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Ornithology

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Abstract

A series of sightings of the Ayres's Hawk-Eagle *Hieraaetus ayresii* were made over two summers in 2020/21 and 2021/22 from a property in Fellside, north-eastern Johannesburg. Sightings of the species were of individual birds in flight over the Linksfield Ridge and Louis Botha Avenue, both located a short distance to the south of the observation location. It is postulated that the combination of an abundance of prey in the form of Rock Doves *Columba livia* that inhabit the built-up urban environment of Louis Botha Avenue in high densities and the presence of a well vegetated (effectively wooded) ridge in close proximity appear to be the factors that draw the species to this particular location within Johannesburg. Although the sighting records did not form part of a dedicated monitoring protocol, the observations of the species were submitted to the Second Southern African Bird Atlas Project (SABAP2), and these and other records of the species in Johannesburg and Pretoria have been analysed to gain an understanding of the timing of the species' occurrence within the urban centres of Gauteng. The wider SABAP2 dataset indicates that the species has been most commonly recorded in mid-summer, with the next highest monthly recording rates being for spring and early summer. Further monitoring and observations for the presence of this species are recommended in areas of suitable habitat within Johannesburg (ridges in close proximity to concentrations of Rock Dove populations) to determine if it favours such locations and occurs more widely and commonly than currently understood.

Introduction

The Ayres's Hawk-Eagle *Hieraaetus ayresii* is an enigmatic and uncommon raptor species, with many aspects of its movement and occurrence over its range being poorly understood (Taylor et al. 2015). The species falls within the *Hieraaetus* genus and is a small eagle that feeds on avian prey, mainly in the form of small birds (Hockey et al. 2005). The species is an intra-African migrant to South Africa, visiting the country during the southern summer (Jenkins 1997), with one breeding record (Roberts & Chittenden 2020).

The species' distribution in South Africa is patchy; records from the Second Southern African Bird Atlas Project (SABAP2) (Underhill 2016, Underhill et al. 2017, Lee et al. 2022) are primarily concentrated within the Lowveld of the Limpopo and Mpumalanga Provinces and the coastal areas of northern KwaZulu-Natal (Figure 1). A small cluster of records of the species exists for Pretoria and Johannesburg. It is in the context of the latter city that a series of observations of the species were made over two years in the summers of 2020/21 and 2021/22 from a location in the suburb of Fellside in Johannesburg that is located close to Houghton and the Linksfield Ridge.

Background to the occurrence and behaviour of the Ayres's Hawk-Eagle in South Africa

The Ayres's Hawk-Eagle is considered rare throughout its range (Brown et al. 1982) and is indeed considered as a rarity in South Africa. Its distribution is poorly understood (Hockey et al. 2005) and the status of this species in South Africa is considered an enigma (Taylor et al. 2015). The species' movements are complex, being considered a resident in other parts of its range in Africa, nomadic, or an intra-African migrant (Hockey et al. 2005). Birds occurring in South Africa are non-breeding summer migrants with the peak period of occurrence being January to April (Jenkins 1997).

The species typically occurs in climax broad-leafed woodland forest edges, usually in hilly terrain (Taylor et al. 2015). The species can however occur locally commonly on the edges of urban centres in north-eastern South Africa, including Mbombela (formerly Nelspruit), Pretoria and Johannesburg. The occurrence of the species in wooded suburbia in certain South African cities is mirrored in Zimbabwe, having been recorded in these areas outside the breeding season (Hartley & Mundy 2003). The species has been noted to often roost in stands of *Eucalyptus* trees (Dewhurst et al. 1988).

Individuals tend to occur singly outside of the breeding season (Taylor et al. 2015). Birds are typically inconspicuous when not breeding, with individuals spending long periods of time perched within the canopy of a tree (Taylor et al. 2015)

The species feeds almost exclusively on birds (Tarboton 1989) and its primary prey is pigeons and doves (Steyn 1982). It is an accomplished hunter of pigeons; thus several individual birds may be attracted to areas where pigeons abound (Taylor et al. 2015). Birds are either hunted from a perch, or on the wing, with the bird engaging in a steep dive from a soaring altitude (Brown et al. 1982). The capture of prey that commences with a steep dive from a soaring position is the most likely hunting method utilised (Steyn 1982). During the dive the wing tips are held tightly to the tail in a highly aerodynamic position (Brown et al. 1982).

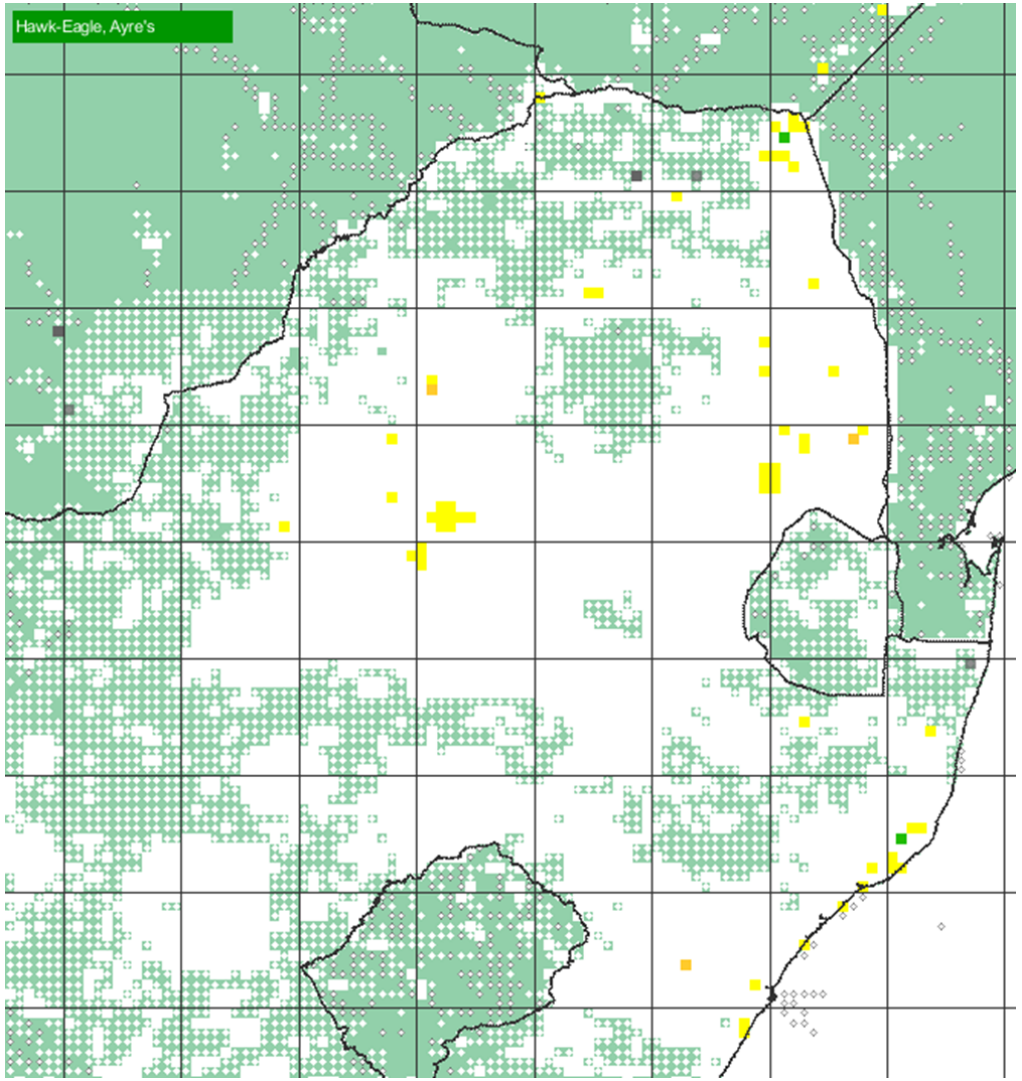

Figure 1: SABAP2 distribution of Ayres's Hawk-Eagle in north-eastern South Africa. See Underhill & Brooks (2016) for a guide to the interpretation of this map.

Record of Ayres's Hawk-Eagle Sightings in the summer months of 2020/21 and 2021/22

A series of sightings of the Ayres's Hawk-Eagle were made from September 2020 to March 2021 and from October 2021 to March 2022 from the property in which the author resides in Castle Street, Fellside. Fellside is a small suburb that is located in the north-eastern suburbs of Johannesburg, adjacent to Houghton to the west, Orange Grove to the east and Norwood to the north (Figure 2). Fellside is located in close proximity to Louis Botha Avenue and the Linksfield Ridge. Louis Botha Avenue, a busy arterial road, comprises the southern boundary of Fellside. Planning permissions have historically permitted the construction of low-rise multi-storeyed (typically three-four storeyed) buildings along Louis Botha Avenue, most of which are utilised for residential and commercial purposes (Figure 3). The stretch of Louis Botha Avenue that is located on Fellside's southern boundary is located in relatively close proximity to the northern side of the Linksfield Ridge. The Linksfield Ridge forms part of a series of quartzite ridges that comprise an important and prominent part of Johannesburg's topography. The Linksfield Ridge forms part of a wider east-west ridge system, stretching from Gillooly's Farm in the east towards Parktown in the west.

Thirteen sightings of Ayres's Hawk-Eagles from September 2020 to March 2022 were made from my residence in Castle Street, Fellside (Table 1). Sightings occurred in clusters in the spring (September) and late summer (February to March) in both summers (Table 1). The sightings were of birds in flight over the Linksfield Ridge and Louis Botha Avenue towards the south and south-east of the residence. Louis Botha Avenue and the taller buildings along the road provide habitat for large numbers of Rock Doves *Columba livia* which constitute the prey of Ayres's Hawk-Eagle. They are located c. 100–150 m from the viewing location; Linksfield Ridge is c. 350–450 m away.

Wherever possible, the sightings were recorded and submitted to SABAP2 as part of full protocol field lists (Underhill 2016). The vantage point is located within SABAP2 pentad 2605_2800, and close to the boundary with the pentad to the south (2610_2800) (Figure 2), within which the Linksfield Ridge is located. The Ayres's Hawk-Eagle sightings were thus submitted for either of these pentads, dependent on the position of the eagle when first observed. Note that the Linksfield Ridge extends eastwards into pentad 2610_2805, and it is possible that sightings could also occur in this pentad.

The vantage point does not have a clear view of the Linksfield Ridge, because the ridge is largely obstructed by buildings and tall trees in the intervening area. However, Ayres's Hawk-Eagle flying above the ridge were visible. The observations reported here do not represent detailed monitoring to determine the presence of this species in the vicinity of Fellside and the Linksfield Ridge; they consist of incidental observations. The timing of the observations coincided with the COVID-19 pandemic, during which many employers mandated a work from home policy for their employees. I worked from home during this period, thus assisting in ability to make observations.

Behavioural aspects apparent from the Ayres's Hawk-Eagle sightings

Each sighting consisted of a single Ayres's Hawk-Eagle (Table 1). Birds of different plumage were observed, with adult birds observed displaying the typical heavy barring on the underparts that characterises most adults of this species (Figure 4). A paler form bird was observed over a number of consecutive days in early March 2021, and this bird was assumed to be a juvenile bird based on its colouration (Figure 5).

Sightings of the species were almost exclusively limited to either the mid-morning or the late afternoon (Table 1). The presence of the species in flight during the mid-morning could be explained by the development of thermal updrafts as the day begins to heat up and such updrafts develop, with raptor species typically using the heating of the day and the appearance of thermals in the mid-morning to assist in becoming aerial.

Afternoons were the period of day at which Ayres's Hawk-Eagles were most regularly observed to utilise the wind (if windy conditions

Table 1: Records of sightings of Ayres's Hawk-Eagle in flight over the Linksfield Ridge and Louis Botha Avenue, Johannesburg, between September 2020 and March 2022. Each sighting was of a single bird.

Date	Approximate time	Age	Behaviour	Notes
12 September 2020	15h25	Adult	Flying along ridge and engaging in dives towards buildings on Louis Botha Avenue; later mobbed by Pied Crow while flying low along ride	Windy afternoon – bird was flying eastwards into the wind
7 February 2021	15h30	Adult	Circling above ridge.	Later, bird had an aerial confrontation/ interaction with an African Harrier-Hawk
2 March 2021	09h20	Unknown	Flying along the ridge; mobbed by Pied Crows	
8 March 2021	09h25	Likely juvenile	Flying along ridge; mobbed by Pied Crows	
9 March 2021	09h00	Unknown	In flight	
12 March 2021	08h55	Unknown	In flight, engaging in dives towards Louis Botha	
13 March 2021	11h40	Likely juvenile	Soaring along ridge, watching ground below	
14 March 2021	07h20	Unknown	Flying low over the ridge and Louis Botha Avenue	
15 March 2021	15h25	Likely juvenile	Circling at higher slightly higher altitude, and engaging in some dives towards Louis Botha; being mobbed by Pied Crows	
16 March 2021	13h00	Likely juvenile	Flying low along ridge line	
17 March 2021	10h35	Likely juvenile	Flying very low along ridge line	
14 September 2021	17h00	Adult	Flying along ridge; mobbed by Pied Crow in flight	
1 February 2022	17h05	Adult	Flying northwards from the Linksfield Ridge	A number of other raptors were present aerial-ly over the ridge, including a Peregrine Falcon and Booted Eagle

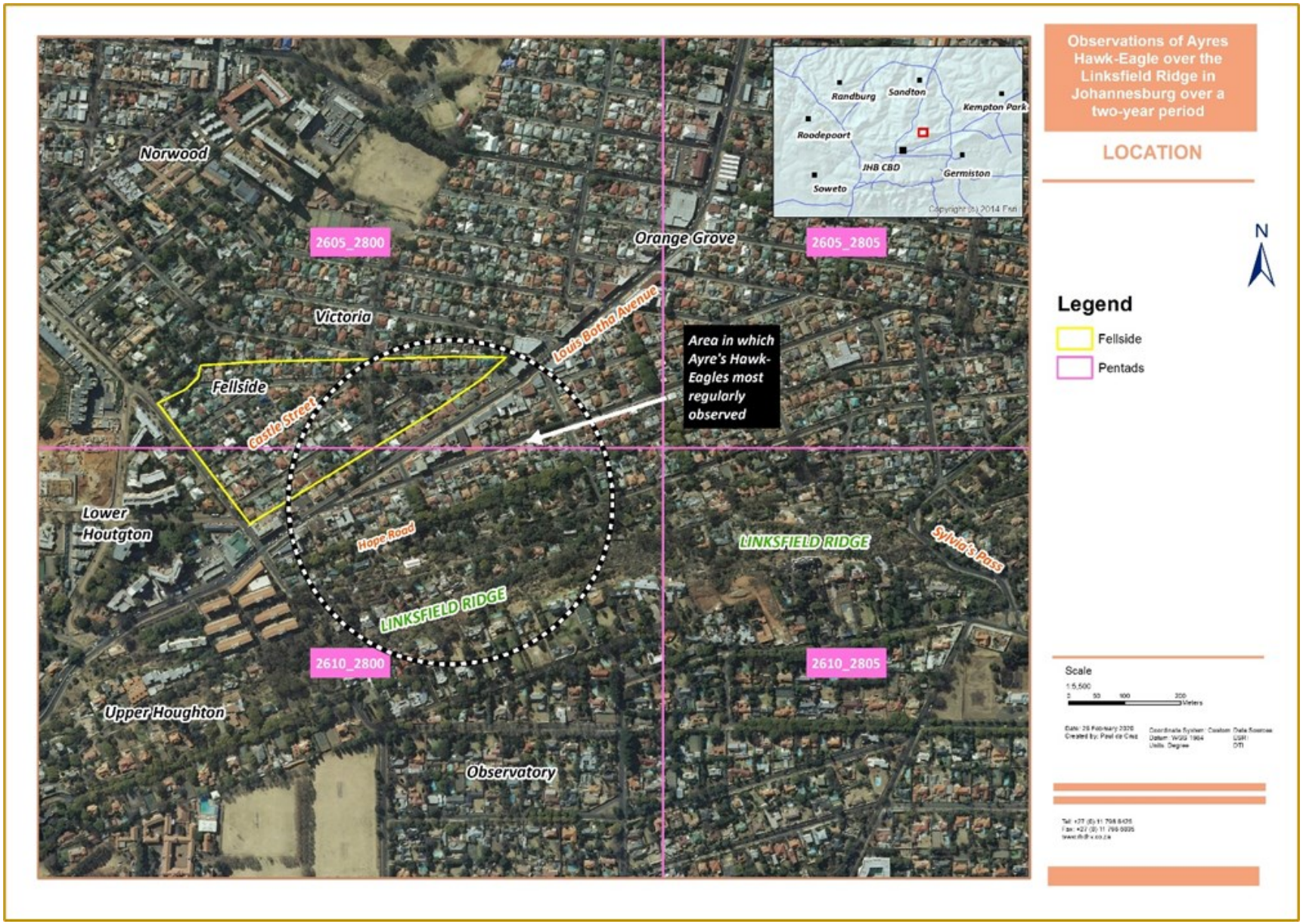

Figure 2: Location map of the Ayres's Hawk-Eagle sightings in Fellside, in relation to Louise Botha Avenue and the Linksfield Ridge, Johannesburg.

Figure 3: A view of Louis Botha Avenue, Johannesburg, with the Linksfield Ridge in the background.

Figure 4: An adult Ayres's Hawk-Eagle in flight over the Linksfield Ridge, Johannesburg, recorded in February 2021.

were present). On these occasions the eagle observed would typically fly roughly parallel to the Linksfield Ridge in an easterly direction, utilising a northerly or north-easterly wind to slowly drift (i.e. applying 'static' soaring) above the area to the north of the ridge, often with its head pointed downwards, presumably scanning the area below for its avian prey. The bird would disappear from sight, reappearing from the west a few minutes later and repeating the eastward path along the ridge.

On more than one occasion birds were observed engaged in a steep dive from soaring/drifting flight. Diving and associated aerial pursuits have been documented as a common hunting method of this species (Steyn 1982, Hockey et al. 2005). Diving appeared to be limited to the adult birds observed. Due to the distance of the vantage point from the likely target of such aerial dives and the intervening obstructions between it and the buildings on Louis Botha Avenue, I was not able to ascertain whether these presumed hunts were successful, but in many of the cases the bird was visible in the sky soon afterwards, suggesting that the hunting attempts were unsuccessful. When faced with the presence of a raptor in close proximity to their preferred habitat of multi-storeyed buildings along Louis Botha Avenue, the response of Rock Doves is typically to take to the air in small to medium sized flocks, grouped tightly in rapid flight and flying at a fair distance above the ground, and this behaviour was always observed when an Ayres's Hawk-Eagle was present above Louis Botha Avenue (Figure 6). Flocking behaviour has been reported for Rock Doves, with flocks of Rock Doves manoeuvring together in flight (Hockey et al. 2005). Flocking behaviour decreases the likelihood of predation ("the dilution

Figure 5: Successive photographs, probably of the same individual bird, recorded in March 2021 over the Linksfield Ridge, Johannesburg. Clockwise from top left: 8 March, 13 March, 15 March, and 15 March.

effect"), making it difficult for the predator to select and chase a single prey individual within the flock ("the confusion factor") (Phelan 1987). The combination of the superabundance of Rock Doves as prey along the buildings of Louis Botha Avenue and the presence of a well vegetated (effectively wooded) ridge in close proximity appear to be the factors that draw the species (and other raptor species that prey on birds) to this particular location within Johannesburg. The urban environment in the vicinity of Louis Botha Avenue and surrounds provides habitat for large numbers of Rock Doves. Rock Doves are well

Figure 6: An Ayres's Hawk Eagle juvenile in the air above the Linksfield Ridge close to a flock of Rock Doves forming a defensive aggregation.

adapted to urban environments and can be described as 'synurbic' (McPherson et al. 2021), defined as a species that has become highly successfully adapted to an urban environment (Parker & Nilon 2012). The Rock Dove is a synurbic species which benefits from the anthropogenic environment through sociality, tolerance of human proximity, having a catholic diet and a capacity for feeding innovations, as well as large breeding productivity (McPherson et al. 2021). The multistorey buildings which line Louis Botha Avenue and which are clustered in nearby parts of Houghton and Norwood provide ample nesting and roosting habitat for hundreds of these doves. The poor state of refuse collection and disposal along some parts of Louis Botha Avenue and surrounds is likely to be a strong factor in enhancing the foraging opportunities and availability of food to sustain large numbers of birds in the urban environment. My observations of

Rock Dove behaviour over the time period of the observations of the Ayres's Hawk-Eagle have indicated that flocks of Rock Doves move from Louis Botha Avenue to other foraging areas, including properties on the northern side of the Linksfield Ridge in the vicinity of Hope Road and Terrace Road. These large numbers of potential avian prey are attractive a number of raptor species which hunt birds. Black Sparrowhawks *Accipiter melanoleucus* and Ovambo Sparrowhawks *A. ovampensis* are two of the most commonly occurring resident raptors in the northern suburbs of Johannesburg; sightings of Peregrine Falcons *Falco peregrinus* are made less regularly in the vicinity of the Linksfield Ridge. Although not preying on adult birds, the African Harrier-Hawk *Polyboroides typus*, another commonly occurring resident raptor in Johannesburg, is also expected to be attracted to the habitat of the Rock Doves to prey on the chicks of nesting birds. Sightings of Booted Eagle *Hieraaetus pennatus* over the ridge have also been made during the reporting period.

The presence of the Linksfield Ridge is also believed to be an important factor in the occurrence of the Ayres's Hawk-Eagle and other raptors in this part of Johannesburg. Within Pretoria, also in Gauteng, the species has been reported in association with similar ridges that occur within the city, and where it is estimated that 8 to 10 individuals occur in summer, mostly between December and March (Taylor et al. 2015). The northern side of the Linksfield Ridge in the vicinity of Upper Houghton and Mountain View (the two suburbs located to the south of Fellside and Louis Botha Avenue where the Ayres's Hawk-Eagle sightings were clustered) is characterised by large properties with established gardens and large numbers of mature tall trees. The 'wooded' nature of the ridge arguably provides suitable and attractive habitat for raptor species such as the Ayres's Hawk-Eagle with ample wooded cover, roosting and perching locations and arboreal vantage points. The existing literature on the species suggests that it prefers wooded habitat in hilly terrain often in suburbia on the edges of large urban centres in north-eastern South Africa and Zimbabwe (Steyn 1982, Jenkins 1997, Hockey et al. 2005).

There are many large gardens with mature trees in the suburbs of northern and north-eastern Johannesburg, but the combination of a ridge and an abundant prey source in close proximity to each other are likely to be the key factors in attracting Ayres's Hawk-Eagle and other raptors to this location within Johannesburg.

Ridges are often favoured by raptors because they are utilised in conjunction with horizontal wind flow to extract energy as they transit through local steady-state updrafts in orographic lift (Koessler 2018). The ridge deflects wind vertically, allowing a bird to gain lift. This 'static' soaring technique requires the bird to maintain nearly constant bank and pitch angles, where the rate of energy increase is based primarily on position and orientation within the flow field (Koessler 2018). The wind direction on days when sightings of the Ayres's Hawk-Eagle were made was mostly from the north or north-east. These windy conditions, when present in the area would allow this and other raptor species to undertake static soaring over the northern side of the ridge, thus placing the raptor directly overhead the buildings along Louis Botha Avenue where the potential prey source is concentrated. The presence of numerous raptor species in and around the ridge appears to indicate that the combination of suitable wooded habitat, favourable topography, and the abundance of prey species (especially avian prey) makes the Linksfield Ridge a local raptor hotspot in the city (pers. obs).

Assessment of species movement patterns and occurrence within Johannesburg

Although the records reported here did not form part of a dedicated monitoring protocol, these observations of Ayres's Hawk-Eagles over a roughly two-year period were submitted to the SABAP2 project. These and other records of the species in Johannesburg can be utilised to gain an understanding of the timing of the species' occurrence within the city.

Data for records of Ayres's Hawk-Eagle were downloaded from the SABAP2 website (https://sabap2.birdmap.africa/species/140) on 11 April 2022. Analysis of SABAP2 data has been undertaken to determine whether the observations of Table 1 corresponded with the time of year of records within Johannesburg. Furthermore, the bi-weekly reports of South African Rare Bird Alert were consulted for records of

Ayres's Hawk-Eagles in Johannesburg, because this species is considered a rarity within Gauteng.

These observations of Ayres's Hawk-Eagles were submitted to SABAP2 on checklists for two pentads, 2605_2800 and 2610_2800. For the latter pentad, three records of the species exist, all contained in Table 1. Four of the eight records for pentad 2605_2800 are in Table 1. The other records consist of one in March 2017 and three in February 2021 (Figure 7).

The only other pentad in Johannesburg for which records of the species exist is 2605_2755, located directly to the west of 2605_2800, and which encompasses some north-western suburbs of Johannesburg such as Northcliff, Weltevreden Park and parts of Randburg. Thirteen SABAP2 records exist for the pentad and were made between December 2018 and early January 2019 (Figure 7). A search of the archives of the South African Rare Bird News Group yielded three relevant records. One was made in Northcliff for 6 December 2018 (https://groups.google.com/g/sa-rarebirdnews/c/nrLSrzFleMA/m/gzHdmJqUBQAJ). Northcliff is located in pentad 2605_2755 and the date of the record coincides with the dates of several of the atlas checklists which recorded the species; it is therefore possible that the record in the rare bird report is also recorded on an atlas checklist.

The two other records of Ayres's Hawk-Eagles in the rare bird reports were made on 19 February 2018, single bird recorded in garden in the suburb of Highlands North, and on 24 February 2017, a juvenile flying over Northcliff Ridge. Neither correspond to SABAP2 records. The SABAP2 dataset and South African Rare Bird News Report records for Johannesburg as a whole appear to indicate that the species is most often present in mid to late summer, December to March; there are two spring (September) records (Figure 8).

The occurrence of the species in Pretoria is relevant due to the relatively small distance (c 50 km) between the two the study areas in Johannesburg and the pentads in Pretoria where most records of Ayres's Hawk-Eagle have been made. The vast majority of SABAP2 records for Pretoria emanate from four pentads within central and

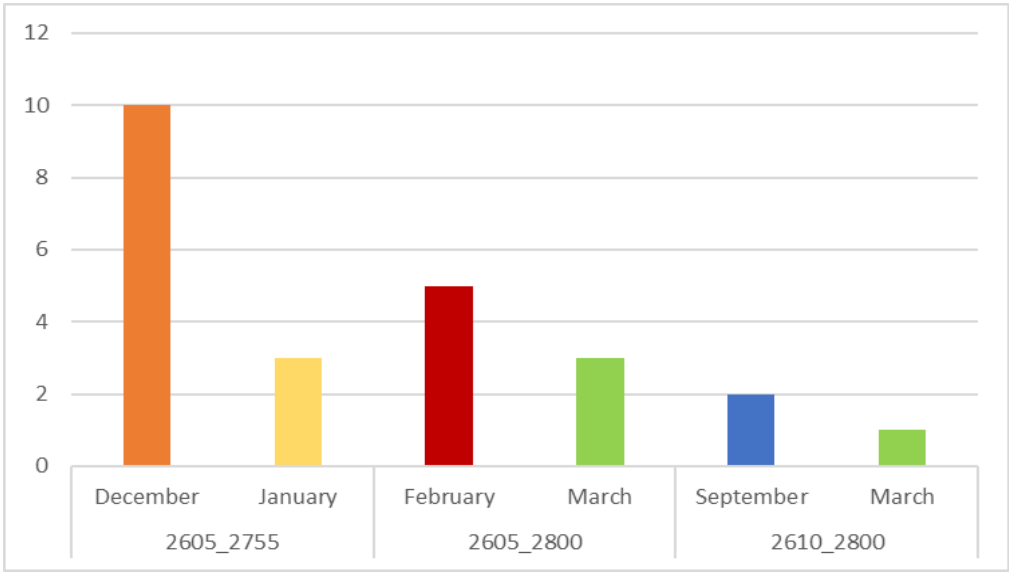

Figure 7: Numbers of SABAP2 records of Ayres's Hawk-Eagle per month for three pentads on Johannesburg.

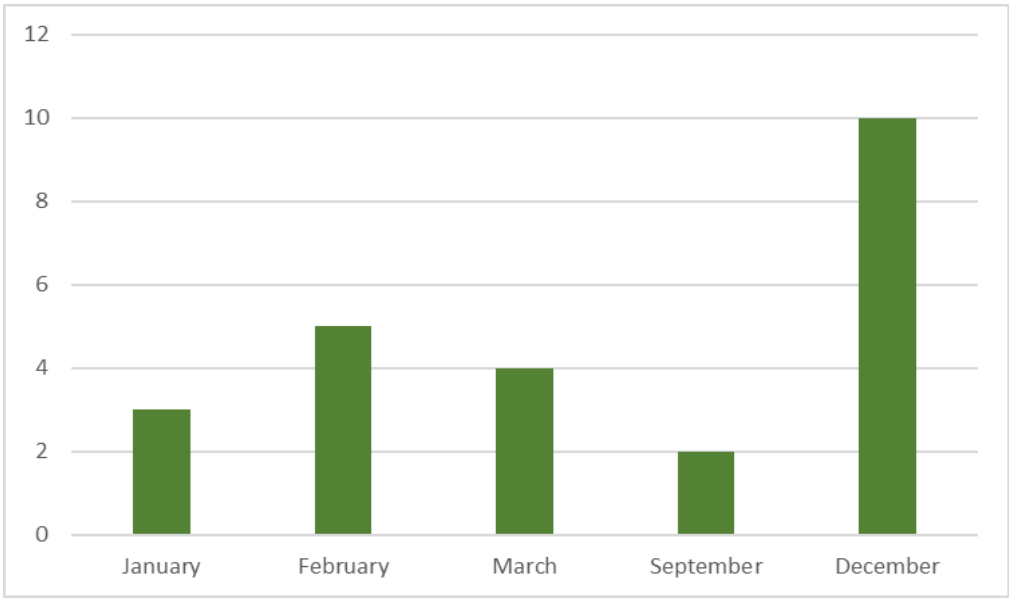

Figure 8: Numbers of records from SABAP2 and the South African Rare Bird News Report for Ayres's Hawk-Eagle per month in Johannesburg.

north-eastern Pretoria (Figure 1). The much larger dataset of records for these four pentads in Pretoria (Figure 9A) shows a wider variation of occurrence across the summer months, with the highest number of records being for December, with a slightly lower number of records for September, October, November and February. This suggests that the species occurs evenly across the summer in Pretoria, occurring most regularly from spring to mid-summer with a small peak of occurrence in February. Some of the smallest numbers of records were for March, suggesting that the species is much less likely to occur in the city in late summer/autumn. When the datasets for the two cities were combined, each of the six months between September and February have more than 10 records, with a peak in December (Figure 9B).

The possible trend of occurrence that could be derived from the set of records made by the observer as part of a larger dataset of SABAP2 records for Johannesburg and Pretoria is that the species appears to occur most regularly in mid to late summer, as evidenced by the records in December and February. The larger Pretoria dataset indicates a smaller but still notable number of records in spring to early summer. The species does not appear to be commonly present on return migration in late summer to March. The SAPAP2 dataset thus appears to slightly contradict the existing understanding of the species' being most likely to occur from January to April, in that records for the species drop off markedly in Johannesburg and Pretoria in March and April. Ayres's Hawk-Eagles occurring in suburban areas of Gauteng appear to most commonly occur in mid-summer, with lower, but still notable presence in spring and early summer. What appears to be evident, however, is that the species occurs very sparsely, with reporting rates in the respective three pentads within Johannesburg in which the species has been recorded of around 0.5% for each pentad and a slightly higher series of reporting rates for three of the pentads in Pretoria in which the species has been most regularly recorded from 1.5%, 1.8% to 2.9%. All of these pentads have large numbers of field lists over a period of sixteen years since the SABAP2 project commenced, thus lending credence to the conclusion that the species occurs very sparsely in the Pretoria-Johannesburg area (Figure 1).

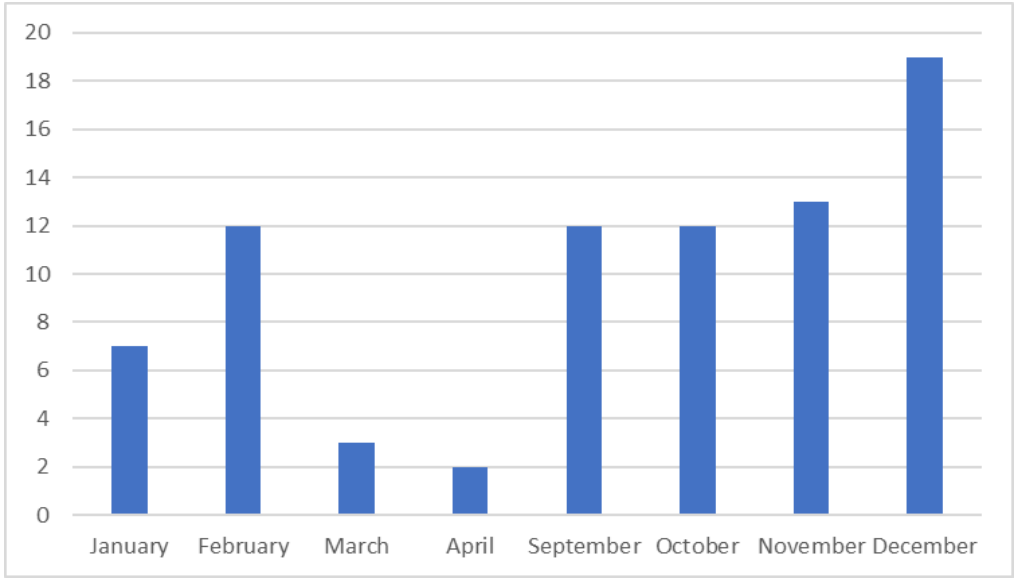

Figure 9A: Numbers of SABAP2 records of Ayres's Hawk-Eagle per month in four pentads in Pretoria (2540_2810, 2540, 2815, 2545_2810 and 2545_2815).

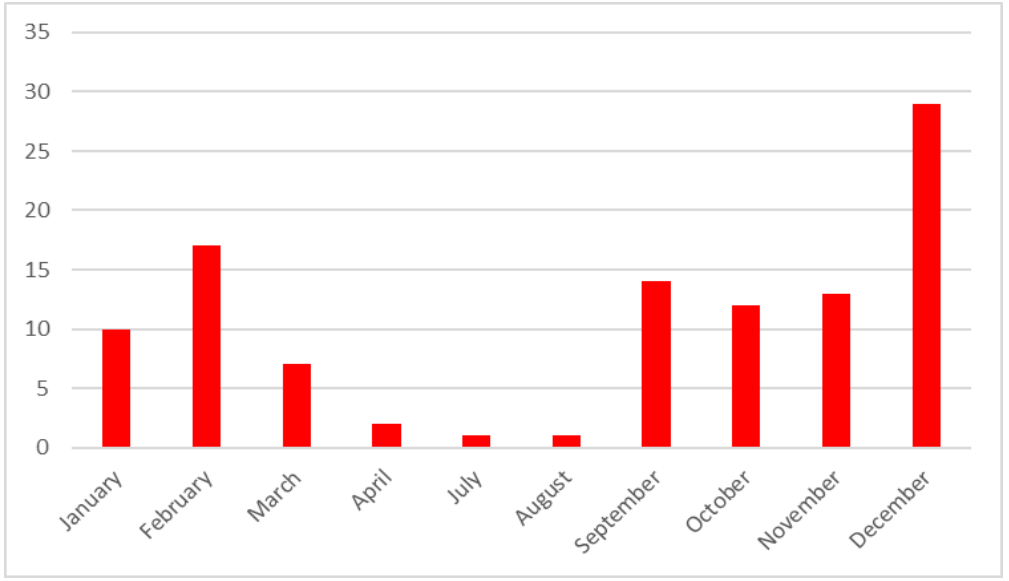

Figure 9B: Numbers of SABAP2 records of Ayres's Hawk-Eagle per month in Pretoria and Johannesburg combined.

The records suggest that individual birds can be present for a number of days at a location (Table 1). Analysis of photographs taken during the cluster of records in early to mid-March 2021 suggest that the records were one juvenile bird; the photographs over the 10-day period from 8 to 17 March 2021 are likely the same individual (Figure 5). After 17 March 2021, this bird was not seen despite daily observations of the ridge and skies above the ridge for the presence of raptors. The presence of a single bird, particularly immature birds, at one location for a number of days appears to be supported by records from the South African Rare Bird News Report, with records of a young bird present in the Uitenhage area in the Eastern Cape for a prolonged period from December 2019 to late April 2020 and an immature bird observed at the Polokwane Bird Sanctuary over several days in late April and early May 2019.

Notes on interactions with other birds, in particular Pied Crows

Interactions of other bird species with Ayres's Hawk-Eagles and other raptors revealed interesting patterns of inter-species behaviours in an urban setting. Mobbing of Ayres's Hawk-Eagles was mostly undertaken by Pied Crows *Corvus albus*; a single observation of an aerial interaction between an Ayres's Hawk-Eagle and an African Harrier-Hawk was made (Table 1). Pied Crows are abundant within the suburban and urban areas of Johannesburg; for pentads 2605_2800 and 2610_2800 they have SABAP2 reporting rates of 79.4% and 69.5%, respectively, placing them in the top 25% of most commonly recorded species in both of the pentads (SABAP2 database). Pied Crows have increased in density and abundance in the last 10 years in South Africa, especially in the south-western part of the country, but also in the wider Johannesburg area and Gauteng (Cunningham et al. 2015). This corvid species is extremely successful in an urban environment, taking advantage of the numerous opportunities posed for foraging and scavenging from urban waste. Pied Crows in Johannesburg typically occur in pairs, or small groups, occurring singly less often (pers. obs). Such groups of Pied Crows are aggressive towards any raptor that is in flight. Groups of Pied Crows were observed to mob Ayres's Hawk-Eagles over the Linksfield Ridge on numerous occasions (Figure 10). The vocalisations of the crows associated with mobbings provided an alert to the presence of an Ayres's Hawk-Eagle or other raptor in the vicinity of the Linksfield Ridge (pers. obs). The aggression shown by the crows appears to be directed towards any larger raptor, extending even to other objects in flight. Such universal aggression were borne out by observations made at the Johannesburg Botanical Gardens, Emmarentia, where a remote-controlled model glider airplane was repeatedly pursued by a group of Pied Crows (pers. obs.).

It is not known whether the aggression shown towards the Ayres's Hawk-Eagles has an effect on their behaviour and occurrence at this location or in the wider Johannesburg area. A theory exists that that mobbing decreases predatory efficiency, mainly by driving the predator from the vicinity (Pettifor 1990). Behaviour of both flight-hunting and perch-hunting European Kestrels *Falco tinnunculus* was modified

Figure 10: An Ayres's Hawk-Eagle being mobbed by a Pied Crow over the Linksfield Ridge in September 2020.

in response to mobbing; individuals of this species flew significantly further between their foraging position when they were mobbed than when they were not mobbed (Pettifor 1990). In addition flight-hunting kestrels were found to be more regularly mobbed than perched birds. Simmons & Barnard (2011) discussed observed harassment of raptor species by Pied Crows; their observations related primarily to piracy of captured prey by Pied Crows.

The Pied Crows in the study area, especially if they are abundant, could adversely impact Ayres's Hawk-Eagles and any other aerial raptors which are hunting avian prey. The presence of a raptor invariably appears to elicit mobbing behaviour by crows; mobbing could be an important factor in deterring a raptor from engaging in aerial predation. The occurrence of Ayres's Hawk-Eagles and other raptors which prey on birds is likely to be adversely impacted by mobbing by Pied Crows. This needs to be explored by regular monitoring and observation.

Conclusion

The observations in this paper were the first observations of Ayres's Hawk-Eagles within the north-eastern parts of Johannesburg, apart from the sight-records of the SABAP2 project. They provided a window into the occurrence and behaviour of this species in the vicinity of the Linksfield Ridge and Louis Botha Avenue near Fellside, a location within Johannesburg where the species had not previously been recorded. The patterns of occurrence which emerged largely confirm the timing and occurrence of this species in Pretoria, where a longer history and greater number of records of this species at a higher reporting rate exist. The timing of records in Johannesburg showed that the largest number of records occurred in midsummer.

The presence of this and other raptor species, in particular Ovambo Sparrowhawk, Black Sparrowhawk, African Harrier Hawk and, to a lesser degree, Peregrine Falcon and Booted Eagle in the vicinity of the Linksfield Ridge indicated that this ridge is a local hotspot for raptor occurrence in northern Johannesburg. Three factors are involved. (1) The presence of the ridge generates opportunities for static soaring. (2) The presence of suitable roosting and perching habitat due to the wooded nature of the properties on the ridge. (3) The nearby occurrence of a superabundance of the preferred prey species, Rock Doves, in the urban built-up area along Louis Botha Avenue.

McPherson et al. (2021) demonstrated that a large number of raptor species are present in the urban areas of South Africa, but that little research has been conducted on the vast majority of these species in an urban context. This paper has attempted to document the occurrence of one such raptor species within a particular part of Johannesburg, and to document aspects of its occurrence, behaviour and ecology. This study has raised a number of potential trends and questions regarding the Ayres's Hawk-Eagle in an urban context that can be answered by further investigation and detailed observation.

As part of a follow up for further study and potential observation of the species within Johannesburg, the species is likely to occur in other areas with similar habitat combinations as found at Linksfield Ridge-Louis Botha Avenue. For example, this ridge system extends westward first to Killarney and Parktown, and further west to around Northcliff Hill (where the species has previously been recorded). There are other extensive ridge systems in central-southern Johannesburg, in Observatory, Kensington/Bezuidenhout Valley and Bedfordview, and also in the southern suburbs of Johannesburg. The sections of these ridges in close proximity to concentrations of Rock Dove populations are priority area for observations. Individual eagles may range over a wide area in a day, visiting these potential sites.

In addition, it is recommended that a dedicated observation protocol for citizen scientists be established in the Linksfield Ridge and Louis Botha Avenue area, particularly between September and April (Figure 9A and B). This would enable an improved understanding of potential occurrence and behaviour of the Ayres's Hawk-Eagle in Johannesburg, including observations of its hunting behaviour and success rate with regards to its assumed primary prey species, the Rock Dove, and other potential prey species. Insights into roosting and the effect of interaction with other raptors and with Pied Crows in particular could be gained by such further investigation.

Surveys for the presence of this species other areas of suitable habitat within Johannesburg should be made. This rarity, sought-after by birders, potentially occurs much more regularly in Johannesburg than is currently understood. Observers with access to suitable habitat, the combination of wooded ridges and adjacent built-up areas, can assist in enhancing the current state of scientific understanding of this rare migratory eagle in an urban context, in north-eastern South Africa.

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