Kenya Bird Map: an internet-based system for monitoring bird distribution and populations in Kenya

Background

Data collection for the first Kenya Bird Atlas started in the 1970s and continued until 1984, and also included pre-1970 data mainly from museum specimens. Over 200 contributors, mainly Kenyan citizens, were involved in the data collection (Lewis & Pomeroy 1989). The sources of data were: published records, museum skins, contributions received directly from observers, nest record cards submitted to the EANHS Nest Record Scheme, and data from the Ringing Scheme of eastern Africa.The data were analysed and published in the book *A Bird Atlas of Kenya* by Lewis & Pomeroy (1989). This atlas used half degree cells, which were 30 min x 30 min, or 54 km x 54 km (Lewis & Pomeroy 1989). The authors noted that, "Its coverage is certainly not complete, but we believe nevertheless that it gives a fair indication of Kenya's avifauna, especially during the main atlas period of 1970–1984" (Lewis & Pomeroy 1989).

Lewis & Pomeroy (1989) provided a good idea of the distribution of birds in Kenya at the time. Bird distributions have changed over the intervening period, primarily because of habitat destruction, but it is not known to what extent. Over the same period, noticeable changes in long-term weather patterns may also have affected bird distributions (see, for example, Humphrey 2004). Since 1989, several attempts to document bird distribution records in Kenya have been made. During the 1990s the then Department of Ornithology at the National Museums of Kenya regularly published range extensions of birds in the now discontinued *Kenya Birds*. From 2006 to 2013, the Kenya BirdFinder Project (http://www.worldbirds.org/v3/kenya.php), based on BirdLife International's World Bird database, kept records of bird observations in Kenya. These initiatives had a few shortcomings as they failed to provide comprehensive answers to the three questions on which the conservation status of a species hinges, i.e. Where are they? How many are they? and What is their trend? (Underhill & Gibbons 2002). The protocol of the Kenya BirdFinder did not allow for robust data analysis as it focused on records from 'hot spots' only. Birders primarily visited the major birding sites, and there were no committed attempts to visit uncovered areas to enable mapping of bird distributions. Furthermore, vetting of records was a major challenge and the data could not be used for scientific purposes without a significant amount of cleaning up.

The Kenya Bird Map (http://kenyabirdmap.adu.org.za) is an internet-based bird distribution database that employs citizen science to map the location of birds and describe their distribution in real time. The database will map observations using a finer scale than the previous atlas and the methodology allows for robust statistical analysis of the data. Specifically, birds are recorded in the order they are seen or heard together with a count of the number of species observed per hour, which provides an index of the relative abundance of each species. So rather than just providing an index of the presence or absence of a species (as the previous atlas did), this atlas will provide a measure of abundance for each species based on the presence of other species and the location where it was recorded. By pooling the efforts of many citizen scientists, the Kenya Bird Map will record the distributions of Kenya's birds and in so doing, provide a powerful tool for conservation.

The Kenya Bird Map employs a finer scale of mapping using 5 min x 5 min (*c.*

9km x 9km) cells, referred to as a 'pentad'. There are 36 pentads in each Quarter Square Degree (QSD) and 8208 pentads in Kenya, as compared to 228 QSDs in the first atlas. This smaller grid cell means that the distribution maps produced will be of far finer resolution and allow for better analysis of species distribution in relation to other variables such as habitat, altitude and human impacts. The pentads are linked to Google Maps and are accessible on the Kenya Bird Map website. The pentad maps allow participants to easily pinpoint their pentad and to identify pockets of different habitats within each pentad that might hold additional species. Data collection is by citizen scientists — volunteer observers who visit the sites and pentads of their choice anywhere in Kenya to map birds.

Mapping protocol

A key strength of the Kenya Bird Map lies in its simple yet robust sampling protocol, which produces data that can be used with confidence for analyses. The main protocol, termed the 'Full protocol' is summarized as follows:

- Spend a minimum of two hours observing and recording birds within a pentad. List all the bird species observed in the order that they are encountered. Make a note of the cumulative number of birds seen at the end of each hour.
- Additional survey time can be added to the same pentad for up to five days from the start of a survey. Add any new species (in the order that you encounter them) to your initial list until the end of the fifth day. A new list should only be started for the same pentad after the end of the five-day period (i.e. on day six).

An additional protocol, the 'ad hoc protocol', is used to map a species' distribution and record the time of year when it was seen, but the records are not used for a species' reporting rate or its abundance. The ad hoc protocol is used when adherence to the full protocol cannot be met, i.e. when the observer is birding for less than two hours within the same pentad. This protocol is simply to submit a list of records for a given pentad on a given date. Observations of interest can be submitted as an 'incidental' observation for a single species such as an unusual species, or a large group of birds, or out of season records.

Entering records into the database is also simple for anyone who is computer literate and has reasonable access to the internet. An offline database management system is being developed that will allow for easier submission of data when internet access is poor, and an application for use in smart phones is planned. Guidelines for inputting data via the website are available at http://kenyabirdmap.adu.org.za/docs/kbm_howto.pdf.

Proper validation of the data is clearly crucial for them to be useful for analyses. The system is set up to automatically vet data once an initial vetting and validation of species in each pentad has been done by a select committee of experienced birders and ornithologists. The initial vetting is therefore quite time intensive, but rapidly reduces as subsequent records are self-validated.

Expected Impacts

The distribution of a species is the most basic information required in order to conserve any species. A dynamic atlas such as the Kenya Bird Map is therefore an invaluable conservation tool. With data available for free, the atlas can be conveniently used by researchers, tourists, policy-makers, etc. The new atlas will provide a clear

and real-time distribution map of bird species that will be comparable to the first Bird Atlas of Kenya data, which will be added to the website. After five years we will analyse the data collected and compare them to the first atlas to show changes in a species' distribution over the 30-year period since the first atlas. Potential applications of the atlas data include:

- An early warning system for environmental change by tracking changes in bird distribution and relating them to environmental degradation, climate change, etc. (see for example, de Villiers 2009 and http://www.adu.org.za/docs/climate_change_booklet.pdf)
- Tracking of the timing and patterns of bird migration
- Monitoring population sizes and trends of threatened and endemic bird species (see Robertson *et al*. 1995)
- Provide evidence of bird species' abundances in Kenya (see Gibbons *et al*. 2007)

The Kenya Bird Map may also encourage development of atlases for other taxa, such as reptiles, mammals, butterflies, etc. (see http://vmus.adu.org.za/).

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Washington Wachira
Ornithology Section, National Museums of Kenya, P.O. Box 40658-00100, Nairobi, Kenya. Email: washingtonwachira@gmail.com

Colin Jackson
A Rocha Kenya; P.O. Box 25924, Nairobi, 00100, Kenya

Peter Njoroge
Ornithology Section, National Museums of Kenya, P.O. Box 40658-00100, Nairobi, Kenya