Citizen science and satellite data shed light on bird diversity in Kruger National Park

In 2022, I wrote a popular article for the South African Environmental Observation Network (SAEON)'s eNews in which I pointed out the debatable importance of Africa's protected areas in conserving bird diversity and preserving threatened birds. In this article, I share some of the processes embarked on and most significant results found when my colleagues and I investigated bird diversity patterns inside and outside the world-renowned Kruger National Park (KNP).

A challenge with answering regional or biogeographical questions (especially those related to the study of the geographic distribution of plants, animals and other forms of life), is that the data required are not commonplace. To assist in answering such questions, citizen science or crowd-sourced Big Data are employed to investigate patterns and/or processes at large spatial and time scales.

One such "proudly South African" project containing this rare data (in the form of millions of species records), is the second Southern African Bird Atlas Project (SABAP2). It continued from its predecessor in 2007 and saw an exponential increase in submissions around 2015 when the popular SA-built BirdLasser smartphone app was launched. The latter enabled birdwatching enthusiasts to log bird species in a simple and intuitive manner and at five-metre accuracy.

Currently, more than two million records are added to the SABAP2 database annually – an invaluable resource for scientists and conservationists but not used as often as one might expect. Here is a link to the SABAP2 website if you want to read further or become a citizen scientist yourself.

Together with this large database of bird data, some environmental data were required to answer questions about the drivers of bird diversity across the region because I (and undoubtedly other people too) am interested in the causes of certain patterns or behaviours observed in nature. In this case, a typical community ecologist such as myself (when I wear the science hat) posed the following question: How do the bird communities inside the KNP differ from those outside and, if they do differ, what are the causes? This has never been

The Olifants River near the Kruger National Park boundary, October 2015. Rivers like this are essential for maintaining bird diversity across South Africa's Lowveld region.

looked at before at a nearly four-million-hectare scale in this part of the world.

Historical environmental data are nearly as rare as "hen's teeth" and especially across the larger scales that biogeographical studies (like ours) focus at, but fortunately I found some high-quality data made available (freely) by Copernicus, the European Union's Earth observation programme. I did, however, employ Google to process the data to my needs.

We subsequently ended up with cover values for the environment such as grass, trees, two types of water (permanent and seasonal) and infrastructure across the region. I could now start walking the path of unforgiving statistical analysis by putting the computer hardware and software to work on a decade's worth of data that Microsoft could not even read.

Something we realised, and had to deal with early on, was that there is significant variation in effort with citizen science protocols such as SABAP2 (albeit brilliantly simple). This brings about challenges when the scientist wants to compare "apples with apples".

For example, if a certain area only ever had two surveys (bird checklists) submitted over 10 years, it cannot be compared with an area for which 100 surveys had been submitted over that same period. Why not? Because judged merely on the data, the latter would contain more species when in actual fact, more species would have been recorded for the first area as well, if 100 surveys had been submitted from there. Those species unaccounted for because of little observer effort is something called "dark diversity" (a recent term in community ecology). It refers to those species not accounted for or absent but that can or should be found in an area.

To counter this, we applied techniques that attempted to account for effort discrepancies. We also decided on a threshold under which grids with too few surveys were discarded from our analyses.

I am not going to bore you with other methodologies, so let's jump into our findings…

Firstly, about 50% of the bird communities from the mosaic are differently composed to those from KNP. That is to say, the combinations of species in the areas outside the national park, compared with most of the areas inside, were very different. However, since more than 500 bird species were considered, we were not interested in which were found where in each of the areas we looked at, as this was not the aim of our study. We did, however, publish a list of species and where they were found in the publication's appendix.

Secondly, what was surprising to us is that numbers-wise, neither the mosaic nor the KNP had significantly more species or larger functional diversity than the other. There were species of more diverse evolutionary ages inside KNP, which was to be expected because "old" species (in evolutionary terms) like the Common Ostrich were present there, as well as a range of "younger" species and everything in between. This contributed to elevated phylogenetic diversity values in the park.

The relationships that surfaced between the environment and bird diversity were most interesting…

Camps such as Satara inside the Kruger National Park are host to many different bird species, compared to outside. However, the bird communities found there are not as functionally or phylogenetically (evolutionarily) diverse compared to the more natural areas inside the park.

Seasonal water inside and outside KNP as well as the camps inside KNP (note, not the infrastructure outside) were host to the largest bird communities (containing the most species). However, the added infrastructure inside the park resulted in a cost in diversity. We found a strong negative association between camps and functional and phylogenetic diversity. In other words, these results seem to show that the camps deterred birds of certain functions and evolutionary ages (possibly older birds along the evolutionary tree such as waterbirds, raptors and obviously the Ostrich).

What was surprising is that infrastructure outside the national park did not impact on these components of bird diversity. This may seem unexpected but there are findings that show how urban areas promote bird diversity as there are different processes at work in and along the edges of towns and cities.

Other interesting and expected results were that an increase in tree cover negatively affected phylogenetic bird diversity across the region in that areas with many trees were not host to birds of diverse evolutionary ages. The conservation implications of this may seem less obvious than the effects of infrastructure but it does confirm the negative impacts of bush encroachment has on bird communities (typically outside KNP) and makes one rethink the importance of elephants as ecosystem engineers in keeping the trees at bay.

Article written for the South African Environmental Observation Network (SAEON) eNews by Rion Lerm, Research Infrastructure Technician and PhD Candidate, SAEON Ndlovu Node/Centre for Functional Biodiversity at the University of KwaZulu-Natal. The scientific publication on which this article is based is freely available and can be found here.

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de Wit, Christo

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