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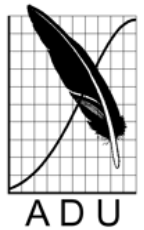

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ENDEMIC FYNBOS AVIFAUNA: COMPARATIVE RANGE DECLINES A CAUSE FOR CONCERN

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ENDEMIC FYNBOS AVIFAUNA: COMPARATIVE RANGE DECLINES A CAUSE FOR CONCERN

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Introduction

The winter rainfall district of the Western, Eastern and Northern Cape Provinces in South Africa is home to the Fynbos biome, which extends from the Cedarberg mountains, south to the Cape of Good Hope, and eastwards to Algoa Bay. The Fynbos biome is recognised as an outstanding global biodiversity hotspot for its high levels of plant diversity and endemism. Approximately 8 600 plant species have been recorded in this biome, of which about 70% are endemic, but there are surprisingly few endemic birds (Table 1).

The Cape Fynbos supports six restricted-range bird species, which are all considered widespread within the biome (BirdLife International 2010a) and are all ranked by IUCN conservation criteria as Least Concern (BirdLife International 2010b). This ranking means that for these species their Extent of Occurrence is not less than 20 000 km^2 combined with a declining range size, habitat extent/quality, a small number of locations or severe fragmentation. The ranking also implies that the population trends appear to be stable, and hence the species do not approach the thresholds for Vulnerable under the population trend criterion (greater than 30% decline over ten years or three generations). This ranking is given when population sizes are believed to be >10 000 mature individuals with a continuing decline estimated to be less than 10% in ten years or three generations.

Lowland Fynbos, however, is highly threatened by crop farming and urbanization, and both lowland and mountain Fynbos are affected by commercial afforestation, alien plant species invasion, dam-building and uncontrolled burning (e.g. Kemper et al. 1999). In addition to these threats, climate change models predict substantially drier and warmer conditions in low-lying areas of the winter rainfall zone within the next 100 years. All this does not bode well for the Fynbos endemics.

The first Southern African Bird Atlas Project (SABAP1) was launched in 1986. Approximately 5 000 citizen scientists gathered bird distribution data from six countries in southern Africa, culminating in the publication of The Atlas of Southern African Birds in 1997 (Harrison *et al.* 1997). By 2007, fifty research publications and eight Ph.D. and master's degrees had emanated from the database (Harrison *et al.* 2008). In July 2007, the follow-up SABAP2 was launched. These projects have been recognised as important tools to assess how local bird populations are shifting in response to climate and land-use changes (Hockey *et al.* 2011).

Comparing SABAP1 and SABAP2 data in terms of species distribution can be difficult (Res Altwegg *et al*., manuscripts in prep.). Are apparent gaps in the distribution true reflections of species' responses to environmental change, or a function of incomplete coverage, differences in survey effort or protocol, or differences in scale? We look at the current apparent patchy distribution of six Fynbos endemic species and compare them to species that are ecologically and/or morphologically similar, which occur in the Fynbos biome, but also have ranges beyond (Table 1). Our reasoning is that by comparing similar species, issues of coverage and scale are reduced as ecologically similar species should often show at least broadly similar trends in coverage or apparent range contraction (or expansion).

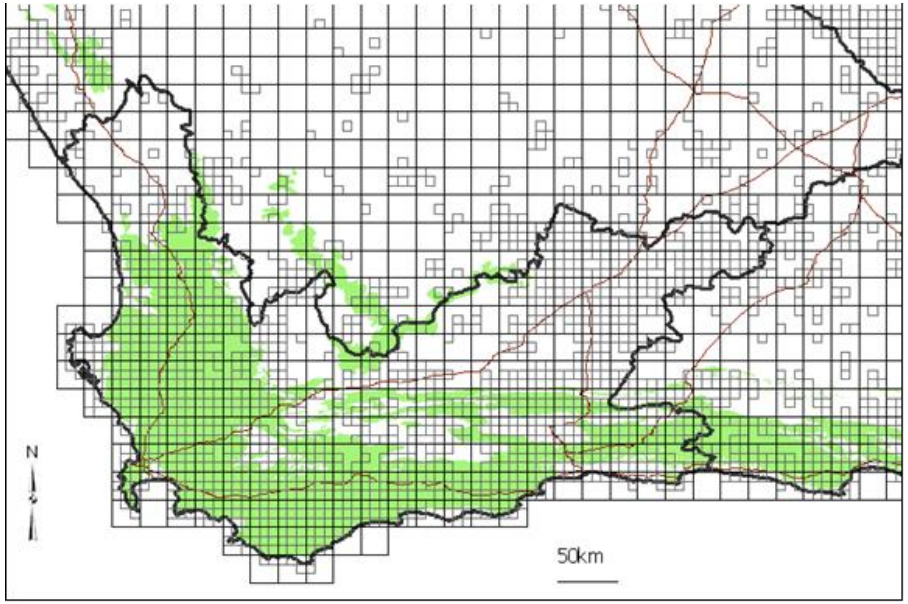

Figure 1 – A map showing the Western Cape province (dark black line) and the Fynbos Biome (light green shading), overlaid by QDGCs (larger black squares) and the pentads surveyed as of 11 May 2011 (small light grey squares). Thin red lines represent major national roads.

Methods

The Fynbos biome stretches across both the Western and Eastern Cape provinces (Figure 1). Since the majority of the biome occurs in the Western Cape, and this province had far better coverage at the time of this review (coverage of >70% of available pentads), we considered only Western Cape SABAP2 records. This also meant that comparisons between species were limited geographically, so influences on the non-Fynbos endemics (the control species) outside the Western Cape were removed from the comparison. As of 11 May 2011, only 1 quarter degree grid cell (QDGC) on the border of the Western Cape had no pentads surveyed for SABAP2. The only other unsurveyed QDGCs were located in Nama and Succulent Karoo Biomes in the north-west and central sections of the province respectively (Figure 1).

We took the 1836 listed pentads for Western Cape and divided by 9 to obtain approximate number of QDGCs (204). SABAP2 and SABAP1 coverage maps for each chosen species were downloaded from sabap2.adu.org.za for comparison on 16 May 2011. At this time the Western Cape's 1836 pentads had 10 784 cards, 527 723 records, and an average of 49.0 species per card.

For each species we then counted the number of QDGCs where presence was recorded for SABAP2 only, SABAP1 only, and both combined from the maps in Figure 2a and Figure 2b. QDGCs overlapping provincial boundaries were included. A measure of reporting rate was taken as the maximum cell reporting rates as presented in Figure 3a and Figure 3b.

We then divided the current (SABAP2) range with the recent historic (SABAP1) range data to obtain a percentage change in coverage. In order to obtain a measure of the species maximum range size (in km^2) we multiplied the number of SABAP2 QDGCs by 616 – the later based on an average QDGC size of 28 x 22 km. We then classified range fragmentation as None, Slight or Moderate based on the following: None – 2 or fewer isolated QDGCs, main population (i.e largest cluster of QDGCs) contiguous; Moderate – more than two QDGCs isolated, main population contiguous or split; Severe – most QDGCs isolated, main population split or no patches obviously larger than others.

In order to determine our current state of scientific research for each species, literature searches were conducted through the science search engine ISI Web of Knowledge (isiwebofknowledge.com). The common name for each species was used to search through all years for the search phrase under all topics (this returns results for articles sometimes not directly focused on the target species). Searches for species with name changes were also conducted using the most recent old name (Rock-jumper – Rockjumper; Southern Double-collared Sunbird – Lesser Double-collared Sunbird; Protea Seedeater – Protea Canary; Streaky-headed Seedeater – Streaky-

headed Canary; Victorin's Warbler – Victorin's Scrub-warbler). As the search for Cape Canary resulted in >350 articles related to the Cape Canary Islands, the search for this species was instead conducted using its Latin name *Serinus canicollis*. Articles post-1970 were checked to ensure ornithological relevance. The final figures are not a comprehensive list of all the references for a species, but a comparative index on the current state of our knowledge for each species.

Variables for the six Fynbos species were compared to the six control species using mean ± standard deviation. Differences in range change for the Fynbos species were compared to those for the Control group using a Mann-Whitney U test. This test was run twice, once using Cape Rock-Thrush as a control, and once using Red-winged Starling as a control. For all other comparisons, Cape Rock-Thrush values were used. This was done as although the Cape Rock-Thrush probably is more equivalent to the Cape Rock-jumper in terms of habits and habitats, its is by no means a generalist and initial analysis shows it may be declining in range following a similar trend to the Cape Rock-jumper. Thus Red-winged Starling was chosen in addition as it is more widely recognised as a habitat generalist.

Results

All species – both Fynbos and control – were recorded in a smaller area from SABAP1 to SABAP2 (Table 1). This reduction was more pronounced for the six Fynbos endemics compared to the control group (difference in QDGCs between surveys: Fynbos: -29% ± 16%; control: -12% ± 9%; $U = 30$, $p = 0.06$). When Cape Rock-Thrush was replaced with Red-winged Starling the difference between the groups was significant (control: -9 ± 2%; $U = 34$, $p = 0.01$). Mean maximum reporting rate was higher for each selected control species compared to the Fynbos endemics (Fynbos: 24 ± 12%; control: 44 ± 11%). Three Fynbos species (Cape Rock-jumper, Cape Siskin, Protea Seedeater) showed a >30% range change between surveys, compared to only one of the control group (Cape Rock-Thrush). Cape Rock-Thrush was also the only control species to show measurable range fragmentation. Range size was below 25 000 km^2 for Cape Rock-jumper and Protea Seedeater – recall that these species were recorded almost exclusively in the Western Cape – so range size is the most accurate for these compared to all other species whose ranges extended beyond that province. These two species also show a severe fragmentation of their distribution. Fynbos endemics also featured in fewer journal articles compared to the control species (Fynbos: 6.5 ± 7.8; control: 19.7 ± 32.1).

Discussion

Issues of coverage and distribution

The ongoing peer-vetting process of SABAP2 could well change the incidences of occurrence used in this review. At the time of this review, it is mainly pentads in close proximity (<100 km) to major urban centres e.g. Cape Town, George and Beaufort West, which have multiple checklists. This means we must tread cautiously when interpreting the seemingly smaller ranges for all species compared to SABAP1. However, since SABAP2 coverage in the Western Cape appears statistically adequate within the Fynbos biome, with only unsurveyed areas in the Karoo biome, one would instead expect species with the larger ranges to show a greater difference between surveys if the changes were due to coverage alone. Overall, Fynbos endemics do not seem to be faring as well as the generalist species that we chose to compare them with. We concede there might be a number of reasons (phylogeny, mutualisms, genetic drift, recent evolutionary history, different physiological tolerances, etc) why responses might differ. Fynbos species mostly occur in areas less easily accessible to the general public. A drive to encourage survey efforts in the central parts of the Fynbos biome which at this stage are largely with two or fewer cards (yellow in Figure 3) is to be encouraged. Only then can we confidently comment on a species' Area of Occurrence and the degree of range fragmentation.

Species	Status	1&2	1 only	2 only	Total current	Historic	% change	Max. Repor-ting Rate	Max range (Km2)	Fragmentation	Articles
Cape Sugarbird *(Promerops cafer)*	**Fynbos endemic**	**104**	**25**	**2**	**106**	**129**	**-18%**	**42%**	**65296**	**None**	**22**
Malachite Sunbird (*Nectarinia famosa*)	control	167	26	6	173	193	-10%	48%	106568	None	84
Orange-breasted Sunbird (*Anthobaphes violacea*)	**Fynbos endemic**	**87**	**30**	**5**	**92**	**117**	**-21%**	**32%**	**56672**	**None**	**6**
Southern Double-collared Sunbird (*Cinnyris chalybeus*)	control	179	17	4	183	196	-7%	55%	112728	None	16
Cape Rock-jumper (*Chaetops frenatus*)	**Fynbos endemic**	**18**	**30**	**7**	**25**	**48**	**-48%**	**10%**	**15400**	**Severe**	**3**
Cape Rock Thrush (*Manticola rupestris*)	control	75	43	6	81	118	-31%	25%	49896	Moderate	1
Red-winged Starling (*Onychognathus morio*)	control	135	23	11	146	158	-8%	67%	89936	None	96
Victorin's Warbler (*Cryptillas victorini*)	**Fynbos endemic**	**39**	**14**	**9**	**48**	**53**	**-9%**	**23%**	**29568**	**Moderate**	**0**
Cape Grassbird (*Sphenoeacus afer*)	control	90	18	7	97	108	-10%	38%	59752	None	4
Cape Siskin (*Crithagra totta*)	**Fynbos endemic**	**71**	**38**	**5**	**76**	**109**	**-30%**	**21%**	**46816**	**Moderate**	**4**
Cape Canary (*Serinus canicollis*)	control	142	22	7	149	164	-9%	55%	91784	None	12
Protea Seedeater (*Crithagra leucopterus*)	**Fynbos endemic**	**29**	**38**	**6**	**35**	**67**	**-48%**	**13%**	**21560**	**Severe**	**4**
Streaky-headed Seedeater (*Crithagra gularis*)	control	96	29	20	116	125	-7%	43%	71456	None	1

Table 1 – Range sizes and changes for six Fynbos endemic species (**bold**) and their selected controls. '1&2' indicates QDGCs where the species was recorded in both surveys. '1 only' represents where a species was recorded in SABAP1 only. '2 only' represents where a species was recorded in SABAP2 only. 'Total current' represents the total number of QDGCs from SABAP2. 'Historic' represents the total number of QDGCs from SABAP1. '%change' is Total current / Historic. 'Max. Reporting Rate' are the uppermost recording rates from Figure 2. 'Max range'is Total current * 616 to give an estimate of area of occurrence in km^2 (see methods). 'Articles' represents the number of journal article results from isiwebofknowledge.com. Values that meet IUCN threatened species status are highlighted in red.

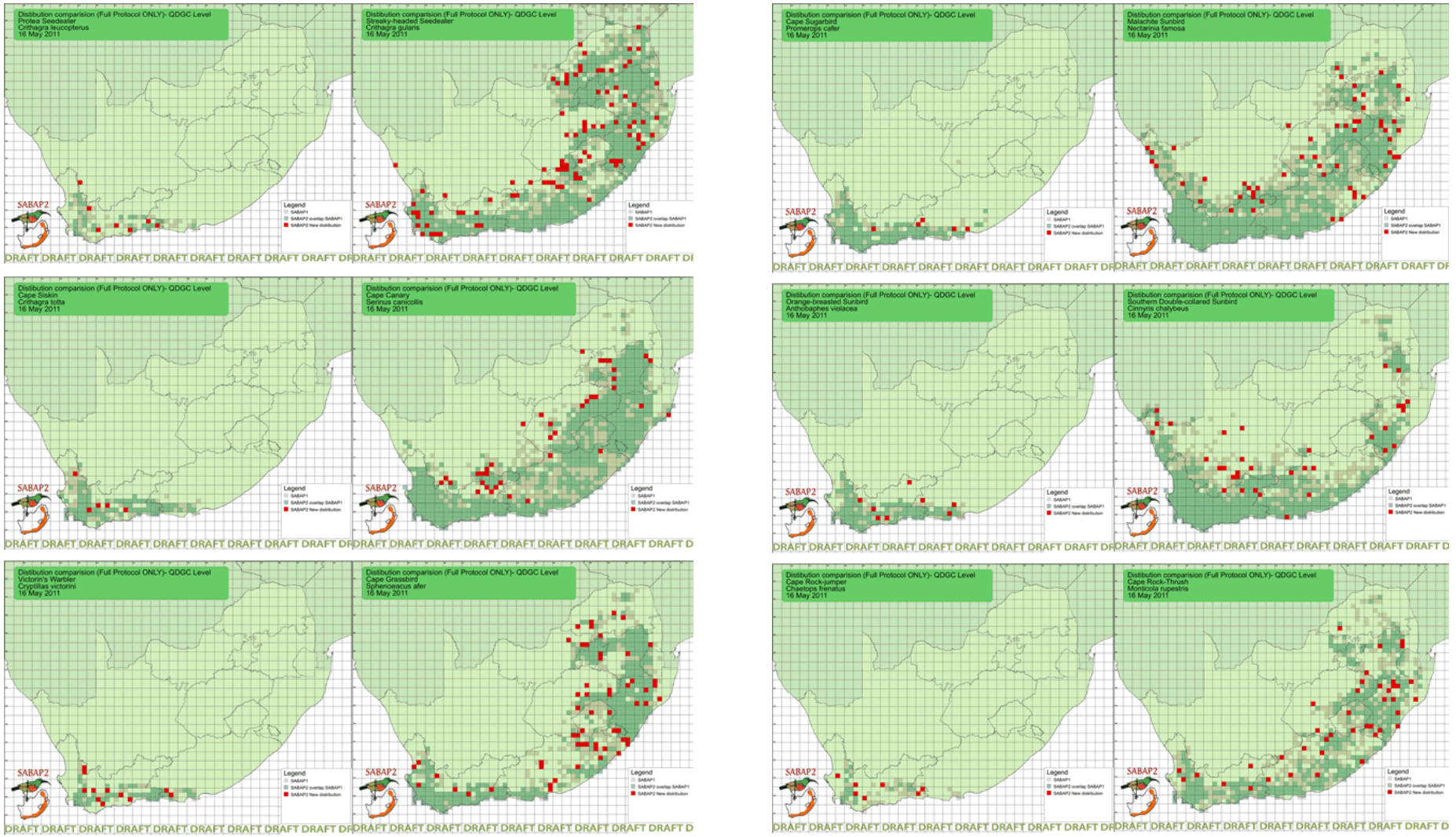

Figure 2a and Figure 2b: Occurrence from SABAP1 to SABAP2 for Fynbos endemic avifaunal species (left column – from top to bottom Protea Seedeater, Cape Siskin, Victorin's Warbler, Cape Sugarbird, Orange-breasted Sunbird, Cape Rockjumpert) compared to 'control' species based on similar morphological and ecological traits (right column – from top to bottom Streaky-headed Seedeater, Cape Canary, Cape Grassbird, Malachite Sunbird, Soutern Double-collared Sunbird, Cape Rock-Thrush). The maps are listed as Draft as they have not yet been vetted for publication.

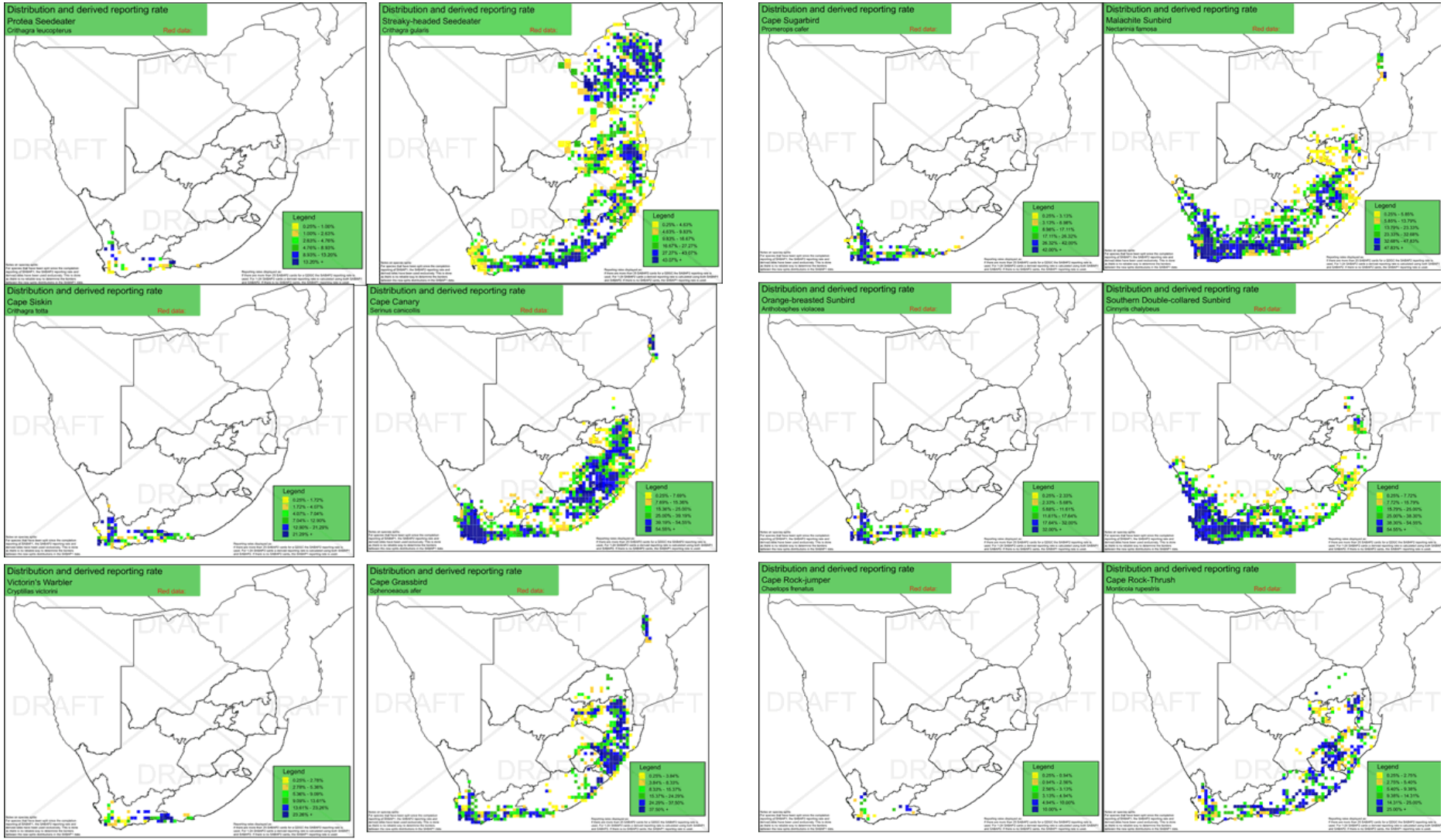

Figure 3a and 3b – Reporting rates and current distribution (i.e. based on SABAP2 data) for 6 Fynbos species (left column – same order as above) and 'control' species (right column – same order as above).

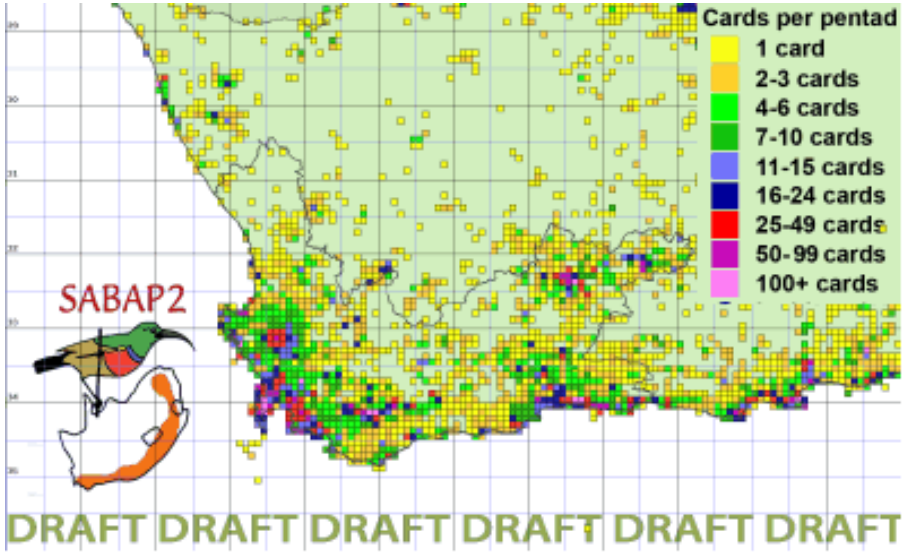

Figure 4 – Survey effort for SABAP2 as of 16 May 2011. Cards represent number of surveys of minimum 2 hour and maximum 5 day duration (full protocol).

Fynbos species accounts

The Cape Sugarbird is the most studied of the Fynbos endemics and has been identified as the most important bird pollinator of Fynbos Proteas (Skead 1967, Cheke *et al.* 2001), foraging on the nectar of 22 species (Collins and Rebelo 1987). Adult Cape Sugarbirds show high site fidelity and usually return to their breeding territories every year (Henderson 2000, Calf *et al.* 2003). Between breeding seasons they move over large distances in search of flowering Protea stands (Harrison *et al.* 1997). Protea communities largely determine spatial resource distributions for Sugarbirds and hence their local abundance and movement behaviour. Since Proteas are an important part of mountain Fynbos, which is well protected in water catchment areas (Bredenkamp *et al.* 1996), the future of Cape Sugarbirds for the near future may seem secure – especially since the species also adapts to gardens and some exotic plant species (Cheke *et al.* 2001). They are also associated with Protea farms (Potgieter *et al.* 2008), although commercial bee keeping activities may have detrimental effects on bird abundance due to interference (Geerts and Pauw 2011). However, they may also be increasingly vulnerable to avian pox, roadkills, and cats (Barnard, unpublished data) and so we are precautionary in our assessment.

Orange-breasted Sunbirds are described as common, but reluctant to leave Fynbos (Hockey *et al.* 2005). The population estimate twenty years ago was given as >100 000 (Siegfried 1992). They feed on nectar from a variety of endemic and exotic plants (they are considered important pollinators of at least 67 *Erica* species), as well as on arthropods (Hockey *et al.* 2005). This species has been shown to be adversely affected by the invasion of alien woody plants and fire (Hockey *et al.* 2005). The Orange-breasted Sunbird has shown considerable relative range contraction between the two atlas projects, compared to the co-occurring Southern Double-collared Sunbird, which occupied 89% of QDGCs in the Western Cape. We predict that the Orange-breasted Sunbird could meet IUCN Vulnerable status in the near future given a 'business as usual' scenario of climate and land-change across the biome.

With the lowest reporting rate of all the species considered here, the Cape Rock-jumper appears to be a species in decline, which may soon no longer be described as 'locally common' (Hockey *et al.* 2005). Simmons *et al.* 2004 identified the Cape Rock-jumper as potentially vulnerable to climate change and we suggest that whatever the reasons for the dramatic drop in reporting rate, this species may soon qualify for a higher IUCN threatened status listing based on extreme relative range contraction combined with a probable extent of occurrence of <20 000 km^2. This iconic species requires urgent attention from conservation biologists and conservation planners.

Cape Siskin was previously categorised as Near Threatened and is described as a locally common resident or locally nomadic (Hockey *et al.* 2005). Although also showing a high relative range contraction,

this species has been reported from areas colonised by alien invasive Rooikrans *Acacia cyclops* and village gardens. Again, further studies are required.

The first publication to focus on the Protea Seedeater was entitled 'The bird nobody knows about' (Siegfried 1972). It appears little has changed, although its status is rivalled by the Victorin's Warbler – a species that could be described as 'The species that science forgot' as the journal search revealed no journal publications after 1976, with short articles referring to the species all published pre-1960 (MacLeod 1946, MacLeod and Broekuysen 1951, McLeod *et al.* 1958). Biometric information for Victorin's Warbler in Hockey *et al.* (2005) was based on the lowest number of individuals (n = 6); by comparison Cape Sugarbird biometrics were based on 639 males and 842 females. Although Victorin's Warbler range contraction between the two atlas projects was low, the Protea Seedeater showed a large decrease in reported range, bringing it close to the critical 20 000 km^2 mark that would classify it as Vulnerable.

Conclusions

Climate change in South Africa is predicted to drive temperatures higher, significantly influence rainfall amount, seasonality and intensity, and increase wind speeds in some areas (Ziervogel and Zermoglio 2009). This may result in range changes southwards or eastwards (e.g. Foden *et al.* 2007). If this is the case, then those species already restricted to the southernmost tip of South Africa may only be able to move upwards in order to remain within acceptable temperature ranges. Furthermore, 25 out of 195 species which have been recorded as extending their ranges southwards are migratory or generalists (Hockey *et al.* 2011), which are not characteristics of the Fynbos specialists. This does not bode well for any of the Fynbos endemic bird species.

Although the bird atlas data cannot give an idea of population size, by two IUCN criteria Cape Rock-jumper and Protea Seedeater would now at appear to at least meet IUCN Vulnerable status criteria, and more rigorous investigation is urgently needed. Further rigorous studies of all Fynbos endemic bird species are urgently required, to supplement and expand our own observations.

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