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ECOLOGY

A DESKTOP STUDY OF THE ECOLOGY OF THE AFRICAN QUAILFINCH *ORTYGOSPIZA ATRICOLLIS* IN SOUTHERN AFRICA

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Introduction

The African Quailfinch's somewhat enigmatic status as a ghostly denizen of open grassy areas is justified, because one seldom gets a clear view of an individual. Their presence is usually revealed by its characteristic contact calls in flight or when they gather in flocks to drink (Penry 1986; Nuttall 1992, 1993) (Plate 1). Although it is common throughout its range, little is known about its general ecology and behaviour *in situ*. In fact, most of our knowledge of the African Quailfinch's natural history is either based on information obtained from captive birds or based on anecdotal observations (Goodwin 1982; Alderton 1986; Brickell 1986; Nuttall 1992; Avicultural Research Unit 1997). However, there may be differences in the behaviour and physiology of captive and wild animals and some authors advise that data from individuals in captivity should only be extrapolated to the field with caution (Kleiman 1989; Snyder *et al.* 1996; Geiser and Ferguson 2001; Gilby *et al.* 2013). The only study of the breeding ecology of individuals in the wild is limited to Nuttall's (1992) study of four nests in KwaZulu-Natal, South Africa.

The African Quailfinch is endemic to sub-Saharan Africa. Its preferred habitat is open, short, grassy areas in semi-arid grassland and savannah near open water, but they also frequently inhabit marshy grounds, fallow lands and cultivated crop lands (Nuttall 1997; Payne 2010). Although the species features prominently in specialist avicultural collections (Alderton 1986), the main source of captive birds are wild caught specimens. As a result concerns have been raised about unsustainable harvesting in parts of its range (Leader-Williams and Tibanyenda 1996; Patterson 2001). Successful conservation of a species necessitates a thorough understanding of its distribution, abundance, habitat preferences and movements across a wide geographic area, as well as fundamental natural history information such as breeding ecology and nesting success parameters and this is where citizen science has the potential to make a major contribution (Hochachka *et al.* 2012).

Plate 1 - African Quailfinches seldom remain in the open for long.

Despite our generally poor understanding of the ecology of African Quailfinches *in situ*, various citizen science databases contain a potential wealth of data which may shed light on some aspects of the biology and ecology of this species without the costs and time involved in field-based studies. For example, Tjørve (2007) and more recently Mashao *et al.* (2015) showed that Nest Record Card Scheme (NERCS) data can provide valuable insights into the breeding biology of poorly known species. Other databases which may also prove valuable include museum records and data from the Southern African Bird Atlas Projects (SABAP1 and 2), SAFRING and the Birds in Reserves Project (BIRP).

Here we report the results of a desktop study aimed to shed light on the biology of the African Quailfinch using data in the NERCS and SAFRING databases. This data has been collected by professional and citizen scientists over many years and represent a largely unexploited source of information on various aspects of a species' biology. The information obtained here will serve as a baseline for a field-based study on the breeding ecology of the species.

Methods

Data collection

Data from the NERCS and SAFRING databases were obtained from the Animal Demography Unit (ADU) at the University of Cape Town, South Africa. To summarise breeding data in the NERCS database, the following parameters were recorded: year, approximate onset of laying, nest and microhabitat characteristics, egg mass and dimensions, clutch size, breeding success and possible causes of nest failure. The date of the onset of laying was estimated by backdating using an incubation period of 15 days and nestling aging criteria given by Nuttall (1992). Clutch size was defined as the maximum number of eggs found in the nest during the incubation period. Because most NERCS cards included only a single visit to a nest it was not possible to reliably estimate clutch size in many instances. Obvious incomplete clutches (e.g. abandoned or predated) and nests first found in the middle to late nestling period were excluded. Thus, clutch size was only recorded if i) the clutch size remained the same on at least two subsequent visits separated by at least two days, or ii) if there was at least one visit during the incubation period and if the number of young and unhatched eggs matched the number of eggs recorded during incubation. Despite these conditions, we still evaluated each record individually to determine if it should be included based on information provided on the cards.

Where records were sufficiently detailed, e.g. a minimum of three visits and the outcome of the breeding attempt was known, the breeding success was calculated using Mayfield's (1975) method. Causes of breeding failure were also noted. Since the NERCS records span a wide geographical area, the data was grouped into three regions: a northern region which includes all the records from Zimbabwe, a central region which includes the Limpopo, Mpumalanga and Gauteng provinces of South Africa, and a southern region which includes the Free State, KwaZulu-Natal and the Eastern Cape provinces. This allowed us to investigate possible seasonal or geographic variation in certain parameters. We also analysed SAFRING data to describe the timing of primary moult of adults.

Statistical analyses were performed using R (R Core Team 2013) and Microsoft Excel (2013). The Mayfield (1975) breeding success estimator was used to calculate the hatching rate, the daily survival rate for the incubation (DSRi) and nestling (DSRn) stages independently, the hatching rate (HR) and the overall breeding success, i.e. for all three stages combined. To determine if there are any geographic differences in any of the parameters analysed, the data was first tested for normality to determine if parametric or non-parametric tests should be used.

Results and Discussion

Nest records

The NERCS database contained 243 cards spanning 85 years from 1906 to 1991 (Fig 1). The records revealed interesting temporal

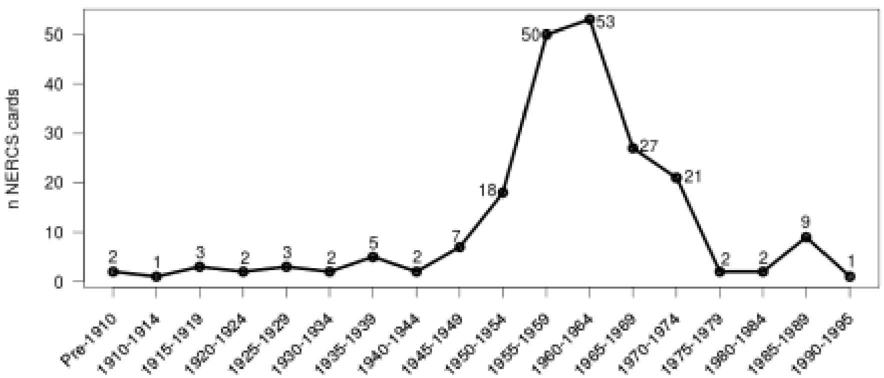

Fig 1 - Temporal distribution of nest records (n = 210) of the African Quailfinch in the NERCS database.

variation in the number of records submitted. Of the 210 cards with the year indicated, 169 cards (80.5%) were from the period 1950-1975, with 49% of all the cards in the decade from 1955 to 1965 (Fig 1). Similar patterns of temporal variation in the number of NERCS cards were also found for the Gurney's Sugarbirds *Promerops gurneyi* (Tjørve 2007), Pink-billed Lark *Spizocorys conirostris* (Engelbrecht and Mathonsi 2012) and Sabota Lark *Calendulauda sabota* (Mashao *et al.* 2015), and may be attributed to a greater general interest in collecting natural history data during this period.

Seasonality

According to the NERCS records, the African Quailfinch has a prolonged breeding season in southern Africa spanning nearly all months of the year (Figs 2 and 3). According to the literature, breeding spans November to May in the subregion but with a peak in late summer (Irwin 1981; Nuttall 2005). The seemingly "out of season" breeding attempts in August reported here may represent opportunistic breeding attempts in response to unseasonal rainfall in those areas. This is not unusual as most birds respond largely to extrinsic factors such as temperature and rainfall (Leitner *et al.* 2003; Verhulst and Nilsson 2008). Food abundance or the availability of nesting materials for suitable breeding conditions also helps to maximize breeding success (Immelman 1971; Lloyd 1999; Dawson *et al.* 2001; Hau *et al.* 2004; Barrientos *et al.* 2007). When one of these conditions is met, birds may respond by initiating breeding. However, it is often the interplay of two or more of these conditions that maximizes breeding success. It is therefore not surprising that according to inscriptions on the cards all these unseasonal breeding attempts in August were unsuccessful.

These opportunistic attempts aside, the results of this study confirm that breeding occurs mainly in the second half of the wet season, i.e. January to March, in southern Africa (Fig 3). Throughout much of the African Quailfinch's range in southern Africa, the peak of the wet season is November and December (Mucina and Rutherford 2006).

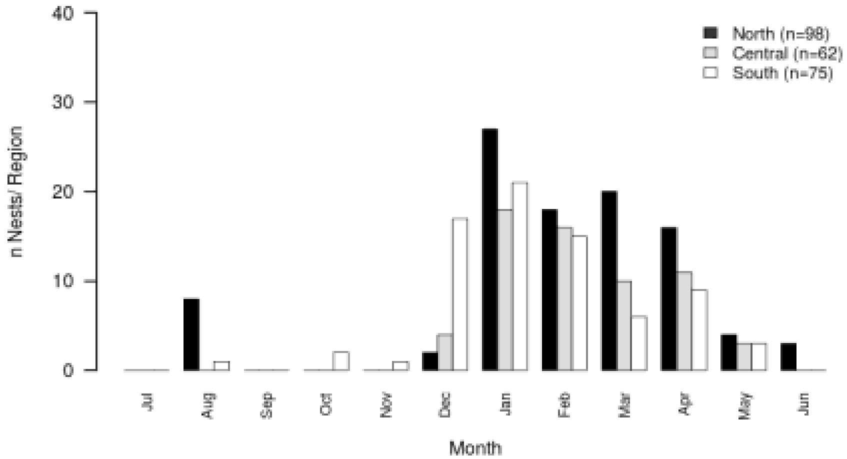

Fig 2 - Breeding seasonality of African Quailfinch in the northern, central and southern regions of southern Africa using NERCS records.

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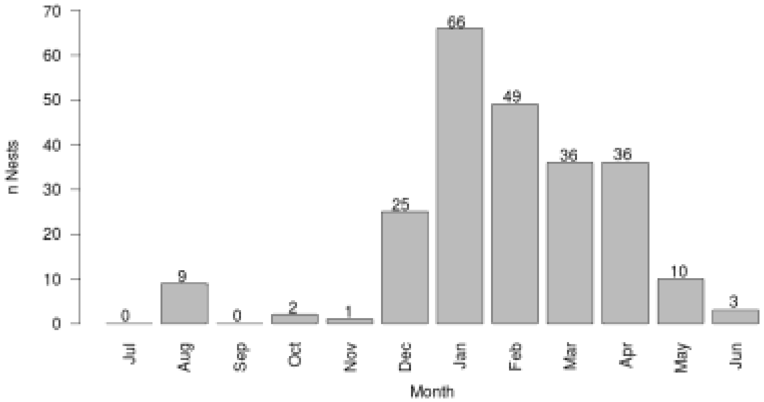

Fig 3 - Monthly distribution of nests records of African Quailfinch in the NERCS database in the period from 1906 to 1991.

Since the diet of African Quailfinch nestlings comprises almost entirely of seeds, the peak breeding season of African Quailfinches coincides with the period when most grasses have set seed. This ensures an abundant supply of food for nestlings.

Microhabitat and description of the nest

There were relatively few NERCS records (n = 9) describing the nest and nest site characteristics. Nevertheless, the descriptions compare well with those given by Penry (1986) and Nuttall (1992, 2005): a ball-shaped nest with a side entrance constructed on the ground within, on or between grass tufts. According to most records, nests are constructed of coarse and dry grass blades, lined with finer grasses and feathers. However, one record indicated that the nest was constructed with green grass blades and covered with living grass. Four records indicated that feathers were used as lining and one specified that the dome of the nest also contained white down.

Although most records described the entrance as a wide, side entrance, there was a single record describing the nest entrance as a short tubular tunnel. This is unusual because according to Nuttall (2005) and Tarboton (2011) the nests of African Quailfinches do not have an entrance tunnel. Five records mentioned the presence of a bare patch or clearing in front of the nest entrance, a nest characteristic also alluded to by Nuttall (1992). One record stated: "*Long grasses in front of nest chewed off. He was trying to clear the front of his hut.*" The functional significance of such a clearing is unknown, but Nuttall (1992) suggested that it may serve as a courtship arena, as a landing and take-off area or to improve visibility of the surroundings from within the nest.

A few records provided details about inter- and intraspecific nest spacing. One record mentioned the nest of a Cape Longclaw *Macronyx capensis* approximately 4.6 m from the nest of an African Quailfinch. Two other records stated: "*Nest of same species 6 feet* [approximately 2 m] *away*" and "*There are three African Quailfinch nests in the immediate area*". Such close distances are unusual because the species is generally regarded as a solitary nester with nests typically 12-20 m apart, although they are known to nest in loose associations on rare occasions (Tarboton 2011).

Description of the eggs, egg dimensions and clutch size

Nine cards described the eggs as white or pure white, one as being "*white-cream coloured*" and another card mentioned the eggs had "*an orangey cast*". Sixteen NERCS cards provided the dimensions of 63 eggs and the mass of five eggs. The dimensions of an additional two eggs were excluded from the analyses as the length of one was abnormally long (19.8 x 10.5 mm) and the other card described it as "about 12 x 10 mm" which is both insufficiently accurate and unusually small compared to the other dimensions provided. The dimensions of eggs in the NERCS database are summarised in Table 1 and correspond well with values given by Maclean (1985): length $\bar{x}$ = 14.4, range 12.7–16.5; width $\bar{x}$ = 11.1, range 10.4–12.9, n = 115.

According to the clutch size criteria used in this study, the mean clutch size of African Quailfinches in the NERCS database was 4.9 ± 1.0 (range 3–6, n = 72). Although there were small differences in the clutch size between regions (northern: $\bar{x}$ = 4.6, n = 24; central: $\bar{x}$ = 5.0, n = 21; southern: $\bar{x}$ = 5.0, n = 27), these differences were not statistically significant (One-way Anova, F = 1.64, *P* = 0.2). Whether the smaller clutch size of northern populations is an artefact of the NERCS data or actually represent real geographical variation in clutch size would be an interesting avenue for future research. In particular, it needs to be established if the August records were opportunistic breeding attempts or if it represents the start of a prolonged breeding season in some regions. Such an extended breeding season could explain smaller clutch sizes because birds will have smaller clutch sizes per breeding attempt but will compensate for this by having multiple brooding attempts (Farnsworth and Simons 2001).

Table 1 Egg mass (g, n = 5) and dimensions (mm, n = 63) of the African Quailfinch as obtained from NERCS records.

	Maximum length	Maximum width	Mass
Min	13.0	10.0	0.85
Max	16.6	12.3	1.00
Mean	14.5	11.3	0.92
SD	0.70	0.55	0.06

Breeding success

Forty nests met the criteria for calculating breeding success using Mayfield's (1975) estimator. Of these, 21 failed in either the laying or the incubation stage and nine during the nestling stage. Young fledged at 10 nests. Of the 167 eggs laid in the 40 nests, only 44 nestlings fledged, giving a crude breeding success estimate of 26.3%. Using Mayfield's (1975) breeding success estimator, the daily survival rate during incubation was DSRi = 0.91 (26%), the hatching rate (HR) was 0.89 and the daily survival rate during the nestling period was DSRn = 0.95 (51%). The overall breeding success using this method was 10.1% which compares well with published estimates of the breeding success of several other estrildids in southern African: 18.3% for the Orange-breasted Waxbill *Sporaeginthus subflavus* (Colahan 1982), 18% (Barnard and Markus 1990) and 33% (Skead 1975) for the Blue Waxbill *Uraeginthus angolensis* and 10–27% for the Green-winged Pytilia *Pytilia melba* (Skead 1975; Barnard and Markus 1990).

Forty-six cards provided details about the causes of nest failure. The main causes were predation (n = 21) and trampling (n = 11). Other causes of failure listed included flooding and observer bias. A few cards gave details about the nest predators or causes of nest failure and these included small rodents, Meerkat *Suricata suricatta*, Striped Polecat *Ictonyx striatus*, Secretarybird *Sagittarius serpentarius*, humans (card states "probably human predator"), trampling by cattle and horses, and a mower ("*…this was found after the mower has passed over it in the process of cutting grass for bedding*"). Three cards clearly indicated that the nests were deserted, e.g. "*…Nest contains desiccated remains of chicks*". Two cards attributed the cause of nest failure to the observer having caused damage to the nest and/or eggs during data collection.

Moult

The SAFRING database contained 1024 African Quailfinch records with 291 providing information on moult. After eliminating those records that did not include birds in active moult or those that contained obvious errors, we were left with 122 records of adults in active primary moult. These records span all months of the year except June (Fig 4), but it is highly skewed with 68% (n = 83) of the records from July and August and the sample size for most of the other months being less than five.

In common with many other estrildids, the primary moult pattern seems complex. According to Nuttall (2005), primary moult in a population from the central Free State of South Africa starts in October and is protracted over a 12 month period. Unpublished data of RJ Dowsett (cited in Nuttall 2005) from southern Zambia shows a pre-breeding moult which is completed by November/December, but it is not clear if the pre-breeding moult also includes the primaries.

Although the sample sizes are rather small, a close inspection of SAFRING data shows what appear to be two waves of primary moult

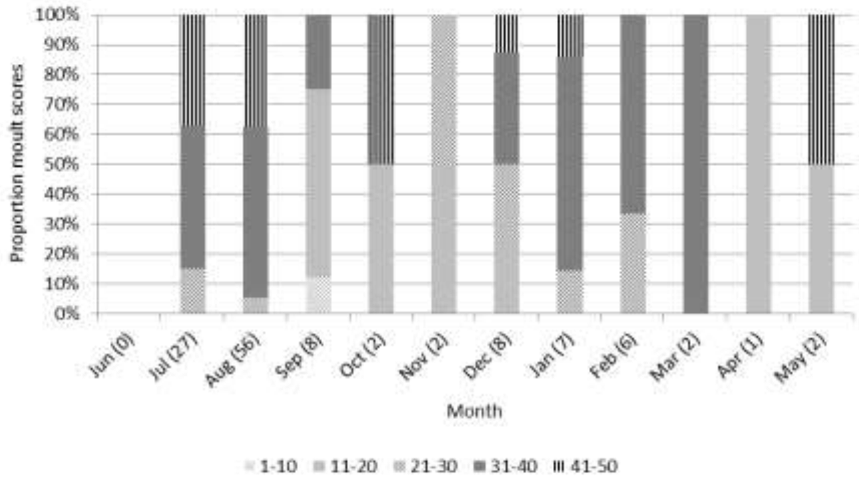

Fig 4 – Numbers of African Quailfinches in active primary moult in each month with the relative contribution of their moult scores.

per year. The first corresponds to a typical post-breeding moult pattern and commences in about April/May whereas a second wave commences at the end of winter/early spring (Fig 4). It is possible that birds finishing breeding late in the season suspend or delay moult in winter until spring, or they may undergo a partial moult of the contour feathers (excluding the flight feathers) at the end of the breeding season followed by moult of the flight feathers in spring and early summer. If primary moult is protracted as suggested by Nuttall (2005), it is likely that birds will suspend primary moult during the breeding season as breeding and moulting are usually mutually exclusive for small passerines.

In conclusion, the present study provided valuable information on the breeding biology of the African Quailfinch. It demonstrated that the various citizen science databases possess a wealth of information which may improve our knowledge of secretive and poorly known species. This, in turn, can serve as a baseline for the design of field-based studies or provide basic knowledge to inform biodiversity management decisions.

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