

PERSPECTIVE

A roadmap integrating research, policy, and actions to conserve Afro-Palearctic migratory landbirds at a flyway scale

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Abstract

The populations of Afro-Palearctic migratory landbirds (breeding in Europe and overwintering in Africa) are declining and conservation efforts to halt or reverse their decline have failed to meet their targets. Yet, most studies and conservation measures focus on migratory landbirds' breeding grounds, whereas knowledge about threats, drivers of their decline and conservation actions in their nonbreeding grounds, where they spend most of their annual cycle, is largely limited. Here, we provide a four-step roadmap to integrate research, policy and actions for conserving Afro-Palearctic migratory landbirds at a flyway scale: (1) assessing and monitoring population trends and defining priority species accordingly; (2) maximizing tracking data to identify important areas for the conservation of priority species; (3) conducting ground-based studies on the nonbreeding grounds to identify conservation challenges; (4) implementing conservation measures, for the benefit of both the avifauna and the local human communities. Alongside these steps, international conventions may facilitate new collaborations across range-states and institutions to engage diverse stakeholders and involve local communities, with particular emphasis on evidence-based policymaking, law enforcement in addition to capacity strengthening and knowledge transfer of new technologies. This four-step roadmap provides guidance for future work on Afro-Palearctic migratory landbirds and will ultimately contribute to their conservation.

KEYWORDS

annual cycle, bird migration, capacity strengthening, *Emberiza hortulana*, evidence-based policymaking, flyway scale, international collaborations, knowledge transfer, nonbreeding grounds, Ortolan Bunting

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1 | INTRODUCTION

European populations of long-distance migratory landbirds are declining at a faster rate than those of short-distance migrants or resident species (Sanderson et al., 2006; Morrison et al., 2013), and conservation efforts and policies to reverse these declines have so far failed to meet their targets (Gamero et al., 2017). It is therefore urgent to devise conservation actions at a flyway scale to halt the ongoing decline. However, conserving migratory species is challenging because of their dependency on multiple sites (e.g., breeding areas, migratory routes including several stopover sites, and nonbreeding/overwintering grounds), which are often geographically and politically distant (Vickery et al., 2014). Up until now, most studies have focused on the breeding season, while a full annual cycle perspective is needed (Marra et al., 2015).

Fortunately, thanks to recent advances in tracking technologies, we now have a better knowledge of migration pathways, strategies, and annual cycles (e.g., Briedis et al., 2016; Hewson et al., 2016). These new findings improve our understanding of the multiple causes for the decline of migratory landbirds. Yet, the conservation potential of these tracking data is not fully exploited: we know where specific species are spending most of their annual cycle, but we still often ignore their ecological needs on their nonbreeding grounds when devising conservation measures. Indeed, only a few studies have assessed the ecological and environmental drivers responsible for the observed decline of Afro-Palearctic migrants in their nonbreeding habitats (Beresford et al., 2019; Gremion et al., 2022). This represents a major knowledge gap and needs to be tackled urgently if we want the conservation efforts made in migratory landbirds' breeding grounds to play a significant role in protecting Europe's most rapidly declining bird species.

The Afro-Palearctic bird migration system is the largest landbird migration network in the world, with an estimated 2.1 billion songbirds and near-passerine birds (e.g., swifts, doves, bee-eaters) migrating from Europe to Africa each autumn (Hahn et al., 2009). Moreover, some species of Afro-Palearctic migrants travel with a broad front (i.e., over large spatial scales; Briedis et al., 2020) and have low migratory connectivity (i.e., individuals from the same breeding population spread over different wintering sites), making it difficult to protect a bird population via conservation actions at specific sites. Thus, successful conservation often needs large-scale policy amendments (Guilherme et al., 2022). Therefore, to conserve Afro-Palearctic migratory landbirds at a flyway scale, we need to establish strong international collaborations and agreements between actors from the governmental and private sector based in Eurasia and Africa. Engaging with such a diverse panel of actors is challenging and requires the

development of structures, instruments, and platforms to facilitate these collaborations. Here, we propose a four-step roadmap to integrate research, policy, and actions for conserving Afro-Palearctic migratory landbirds at a flyway scale. To illustrate these steps, we refer to a case study on the Ortolan Bunting (*Emberiza hortulana*).

2 | STEP 1: ASSESSING SPECIES' DISTRIBUTION AND POPULATION TRENDS TO IDENTIFY PRIORITY SPECIES

Before starting any species-specific conservation venture, it is essential to know a species' distribution and population trend. Long-term monitoring programs that include several migratory landbirds, such as the Pan European Common Bird Monitoring Schemes (PECBMS; <https://pecbms.info/>) generate highly valuable information on the trends and status of breeding birds at the continent-scale. Additionally, the recently published European Breeding Bird Atlas (second edition, Keller et al., 2020) provides further detailed information about spatially-explicit population sizes of all European breeding birds. However, knowledge on the distribution of birds in Africa is largely missing or not accessible in a centralized database. At the same time some regions of Africa have already been identified as high priorities for the development of new and the reinforcement of existing citizen science initiatives (Callaghan et al., 2021). The development of a continent-wide African Bird Atlas (Lee et al., 2022) integrating country-wide monitoring programs (Nigerian Bird Atlas Project (NiBAP), Kenya Bird Map, Southern Africa Bird Atlas Project (SABAP)) is therefore urgent. This atlas would provide invaluable information about the distribution of priority species along the annual cycle, not only regarding Afro-Palearctic migratory landbirds but also Intra-African migrants and resident species. In this context, the collection of citizen science data has considerably increased and can help to monitor and conserve migratory species over their full annual cycle (Schuster et al., 2019). In particular, data from multiple web applications (e.g., eBird [www.ebird.org], iNaturalist [www.inaturalist.com], NaturaList [by Biolo-vision: <https://data.biolo-vision.net/data-biolo-vision.net>], BirdLasser [www.birdlasser.com]) have proven useful in a wide range of biodiversity monitoring and conservation projects (Callaghan et al., 2021) and combining these data on a common and accessible platform could lead to a higher impact. Other new technologies, such as passive acoustic monitoring and the automated detection and identification of bird sound recordings are a promising avenue for cost-effective monitoring of resident and

migratory birds (Sugai et al., 2019), especially in areas that are difficult to monitor because of their inaccessibility or insecurity (e.g., conflicts, terrorism). Yet, these methods are currently not applied in most African countries where knowledge transfer and training programs need to be strengthened or established. The proper use of all these resources, in addition to more detailed national or regional monitoring schemes, would help to identify priority species, to define the importance of the main staging and overwintering sites in time and space, and potentially to elucidate the conservation challenges species face at different stages of their annual cycle.

3 | STEP 2: STUDYING MIGRATION PATTERNS AND MAXIMIZING THE USE OF TRACKING DATA

Recent advances in tracking technologies, such as miniaturized solar-driven GPS systems (Sarà et al., 2019), light and multisensor data loggers (Liechti et al., 2018), genetic approaches (e.g., genoscapeing; Ruegg et al., 2020) and stable isotopes (Jiguet et al., 2019) provide an opportunity to collect considerable amounts of data and shed light on animal movements across continents. By allowing a better understanding of migration strategies along the full annual cycle (Briedis et al., 2016; Hewson et al., 2016), these data may ultimately help identifying areas of high conservation concern during migration, including stopover sites and species' main nonbreeding grounds (Ruegg et al., 2020). Nevertheless, intraspecific genetic loss (i.e., the decline or disappearance of subpopulations representing distinct genetic lineages) is often overlooked despite the potential for it to cause population declines. Combining genomic techniques with network modeling is a promising avenue to understand the cause of populations declines beyond the species level (Ruegg et al., 2020). High-resolution tracking data, alongside new genomic techniques and network modeling may herewith set the basis for flyway-scale conservation planning and have a great potential to help inform conservation policy and management (Guilherme et al., 2022). Ideally, published tracking data should be made available in online databases (e.g., Movebank, www.movebank.org) allowing stakeholders from private and governmental sectors free access. Moreover, these new technologies remain largely inaccessible in nonbreeding grounds, especially in Africa, and more awareness and training programs are urgently needed in these areas. Another limiting factor is that most of the tracking data come from bird populations in Western and Central Europe with a marked underrepresentation of populations and species breeding in the eastern range of the Afro-Palearctic migration system (Guilherme et al., 2022),

while data on Intra-African migrants is largely unavailable. Thus, we urge researchers to conduct more tracking and genetic studies across multiple sites to cover the whole breeding and nonbreeding ranges of Afro-Palearctic migratory landbirds. While the collection of these data is currently mostly used in the framework of hypothesis testing and fundamental research, we strongly advocate for more applied contributions (e.g., identifying single- and multispecies conservation hotspots; see Guilherme et al., 2022).

4 | STEP 3: IDENTIFYING THREATS AND CONSERVATION CHALLENGES

Once we know the year-round whereabouts of Afro-Palearctic migratory landbirds, we need to identify in which geographic regions, in which habitats and at which stage of their annual cycle they are facing potential threats. For example, the observed population decline of Afro-Palearctic migrants can be due to single or combined effects of various sources ranging from low breeding success due to climate change (e.g., phenological mismatch between breeding and peak food availability) or carry-over effects from wintering grounds, low annual survival due to illegal killing during migration, to habitat loss and degradation due to climate or environmental and land-use changes (e.g., agricultural intensification, overgrazing; see Bairlein, 2016). However, current studies are heavily biased toward the breeding grounds and knowledge of what is happening on the nonbreeding grounds is largely missing (Marra et al., 2015). Even studies that assessed the causes of decline of Afro-Palearctic migrants in their wintering grounds focused primarily on remote sensing techniques (Beresford et al., 2019) despite that habitat preferences of landbirds are often only detectable by quantifying fine-scaled habitat characteristics necessitating ground-based fieldwork in Africa (Marcacci et al., 2020, 2022; Gremion et al., 2022; see step 3 in Box 1). We therefore strongly encourage more ground-based studies in the identified geographic regions at the relevant stages of the targeted species' annual cycles in order to determine the potential threats and drivers of population declines and how to mitigate them.

5 | STEP 4: IMPLEMENTING CONSERVATION MEASURES BENEFITTING BOTH PEOPLE AND BIODIVERSITY

To have a long-lasting impact, every conservation initiative should be devised based on scientific evidence compiled

A case study: the Ortolan Bunting

Step 1: Population trends

The Ortolan Bunting (*E. hortulana*) has shown a dramatic population decline (-92%) all over Europe in the last decades (PECBMS). It is the species exhibiting the strongest reduction in population size and distribution of all European birds (Keller et al., 2020). The effects are most pronounced in western and northern populations, where the species became extinct in multiple countries in the last decade (e.g., Switzerland, Belgium, The Netherlands, Hungary). High abundance estimates and stable trends were still reported from a few southeastern populations (e.g., Turkey; Keller et al., 2020).

Step 2: Maximizing tracking data

Jiguet et al. (2019) studied the migration of Ortolan Buntings combining tracking data from light loggers, stable isotopes, and genetic approaches collected from all over their breeding range (Europe, Russia, Middle East). The results indicated two distinct populations following two different routes: a western flyway with a migratory bottleneck in southwestern Europe and overwintering in Western Africa, and an eastern flyway used by the eastern population with overwintering in Eastern Africa. The western population is small, fragmented, and significantly declining. In contrast, Ortolan Buntings from the eastern population, which represents 90% of the species' global population, overwinter almost exclusively in the Ethiopian and Eritrean Highlands, highlighting the great responsibility of these two countries regarding the conservation of the species.

Step 3: Identifying threats and conservation challenges

The ongoing decline of the Ortolan Bunting has multiple causes. Along the western flyway illegal killing in France in addition to major land-use changes (abandonment of traditional agriculture) in the breeding grounds are the main factors increasing the extinction risk in several countries (Jiguet et al., 2019, Keller et al., 2020). The recent tracking data demonstrating that the majority of the world population overwinters in the Ethiopian Highlands calls for concerted research activities in this seemingly important habitat. Gremion et al. (2022) conducted a field study in Ethiopia to investigate the habitat preferences of the overwintering Ortolan Buntings. They demonstrated the importance of small-scale agriculture with traditionally managed cereal-grain fields interspersed with semi-natural habitats for the conservation of the species. Particularly, manually harvested fields seem to be important due to the remaining seed-rich stubbles. The ongoing agricultural intensification in Ethiopia, with the recent creation of large-scale monocultures, could thus represent a serious threat to the Ortolan Bunting's global population. This threat is evidenced by Marcacci et al. (2020, 2022), who demonstrate that both large-scale farming and reduced landscape complexity (i.e., amount of semi-natural habitats) negatively impact migratory species in this agroecosystem. Knowledge on the Ortolan Buntings' overwintering habitats in Western Africa is however still missing.

Step 4: Implementing conservation measures benefitting both people and biodiversity

The implementation of measures and actions need to consider the magnitude of a threat in time and space. In Europe, the hunting ban on the Ortolan Bunting, following the recommendations of Jiguet et al. (2019), is expected to lessen anthropogenic pressures on the western population. On the nonbreeding grounds, projects such as the Great Green Wall for the Sahara and Sahel Initiative as well as other conservation initiatives (e.g., Brown et al., 2011) are in line with the habitat requirements of the Ortolan Bunting (Gremion et al., 2022) and should result in multifunctional landscapes benefitting both the avifauna and the local communities.

Promoting international collaborations for a flyway scale impact

To enlarge this regional focus to a flyway scale, action plans are needed for migratory landbirds in general (i.e., AEMLAP), but also specifically for single or multiple species. This is where adopting a multispecies action plan for migratory buntings embedded in the Convention of Migratory Species (CMS) would represent a valuable instrument at the research-policy interface. A guild or multispecies approach incorporating phylogenetically related taxa (e.g., on a family level) is an interesting way of trying to push forward conservation actions for numerous endangered species sharing similar life history traits and habitat preferences (See figure 1).

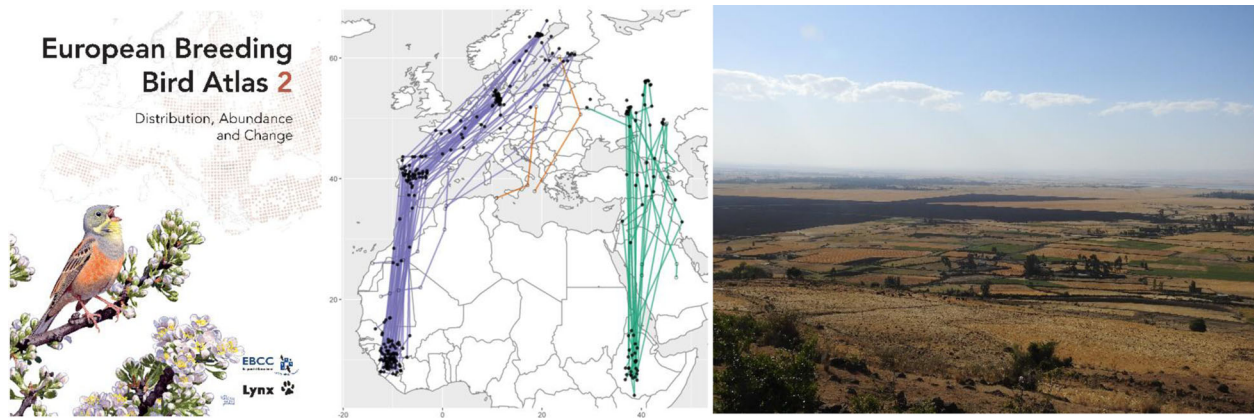


FIGURE 1 (a) the cover of recently published European Breeding Bird Atlas, second edition (Keller et al., 2020; cover illustration: Ortolan Bunting *Emberiza hortulana* ©Szabolcs Kókay; Cover map: Ortolan Bunting *Emberiza hortulana* ©European Bird Census Council EBCC). (b) Ortolan Buntings' western and eastern migratory flyways (from Jiguet et al., 2019; ©Jiguet et al., some rights reserved; exclusive licensee AAAS. Distributed under a CC BY-NC 4.0 License (<http://creativecommons.org/licenses/by-nc/4.0/>)). 90 % of the world population of the Ortolan Buntings uses the eastern flyway to overwinter in Ethiopia. (c) Typical cereal-grain dominated agricultural landscape in the Ethiopian Highlands (picture: ©Gabriel Marcacci). Traditional small-scale farming (foreground) is a prime habitat for overwintering Ortolan Buntings, whereas buntings avoid large-scale monoculture (background), which also pose a threat for other migratory landbirds.

throughout the three previous steps. Implementing conservation actions in Sub-Saharan African countries requires a focus on solutions and trade-offs that benefit both people and biodiversity and that acknowledge the cultural diversity and specificity of local communities. In particular, cross-disciplinary studies in close collaboration with local communities integrating their interest will promote the success of the implemented conservation measures in the long run (Maas et al., 2021). Many Sub-Saharan African countries are experiencing a fast human population growth while food insecurity is endemic. To meet the growing demands for food and space for housing, the negative impacts on ecosystems will rapidly increase over the next decades. The current combination of multiple global crises (e.g., COVID-19 pandemic, Russo-Ukrainian war, terrorism in the Sahel zone, climate change) is further increasing food insecurity and poverty, with severe consequences for people and natural ecosystems. Reconciling human activities (e.g., food production) with biodiversity conservation is therefore a major challenge, and involving local communities is crucial. Despite this challenging situation, several opportunities exist. For instance, restoring degraded habitats benefits both biodiversity and local communities through the provision of multiple ecosystem services such as soil protection against erosion, water security, timber, and natural products (e.g., fruits, honey, medicinal plants; Messier et al., 2022) and can help fighting land desertification in the context of climate change (e.g., Great Green Wall for the Sahara and Sahel Initiative, United Nations Convention to Combat Desertification

[UNCCD]). The Pan African Great Green Wall Agency (PAGGW) has for example signed a Memorandum of Understanding with BirdLife International for the integration of biodiversity, with a focus on bird monitoring, into the initiative's program, which will provide a vital tool to foster synergies to make the Sahel greener for biodiversity and people. Similarly, ecological intensification and sustainable agriculture (e.g., biodiversity-friendly farming, agroforestry) offer opportunities to achieve multifunctional landscapes, thus ensuring biodiversity conservation and food security (Tscharnkte et al., 2012; Gergel et al., 2020). For example, migratory landbirds provide important ecosystem services such as biological pest control, which can increase crop yield (Ndang'ang'a et al., 2013; Tela et al., 2021). Conservation projects can also combine biodiversity conservation with socioeconomic development to offer new livelihood and job opportunities (Gergel et al., 2020). In this context, using novel socioecological approaches to maximize ecosystem multifunctionality (i.e., the provision of multiple ecosystem services; see Linders et al., 2021) among different stakeholders could be key to devising the optimal conservation strategy that benefits both people and biodiversity. However, due to the broad front migration and the low migratory connectivity of some species of Afro-Palearctic migratory landbirds (Briedis et al., 2020; Guilherme et al., 2022), local conservation actions alone are insufficient and large-scale policy amendments involving multiple countries and stakeholders such as the MoU signed between the Pan African Great Green Wall Agency and BirdLife International are needed.

6 | PROMOTING FAIR AND EQUITABLE INTERNATIONAL COLLABORATIONS FOR A FLYWAY-SCALE IMPACT

We have seen in all four steps that conserving Afro-Palearctic migratory landbirds at a flyway scale requires establishing strong international collaborations between institutions and different actors based in Europe and in Africa. As stakeholders additionally belong to different sectors (e.g., governmental, academia, NGOs, policy makers, local communities, private sectors), coordinating and funding conservation projects often represent a challenge. Thus, devising successful implementation of large-scale conservation actions mainly depends upon international coordination. Such multistate collaborations can be facilitated by international conventions among range-states. For migratory birds, the Convention on the Conservation of Migratory Species of Wild Animals (CMS) aims to promote the protection of migratory species via agreements for the protection of specific species under conservation concern (e.g., AEWA International Single Species Action Plans [ISSAPs], MoU Aquatic Warbler, Single Species Action Plans for the European Turtle Dove and the European Roller) and for landbirds in general along the African Eurasian flyways (African Eurasian Migratory Landbird Action Plan [AEMLAP]). Moreover, instruments such as the Intergovernmental Task Force on Illegal Killing, Trade of Migratory Birds in the Mediterranean (MIKT), or the CMS Energy Task Force focus on specific threats that landbirds face along their migratory routes supporting policy makers to formulate precise legislations allowing strict law enforcement. Altogether, these instruments form vital tools facilitating the coordination among range-states and the vast number of stakeholders and actors between Europe and Africa, thus ensuring durable and sustainable collaborations.

When devising such collaborations, it is crucial to engage local stakeholders at an early stage of projects and to ensure from the start that diverse perspectives are taken into account (Maas et al., 2021). Helicopter science should be banned and it is essential to equally balance the workload and the responsibilities among the collaborators and to promote diversity, equity, and inclusion. In particular, capacity strengthening and knowledge transfer should be fostered and seen as a major outcome of the project. This can be accomplished via trainee programs to form ambassadors and multipliers in range-states and by promoting leadership among local partners. For example, organizing workshops and courses in collaboration with local research institutions on how to use new technologies such as radio-tracking, passive acoustic monitoring, and genomic techniques in African countries is greatly needed to successfully transfer these technologies

and maximize their impacts. Likewise, web applications and platforms to collect citizen science data can be locally adapted to best respond to the needs of different stakeholders. Whenever possible, we encourage scholars from research institutions based in Europe to consider the supervision of undergraduate students in Africa before systematically sending their own students overseas. Several partnerships between European and African research institutions already exist to cosupervise students and conduct joint research such as A. P. Leventis Ornithological Research Institute (APLORI) in Nigeria or the Harrison Institute (<https://www.harrison-institute.org/>), which could be regarded as examples. Furthermore, all conservation projects need to aim at disseminating the outcomes of the study (e.g., education, information) to increase public awareness and support, both in Europe and in Africa, which in turn will help translating the evidence-based recommendations into practice (Maas et al., 2021). One way to promote public awareness and to foster its engagement with bird conservation is to establish local bird clubs and ornithological societies. Feeling part of a birding community increases social recognition and motivates people from various backgrounds to get involved in different activities beyond birdwatching, including bird monitoring and the participation in citizen science and other conservation initiatives. Finally, if we are to be successful, data need to be openly accessible (e.g., published research articles, citizen science data, tracking data, sound recordings) and language barriers must be removed (including between English, French and Portuguese speaking African countries).

7 | CONCLUSION

The conservation of migratory landbirds is an urgent but challenging endeavor. We propose four steps to address this challenge. Monitoring schemes, bird atlases, citizen science, and new technologies can be used to define priority species, and information on their distribution and population trends in their breeding and nonbreeding grounds must be gathered. The collection of tracking data needs to continue and should be conducted in a systematic manner, and the findings should be made openly available to maximize their use in identifying when and where migratory landbirds are facing threats, and how to mitigate them. We encourage more ground-based and cross-disciplinary studies and targeted conservation actions on the African nonbreeding grounds of long-distance migrants. We believe that international collaborations, the engagement of local communities, capacity strengthening and knowledge transfer are key to successfully implement evidence-based conservation measures and policy changes

that have a flyway-scale impact. Despite the challenge that it represents, working together with such a diverse panel of collaborating partners provides a pivotal opportunity to reverse the decline of migratory landbirds.

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CONFLICT OF INTEREST

The authors declare that there is no conflict of interest that could be perceived as prejudicing the impartiality of the research reported.

DATA AVAILABILITY STATEMENT

No data were used for this paper.

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