Developing biodiversity indicators for African birds

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SUPPLEMENTARY MATERIAL 1 Survey design

Introduction

There exists an extensive literature on bird survey design (e.g. Bibby et al., 2000; Sutherland et al., 2004; Sutherland, 2006; Voříšek et al., 2008), and potential sampling approaches and survey techniques were reviewed in an African context by Senyatso et al. (2008). BirdLife Partners BirdLife Botswana and Nature Uganda established monitoring schemes in 2009, with the technical and financial assistance of the Royal Society for the Protection of Birds (RSPB). The scheme in Uganda was an adaptation of a standardized land bird monitoring programme that was instigated in 1983 by Makerere University Institute of Environment and Natural Resources, and the National Biodiversity Databank in Kampala (Pomeroy & Asasira 2008). In that programme, observers were drawn from the staff and students of Makerere University, and birds were recorded by using Timed Species Counts, developed to cope with species-rich habitats (Pomeroy & Tengecho, 1986; Pomeroy & Asasira, 2008). The Kenyan monitoring scheme was started in 2011 and is organized and coordinated by Nature Kenya, with the support of RSPB, the National Museums of Kenya, the Kenya Wildlife Service, Kenya Forest Service, Kenya Airports Authority, and the National Environment Management Authority.

Sampling design

To select survey sites in Botswana, coverage was stratified according to the 12 major biomes (Bekker & De Wit, 1991), to ensure adequate coverage of the whole country. The number of proposed sampling units in a biome was based on its land cover proportions (Senyatso et al., 2008). There are just over 800 quarter-degree squares covering Botswana; therefore to

sample 10% of the area, every eighth quarter-degree square (each c. 50 × 50 km) was chosen as the location for a sampling unit. Transect locations were selected randomly within each square.

In Uganda, survey sites included those covered in the existing land bird monitoring programme as well as newly selected sites, with a semi-random approach to site selection. New sites were selected from areas where potential volunteer observers lived or worked, which were mostly protected areas, residential areas or tourism sites where volunteers were based permanently (to minimize costs and ensure sustainability of the scheme) or visited regularly (e.g. for other counts, such as waterbird counts), or were otherwise easy to access. Each observer selected their monitoring site randomly from 1:50,000 topographical maps, and marked a 2 km transect in a 1 × 1 km grid square selected at random from all those within that area. The scheme uses surveys along standardized line transects of 2 km, following a predefined route within each selected survey square.

In Kenya, a quarter-degree square grid was overlaid over a bird atlas of Kenya (Lewis & Pomeroy, 1989), and transect locations were selected randomly, roughly in proportion to the overall land cover types. In some cases existing monitoring transects were used, such as those used by the network Site Support Groups affiliated to Nature Kenya.

Field methods

In Botswana, the approach used in the first year of the scheme was to survey transects (of c. 10 km in length) along roads by driving between count locations, but this proved a barrier to participation, as many potential volunteers did not have access to a vehicle. Since 2010 the survey has entailed walking a 2 km transect, undertaking a 5-minute count of all birds seen or heard at 11 points spaced at 200 m intervals along the transect. The start and end points of each transect and the route followed are recorded precisely using a global positioning system,

so if there are any changes in observers, the transect routes can be maintained. Surveys are undertaken twice per year, in February and November, to cover periods when Afro-Palearctic migrants are present, and when birds are most likely to be readily detected through breeding activity.

In Uganda, transect routes were defined by the observer, typically following used footpaths, small roads used only occasionally by vehicles (<1 per hour), or other linear features, so that the routes were repeatable. Each transect is c. 2 km in length, divided into 200 m count sections. Bird surveys are undertaken by walking the route at a steady pace and recording numbers of all bird species seen or heard in each section within 500 m either side of the transect line. Surveys are conducted twice per year, in January–February, when most Afro-Palearctic migrants are likely to be present, and July–August, when resident and intra-African migrants are most likely to be detected. Counts are carried out by a team of two or three people, with a lead observer or two, and a competent recorder.

In Kenya, a point count survey design is used, with observers recording all birds seen or heard during a 10-minute period at 11 points, every 200 m, along a 2 km route. Counts are undertaken approximately 6 months apart, in February and August, similar to Uganda.

In general, observers are asked to ensure that each survey lasts no more than 3 hours, with the line transect or first point count starting at c. 07.00 and the line transect or last point count finished by 11.00, when birds are most active and easier to detect. However, this was not always possible, and in Uganda time restrictions were relaxed. Standardized recording forms were created for line transect and point count surveys, and adapted for local use by each BirdLife Partner.

Volunteer engagement and training

Supporting materials included a user-friendly survey protocol and brochures to encourage participation. In Botswana, the existing volunteer network was based upon BirdLife Botswana members and biased towards the capital city, Gaborone, so considerable work was required to identify, motivate and train participants (including Department of Wildlife and National Park rangers, tour guides, birdwatchers and members of community-based organizations) in rural areas, to spread coverage geographically. Volunteer training was conducted face-to-face, either one-on-one or at workshops with multiple participants, and through the dissemination of supporting materials. The interest of participants has been maintained by frequent contact, feedback in the form of annual reports, and by the production of items such as field guides and CD recordings of common bird calls.

In Uganda, counts are organized and coordinated by Nature Uganda but are carried out by volunteer birdwatchers, Nature Uganda staff, Uganda Wildlife Authority rangers and by professional bird guides acting in a voluntary capacity. At the start of the scheme, workshops were held by Nature Uganda to train volunteers in the survey methods; these volunteers were later asked to encourage other birders to take part in the scheme by cascading their skills and knowledge. These additional volunteers were trained on site by the participating volunteers. Refresher training courses were conducted for participating volunteers to keep them active and motivated, and these are repeated whenever funding becomes available.

In Kenya, initially at least, many of the transects were surveyed through the existing Site Support Group network established by Nature Kenya. More recently, Kenya Airports Authority and some Kenyan universities and their students have become involved. It has been apparent that many people are keen to participate but lack the required level of bird identification skills, and local workshops are run to help address this.

RSPB and BirdLife International provide ongoing support to the three schemes in the form of modest core funding from RSPB, regular contact, help and advice, annual scheme catch-ups and reviews, and especially in data sharing and management.

Developing motivated and skilled citizen scientists is key to the success of volunteer-based count schemes, as we describe here. A key challenge is the lack of a tradition and culture of bird watching and systematic bird recording in Africa, as in other parts of the world. Various approaches to volunteer recruitment have been used by BirdLife Botswana and Nature Uganda. In Botswana, the aim of recruiting keen surveyors regardless of experience, with the intention of providing sufficient training to facilitate successful participation, has resulted in greater, and less geographically biased, survey coverage in Botswana compared to Uganda. In Uganda, the policy has been to recruit experienced surveyors from the outset, meaning that there was a smaller pool of recruits from which to draw, and with hindsight more limited scope for expansion. In Kenya, volunteer uptake was slow initially but there has been targeted recruitment through Nature Kenya's network of Site Support Groups, as well as a number of universities in Kenya and from Kenya Airports Authority. In all three countries, staff from government wildlife agencies, who are often highly skilled observers and are required to accompany those visiting national parks, are also involved in the schemes. This is encouraging and should be applauded, as it helps to unify monitoring ambitions and build partnership support for projects. We strongly recommend an inclusive partnership approach to monitoring programmes. We note also that a recent systematic literature study did not show that data collected by professionals were less variable than data collected by volunteers (Lewandowski & Specht, 2015), dispelling the myth that their abilities would differ in well-designed monitoring programmes.

There are potential drawbacks in recruiting and using more inexperienced surveyors from the start of monitoring schemes, and such effects need to be assessed carefully. In Botswana,

five of the six indicators show a significant increase between the baseline year of 2010 and 2011 (Table 2). We think it probable that some of the initial surveys that were carried out by inexperienced surveyors may have under-recorded birds in the first year at least. Over time, it is likely that such surveyors will gain experience and thus become better able to identify birds by sight and call, and therefore produce more records per count. It should also be noted that in Uganda four of the seven indicators also showed a significant increase between the baseline year of 2009 and 2010 (Table 2), although learning effects there should be much less pronounced, although still present. Analysis of Breeding Bird Survey data in England shows no consistent first-time observer-experience effect across species, and that including observer experience in the population models is unlikely to improve or change population estimates (Eglington et al., 2010). However, Kendall et al. (1996) have shown first-year learning effects in the North American Breeding Bird Survey. Another consideration is that the smaller number of transects surveyed in the first year in Botswana may have had an effect on the changes between 2010 and 2011 (Table 1). In time, such effects can be alleviated or overcome by removing time series endpoints, statistical smoothing of trends, or by including observer effects in the trend models themselves, and we acknowledge this may be an issue where there is little experience of species monitoring and where the bird communities are species rich.

A workshop with all three BirdLife Partners was organized in November 2013, which proved useful for the scheme organizers to identify common issues and to discuss the approaches taken within each country. We strongly recommend similar initiatives to foster cooperation and knowledge sharing. There are some simple rules to good survey practice; for example, value, nurture and train volunteers; provide regular feedback to volunteer counters, with regular updates on progress and results in newsletters, leaflets, media and scientific publications; bring existing surveyors and new recruits together in annual workshops that

rotate in location; analyse, interrogate and use the data; learn from others; build strategic partnerships; and aim high, but not too high, in terms of ambition and complexity.

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TABLE S1 The indicator trend classification, as defined for the TRIM program and MSI_tool.

Significance category	Trend criteria (description)*
Strong increase	Lower CL > 1.05 (significant increase of >5% per year)
Moderate increase	1.00 < lower CL < 1.05 (significant increase, but not significantly >5% per year)
Stable	CI includes 1.00 AND 0.95 ≤ lower CL AND upper CL ≤ 1.05 (no significant increase or decline, likely that changes are <5% per year)
Uncertain	Lower CL < 0.95 AND 1.05 < upper CL (no significant increase or decline, unlikely that changes are <5% per year)
Moderate decline	0.95 < upper CL < 1.00 (significant decline, but not significantly >5% per year)
Steep decline	Upper CL < 0.95 (significant decline of >5% per year)

*****CI, confidence interval; CL, confidence limit (Soldaat et al., 2007)