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BIRD DISTRIBUTION DYNAMICS

BIRD DISTRIBUTION DYNAMICS 8: HADEDA IBIS *BOSTRYCHIA HAGEDASH* IN SOUTH AFRICA, LESOTHO AND SWAZILAND

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Introduction

This is the 8th paper of a new series in *Biodiversity Observations.* The objective is to report on the ranges of bird species as revealed by the Second Southern African Bird Atlas Project (SABAP2, 2007 onwards) and to describe how their ranges have changed since the first bird atlas (SABAP1, mainly 1987–1991), about two decades apart.

This series of papers is also made feasible by the development of two new standards for the presentation of maps, firstly pentad-scale distribution maps derived from SABAP2 data, and secondly range-change maps, using quarter-degree grid cells, showing how distributions have changed between SABAP1 and SABAP2 (Underhill & Brooks 2016a, b). Because all of the papers in this series use these two new maps, the rules for interpretation are not provided in detail in each paper.

Figure 1: This is a caricature of the Hadeda Ibis, delivering its characteristic call, in flight. The locality and date are Witsand Kalahari Nature Reserve, 11 February 2014. The Hadeda Ibis is a relative newcomer to this region of the Northern Cape. The photographer is Richard Jessnitz ©, and the record forms part of the BirdPix section of the ADU Virtual Museum (for details see http://vmus.adu.org.za/?vm=BirdPix-6764

This paper deals with the Hadeda Ibis *Bostrychia hagedash*, a member of the family Threskiornithidae (Figure 1). It is evaluated as Least Concern on the IUCN Red List of Threatened Species. In atlasing terms it is a bird of high detectability and is unlikely to be overlooked or misidentified. Even if only a small number of Hadeda Ibises is present in a pentad at the time of an atlas survey, the species is likely to be recorded on the checklist.

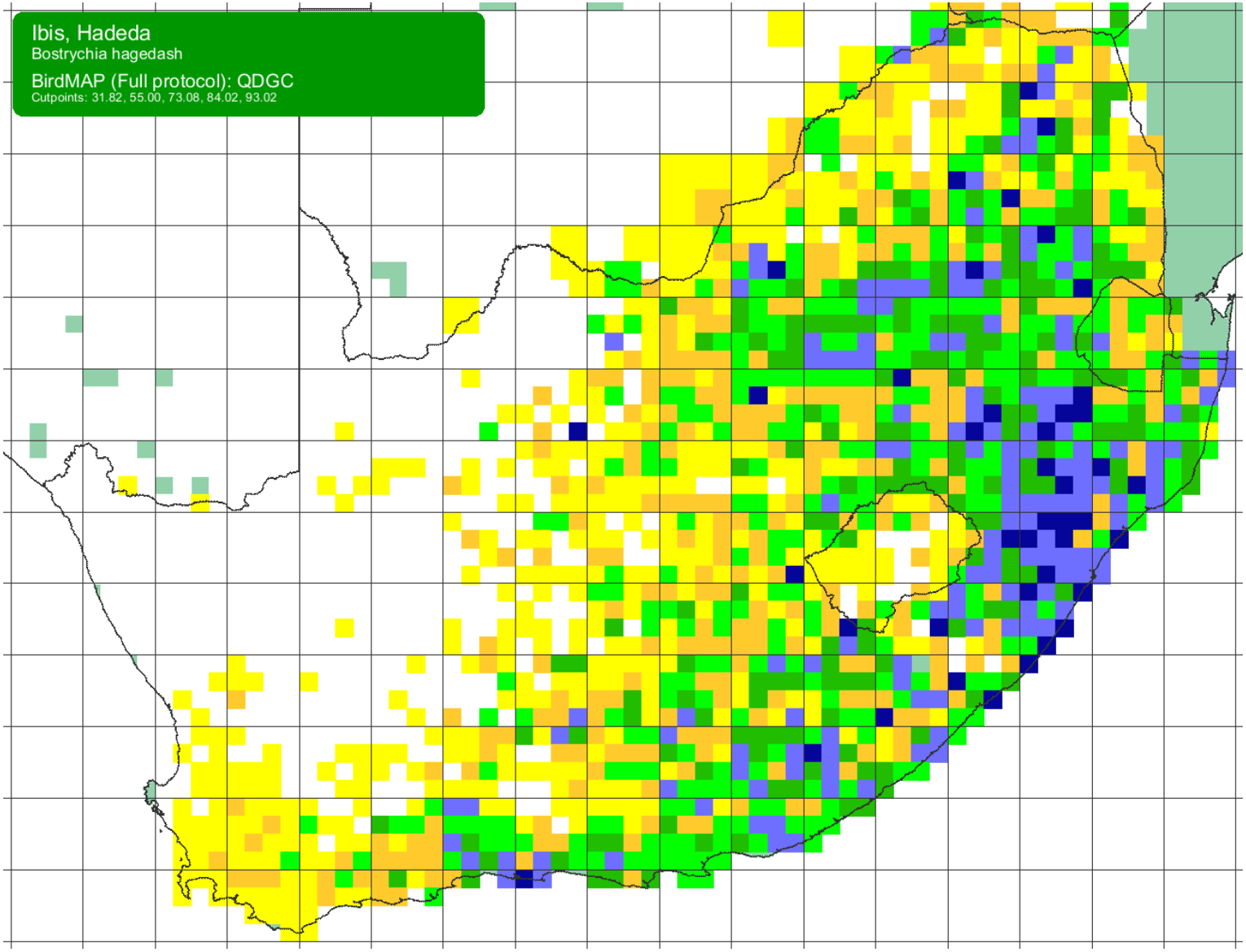

Figure 2: SABAP1 distribution map for the Hadeda Ibis. Quarter-degree grid cells are shaded turquoise if there were no checklists for them during SABAP1, white if the species was not recorded, or in colour, with shades based on reporting rate: yellow 0–31.8%, orange 31.8–55.0%, light green 55.0–73.1%, dark green 73.1–84.0%, light blue 84.0–93.0 and dark blue 93.0–100%. These are the same cutpoints as used in Figure 3 for the SABAP2 distribution map.

Hadeda Ibis *Bostrychia hagedash*

Background to the species

The Hadeda Ibis is found in all but the most arid parts of sub-Saharan Africa in open grasslands, savanna and wetlands, as well as golf courses, urban parks, school fields and gardens (del Hoyo et al. 1992, Anderson 1997). It is also associated with irrigated agricultural land and artificial water bodies. Early accounts of its distribution in South Africa describe it as limited to KwaZulu-Natal and the coastal areas of the Eastern Cape, but it was possibly already expanding its range before 1910 in response to human modification of the landscape (Macdonald et al. 1986).

Macdonald et al. (1986) provided a detailed description of the range expansion in southern Africa up to 1985, the year before the main fieldwork for the first bird atlas started in January 1986 (Harrison et al. 1997). They estimated that, between 1910 and 1985, the southern African range of the Hadeda Ibis expanded by 250%, from 530,900 km^2 to 1,323,300 km^2 over the 75-year period. Major range expansions occurred into the fynbos biome of the Western Cape, the Karoo, the grasslands of the Eastern Cape, the Free State and the Highveld of the central interior. Smaller expansions have been recorded in Lesotho, eastern Zimbabwe, and central Mozambique; there have also been westward range expansions along the Zambezi, Okavango, Limpopo and Orange Rivers (Macdonald et al. 1986). The year-by-year expansion in the area of the Western Cape south and west of the Olifants River and Breede River in the Western Cape from 1982 to 1986 was presented graphically by Underhill & Hockey (1988).

The expansion in range of the Hadeda Ibis was attributed by Macdonald et al. (1986) to several factors: a reduction in human persecution following the introduction of legislation in the period 1934 to 1941, the planting of alien trees in formerly treeless areas, the construction of artificial impoundments, and the increase of areas under irrigation. All these factors are anthopogenic. They appear to have complemented each other, working in unison to create favourable conditions to facilitate the range expansion.

The process of range expansion, based on multiple descriptions, was crisply summarized by Macdonald et al. (1986): “The initial recording of a Hadeda Ibis is almost inevitably followed by an increase in frequency of records, increase in numbers of birds present, the species finally taking up residence and finally breeding there.”

Macdonald et al. (1986) was written in an era before the concept of climate change had not yet become established. They considered the potential impact of drought on the Hadeda Ibis. They reported an observation by Ossowski (1952), who said that mass mortality during droughts occurred “due to their inability to insert their bills into the hard, sun-baked soil.” This cause of mortality needs confirmation. However, a series of papers confirms the importance of soil moisture in enabling Hadeda Ibises to feed (Duckworth et al. 2010, 2012, Duckworth & Altwegg 2014).

SABAP1 distribution

During the 1980s, the core of the range of the Hadeda Ibis was in KwaZulu-Natal (Figure 2). The westernmost area of high reporting rates was along the Garden Route region of the Western Cape, and scattered quarter degree grid cells across the more mesic western half of the region had reporting rates above 84%, and are shaded blue or dark blue in Figure 2. Compared with Figure 3 of Macdonald et al. (1986), which was a contour plot of ranges of the Hadeda Ibis at 15 year intervals up to 1985, the SABAP1 distribution map shows westward expansion into the Karoo and along the Orange River (Figure 2).

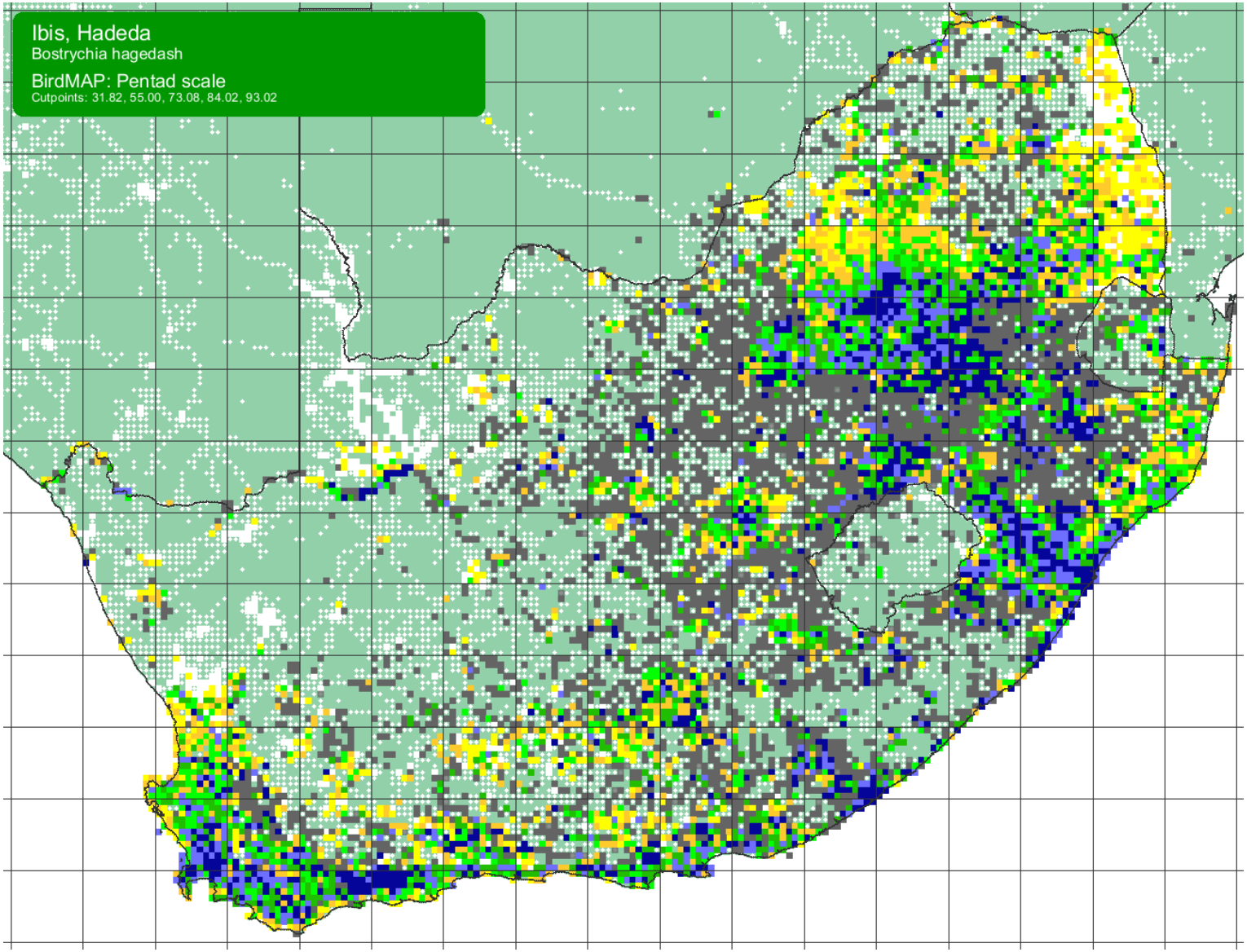

Figure 3: SABAP2 distribution map for the Hadeda Ibis, downloaded 15 January 2016. Hadeda Ibis has been recorded in 8,809 pentads in South Africa, Lesotho and Swaziland. The detailed interpretation of this map is provided by Underhill & Brooks (2016a). Pentads with four or more checklists are either shaded white, species not recorded, or in colour, with shades based on reporting rate: yellow 0–31.8%, orange 31.8–55.0%, light green 55.0–73.1%, dark green 73.1–84.0%, light blue 84.0–93.0 and dark blue 93.0–100%. In pentads shaded grey or with white dots, there are one, two or three full protocol checklists, or there are ad hoc lists, or incidental records. In pentads shaded grey, the species was recorded as present; in pentads with white dots the species has not been recorded. If a pentad has four or more checklists, and the species has been recorded on an ad hoc checklist or as an incidental recorded, it is shaded yellow, indicating that the species has a small reporting rate.

SAPAB2 distribution

On the pentad scale, the SABAP2 distribution map (Figure 3) shows that Hadeda Ibis is not only widespread across the moister eastern part of South Africa, including the highveld, KwaZulu-Natal, the Eastern Cape, and parts of the Western Cape; it is also present across much of the Limpopo and North West and parts of the Northern Cape.

The main core of its range, based on current atlas coverage, appears to be urban Gauteng, extending southeast to the moist grasslands, stretching as far as Memel, Wakkerstroom and Newcastle. In the most atlased urban pentads of Gauteng, which appear to make up the densest part of this core, Hadeda Ibis frequently has the largest reporting rate of any species; it is recorded on over 97% of all atlas lists for these pentads (SABAP2 website). According to the current atlas coverage, there appear to be smaller core areas centred on the Vryheid–Bethlehem region of the eastern Free State, and along the Durban-Pietermaritzburg-Estcourt corridor of KwaZulu-Natal. There are concentrations around Bloemfontein, and in the Middelburg–Cradock area of the Eastern Cape. There are hot spots for Hadeda Ibis along the KwaZulu-Natal coast, at East London and along the Garden Route. There is a core area two to three pentads inland of the coast at Stillbaai, stretching from about Swellendam to Albertinia. Finally, near Cape Town, there is a concentration in the Cape Flats and western Overberg areas.

The Vaal and Orange Rivers have historically provided corridors for range expansion for Hadeda Ibis (Macdonald et al. 1986), and a thread of pentads with high reporting rates stretches along the Orange River from around Upington to Kakamas, where there is abundant riverine growth and much irrigated agricultural activity.

Reporting rates in the savanna areas of northeastern South Africa are low. This is especially true of the Kruger National Park (Figure 3).

By January 2017, the species had been recorded 110,482 times in 8,809 pentads on full protocol checklists. This constitutes 51% of all pentads, and 66% of the pentads for which there are full protocol checklists.

Range change between SABAP1 and SABAP2

The approach described in Underhill & Brooks (2016b) was used to classify the quarter degree grid cells into six categories of increase and decrease (Figure 4). The relative increases and decreases are estimated using the Griffioen transformation (Underhill & Brooks 2016b), and involve an assumption that, in pentads where Hadeda Ibis occurs, they are randomly distributed across the landscape: that is, they are not clustered or in flocks. For the Hadeda Ibis, this is probably only partially true, so the results need to be treated with some caution. However, the qualitative results are likely to be correct.

Results are shown for only the 1,578 quarter degree grid cells for which there are four or more checklists for both SABAP1 and SABAP2 and in which Hadeda Ibis occurred in SABAP1 or SABAP2 or both (Table 1). Of these 1,578 quarter degree grid cells, the numbers of grid cells shaded blue (very large increase) and dark green (large increase) are 490 (31%) and 297 (19%) respectively. This suggests very large or large increases in 50% of the quarter degree grid cells. In contrast, 95 grid cells (6%) are red, and 189 (12%) are orange. This suggests very large (red) or large (orange) decreases in 18% of the quarter degree grid cells. The apparent increases massively outweigh the decreases.

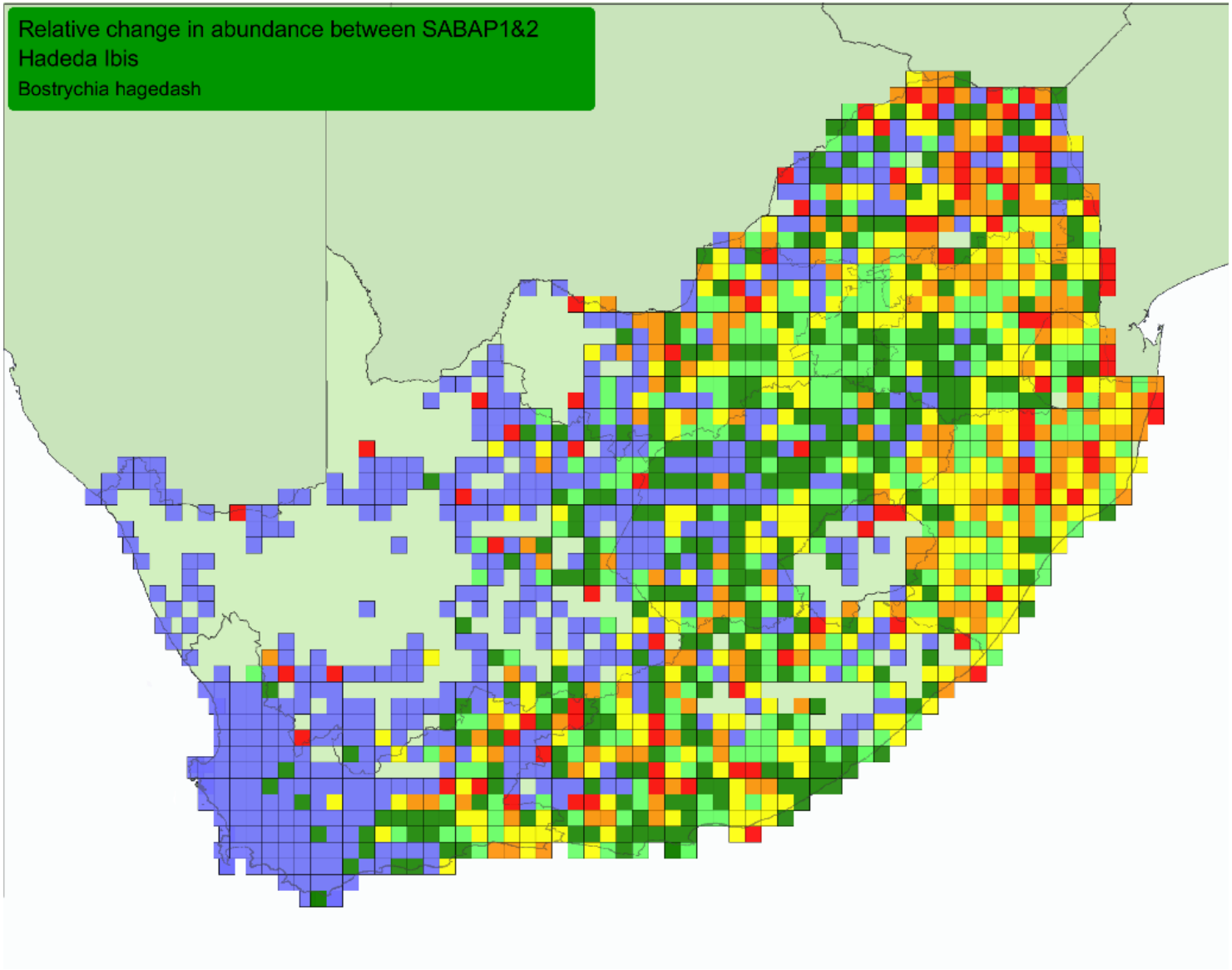

Figure 4: Range-change map between SABAP1 and SABAP2 for the Hadeda Ibis, downloaded 9 January 2016. Red, orange and yellow represent quarter-degree grid cells with very large, large, and small relative decreases and blue, dark green and light green represent grid cells with very large, large and small relative increases. A count of the number of grid cells in each category is provided in Table 1. Only grid cells with at least four checklists in both SABAP1 and SABAP2 are shown. All these gird cells had Hadeda Ibis recorded in them either in SABAP1 or in SABAP2 or in both. Fuller information on the interpretation of this range-change map is provided in Underhill & Brooks (2016b).

Because this analysis uses grid cells with as few as four checklists in both SABAP1 and SABAP2, results are subject to sampling error (Underhill & Brooks 2016b). When the analysis is restricted to grid cells with at least 30 checklists in both SABAP1 and SABAP2, sampling error is considerably smaller, but there are only 615 grid cells which meet this criterion (Table 1). In this restricted analysis, 18% of grid cells show large or very large decreases and 40% show large or very large increases. The difference is due to the fact that large districts where Hadeda Ibis is increasing are in areas which were quite poorly covered, especially in SABAP1, and many of these grid cells were, therefore, excluded from the "at least 30 checklists" analysis (see Figure 5 of Harrison & Underhill 1997 for relevant statistics related to SABAP1).

The continuous carpet of blue squares in the western half of Figure 4 is a strong indication that the species is gaining abundance and a range expansion is taking place. Thus, the overall conclusion has to be that Hadeda Ibis has undergone a range expansion since the 1985 cut-off in the analysis of Macdonald et al. (1986). In addition, it is likely to have become numerically more abundant in the two-decade period between SABAP1 and SABAP2. This is in keeping with, and a continuation of its gains since 1910 reported by Macdonald et al. (1986), not only in the Western Cape but additionally a westward expansion into the more arid areas in North West and the Northern Cape. Particularly striking is the expansion into Namaqualand, especially the Kamieskroon area, Port Nolloth and the Orange River estuary (Figures 3 and 4).

In the period between SABAP1 and SABAP2 there appears to have been a moderate decline in reporting rate in the Pongola-Ulundi area of KwaZulu-Natal and the Polokwane–Louis Trichard–Thohoyandou corridor of Limpopo (Figure 4). This may be attributable to bush encroachment.

Table 1. Summary of range-change summary for Hadeda Ibis in SABAP2 relative to SABAP1. Numbers (and percentages) in each colour category of Figure 2, for which there are at least four checklists per quarter degree grid cell in both SABAP1 and SABAP2. Also shown are the same summaries when the analysis is restricted to grid cells with at least 30 checklists for both SABAP1 and SABAP2.

Status	Four+ checklists for SABAP1 & SABAP2		30+ checklists for SABAP1 & SABAP2	
	Count	%	Count	%
Red (very large decrease)	95	6	18	3
Orange (large decrease)	189	12	91	15
Yellow (small decrease)	258	16	133	21
Light green (small increase)	249	16	127	21
Dark green (large increase)	297	19	126	20
Blue (very large increase)	490	31	120	20
Total	1,578	100	615	100

Discussion

The fortunes of Hadeda ibis are closely tied to human activities in the landscape, particularly where agricultural land is irrigated or artificial water bodies created, and where stands of alien trees provide the opportunities for roosting and nesting (Macdonald et al. 1986). These human activities have allowed the species to establish a presence in all but the most inhospitable parts of the South African landscape.

The widespread distribution of Hadeda Ibis (Figure 3) allows insights into the state of coverage of SABAP2, and to make recommendations for atlas fieldwork in relation to this species:

- Large parts of the Free State and Mpumalanga adjoining the Gauteng core range are consistent blocks of grey, meaning that Hadeda ibis is recorded, but the number of full protocol checklists per pentad has not yet reached the threshold of a minimum of four atlas lists needed to initiate the calculation of reporting rates. Atlasers are encouraged to improve coverage in these areas. As the pentads in these areas get their fourth list, the core of the distribution, shown in dark blue in Figure 3, is likely to shift subtly, and the true core of the range will be revealed in time. The pentads shaded dark blue comprise of the one-sixth of pentads with the highest reporting rates (and have four checklists). As additional pentads with high reporting rates receive their fourth checklist, some pentads may shift below the threshold (cut point) between dark blue and light blue, and becoming light blue.

- For example, once the true core of the distribution is known, the block of dark blue pentads inland of Stillbaai may be "demoted" to light blue. This block is a reflection of the dedicated local atlasing efforts of the Stilbaai Bird Club; the members were determined to obtain a minimum of four checklists per pentad over this region. Once the true core of the range of Hadeda Ibis is known, this region might no longer be as conspicuous a part of the core of the range as it is now.

- The observed reporting rate gets closer to the true reporting rate as the sample size, the number of atlas checklists, increases. Even with four checklists, sampling error can be substantial. The likelihood that a pentad is assigned the "wrong" colour decreases as the number of checklists increases (Underhill & Brooks 2016b). The colours assigned to pentads with close to four checklists are more likely to change as further checklists are submitted than pentads with many checklists. Atlasers are encouraged to increase the number of checklists in all pentads.

- Figure 3 shows how the areas of focused atlasing in the Four Degrees region of Greater Gauteng (Ainsley 2015) and its extensions, especially towards Klerksdorp, southeastward towards Standerton, southward into the Free State and northward into Limpopo have revealed a remarkably nuanced detail of the distribution of the Hadeda Ibis in a way that has not been revealed before. Atlasers are encouraged to expand this area of four-checklist coverage so that the areas in colour in Figure 3 are linked.

- The Turning Kruger Green project generated a minimum of four atlas lists for every pentad of the Kruger Park. As a consequence, Figure 3 enables us to state with confidence that Hadeda Ibis generally has low reporting rates in the Kruger National Park and that reporting rates, and therefore abundance, decrease from south to north in the park.

- The absence, or near-absence, of Hadeda Ibis in parts of the northern and western sections of the Northern Cape is confirmed by the pentads shaded white which all have at least four checklists: north of Loeriesfontein, in the Kgalahadi Transfrontier Park, and in the area between the Orange River and the Botswana border where Vincent Parker has generated a series of white corridors north of Upington. White pentads have at least four full-protocol checklists without a Hadeda Ibis being recorded; in other words at least eight hours of focused birding was undertaken in these pentads without the species having been seen or heard.

- It is not possible, with current SABAP2 coverage levels, to make a firm statement on the status of the Hadeda Ibis in the former Transkei. This is an area that needs attention by atlasers.

The Hadeda Ibis can be a mundane and somewhat automatic addition to an atlas list within the core of its range, but it should be remembered that Hadeda Ibis is one of the most dynamic and successful species in the SABAP2 region. In South Africa's most arid areas it is still expanding its range and increasing in abundance. The factors underpinning the increase are anthropogenic. As the effects of climate change play out – mainly drier and warmer conditions leading to the "hard, sun-baked soil" of Ossowski (1952) – it seems likely that the momentum of its expansion will be moderated and potentially reversed. The interplay of anthropogenic and climate change factors on the distribution and abundance of Hadeda Ibis makes this an interesting and important species to monitor during the forthcoming decades of the 21st century.

Acknowledgements

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