conditions are favourable, resulting in larger clutch sizes to compensate for poor breeding when conditions are less favourable. There was an unusual record of a clutch of five eggs in the NERCS database which is larger than the clutch size of any southern African lark. This is clearly exceptionally large and may be a case of egg-dumping by another female/s or a case of mistaken identity by the observer.

Duration of the incubation and nestling periods and breeding success

Very few nests included multiple observations over a sufficiently long period to determine the duration of the incubation and nestling periods or breeding success. However, one record showed incubation is at least 10 days long, and most records of the nestling period showed that nestlings are fully feathered and capable of moving around when 10 days old. There was also a record that reported fledged young flying approximately 10m just after fledging.

Table 1. Egg dimensions (thick-billed: $n = 12$ eggs; slender-billed: $n = 9$ eggs) and clutch sizes (thick-billed: $n = 26$; slender-billed: $n = 41$) of the thick- and slender-billed groups of Sabota Lark *Calendulauda sabota* as obtained from NERCS records. Significant differences were set at $P < 0.05$.

	Thick-billed	Slender-billed	
	Mean \pm SD., range	Mean \pm SD., range	<i>P</i>
Length (mm)	21.2 ± 0.7 , 19.9–21.8	20.6 ± 0.8 , 19.6–21.8	0.3
Width (mm)	15.4 ± 0.3 , 14.9–15.7	15.2 ± 0.5 , 14.3–15.6	0.3
Clutch size	2.9 ± 0.8 , 1–5	2.3 ± 0.5 , 1–3	< 0.001

Diet

According to Willoughby (1971) and Kopij (2005) the Sabota Lark is primarily granivorous and occasionally feeds on insects. Analysis of stomach contents ($n = 35$) confirmed this with vegetable matter (mainly seeds) recorded in 91.4% of stomachs and invertebrates recorded in 88.6% of stomachs. Figs 6 and 7 include examples of seeds and invertebrates found in stomachs. Invertebrate remains included mostly beetles (Coleoptera, 57.1% of stomachs) and termites (Isoptera, 54.3% of stomachs). Other invertebrates recorded were ants (Hymenoptera, 11.4%) and grasshoppers (Orthoptera, 8.6%). There were single records of a soft-bodied worm, a small snail, maggots (Diptera) and a faecal sac in stomachs. All stomachs contained a small amount of grit. One stomach contained small pieces of glass which was recorded as grit (Fig 7). Unfortunately the sample sizes were too small to determine if the species exhibits seasonal or geographical variation in its diet.

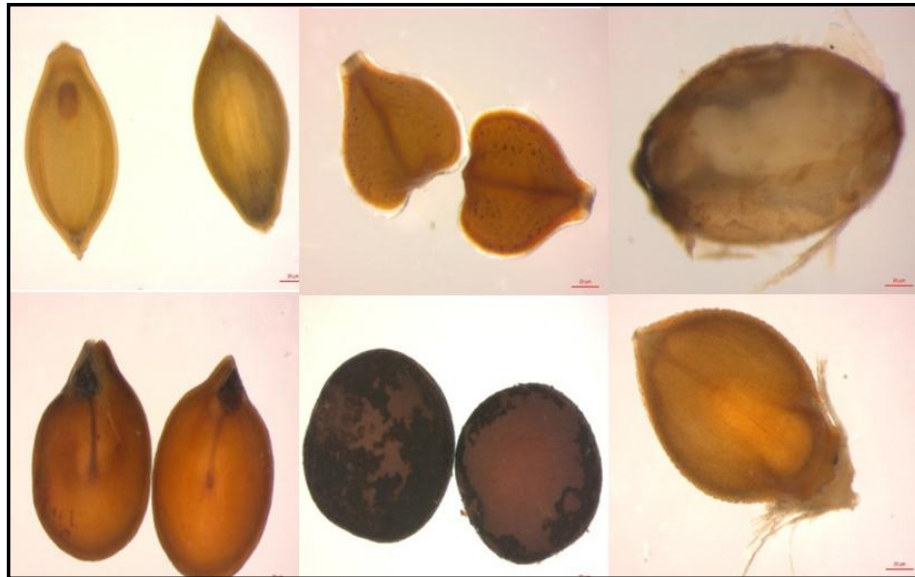


Fig 6 - Examples of different types of seeds found in Sabota Lark *Calendulauda sabota* stomachs in the collection of the National Museum Bloemfontein.

Moult

Analysis SAFRING data shows that the Sabota Lark undergoes the usual lark pattern of scheduling moult to commence at the end of the breeding season (de Juana *et al.* 2004). Since the two groups exhibit geographical variation in the onset and termination of their breeding seasons, it is not surprising that there is also geographic variation in the onset of moult. In the slender-billed group, moult started in February/March and primary moult appears to be completed in about May/June. The limited data for the thick-billed group confirms a post-breeding moult with primary moult 50–70% completed by June/July, suggesting a later onset of primary moult. The results of this study contradict Hall's (1956) finding that moult of the slender-billed group in north-eastern Botswana was nearly completed in November. Since

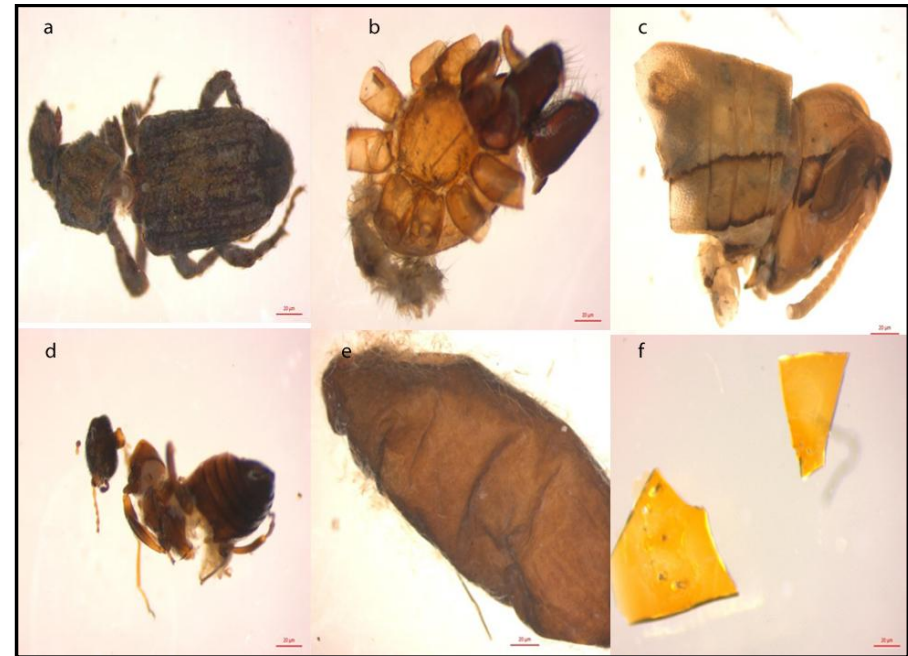


Fig 7 - Examples of a) a beetle (Order Coleoptera), b) a spider (Arachnida), c) a grasshopper (Orthoptera), d) an ant (Order Hymenoptera), e) a faecal sac and f) pieces of glass found in the stomachs of Sabota Larks *Calendulauda sabota* in the collection of the National Museum Bloemfontein.

Hall (1956) does not indicate which feathers were moulting, it is not possible to provide an explanation for this seemingly out of season strategy. It is possible that it may have been a partial pre-breeding moult or perhaps only the inner secondaries that were replaced during the breeding season as is common for some larks (Herremans and Herremans 1992; de Juana *et al.* 2004).

In conclusion, the results of this desktop study showed that various



databases exist with a wealth of information which may contribute to our knowledge and understanding of the life history of poorly known species. The present study revealed geographical variation in the onset of the breeding season, clutch size and moult.

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Acknowledgements

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