KRUGER TO CANYONS MIGRATORY BIRD PROGRAMME

Chris Van Rooyen

Rael and Helene Loon, October 2013

The Wilderness Way

Tel: 015 793 0919;

Cell: 084 811 4314/ 084 811 4327

Email: rmloon@icon.co.za/ helene_loon@yahoo.com

1. MISSION

To improve our understanding of the status of migratory birdlife visiting the Kruger to Canyons Biosphere Region of South Africa and to collaborate with relevant local and international organisations in developing appropriate strategies to aid their conservation.

2. BACKGROUND

Twice a year, more than 5 billion migratory birds (representing over 2000 species) around the world embark on epic journeys to and from their breeding and non-breeding grounds, stopping along the way to rest, eat or find shelter – an incredible natural phenomenon that has amazed and intrigued scientists, as well as holding huge cultural significance throughout time as it is symbolic of the changing of seasons. Collectively, the three Palaearctic Flyways (East Atlantic Flyway, Mediterranean/Black Sea Flyway and east Asia / East Africa Flyway) constitute the world's largest bird migration system with over 2 billion passerines and near-passerines migrating from their breeding grounds in Europe and central and western Asia to winter in tropical and sub-tropical Africa each year (Hahn et al 2009).

Our project is focused in the Kruger to Canyons Biosphere Region of South Africa, a UNSECO reserve which encompasses the expansive region from the Kruger National park in the east to the escarpment and Drakensberg Mountain range and canyons in the west. It covers an area of over 2.5 million hectares and has been zoned into core (923 000 hectares), buffer (476 000 hectares) areas, and transition zones (1.1 million hectares). Important Bird Areas in the region include the Kruger Park, the Blyde River Canyon and the Wolkberg.

As many as 75 migrant bird species depend on the diverse habitats and rich food supplies in the Kruger to Canyons Biosphere Region, arriving in the spring (August/September) and departing at the end of the summer (March/April). In addition to Palaearctic migrants, these also include various Intra-African migrants that travel south from countries further north in Africa. These Migrant species range from raptors and waterbirds, to numerous passerines.

Derived from the Latin word *migrare* meaning 'to move from one place to another', migration can be defined as the regular seasonal movement of animals from one place to another, usually from a breeding site to a non-breeding site and back again. Although the complexities of bird migration are still not completely understood, a lot more is known now than in the past. Two thousand years ago, Aristotle believed that swallows hibernated in the mud during winter, while a hundred odd years ago, people thought they flew to the moon at the end of summer, and cuckoos were believed to change into hawks in winter, which explained why they disappeared as it got colder!

Gradually, as a result of bird ringing, laboratory studies, and innovative new tracking techniques, the movements of birds and the mechanisms governing their migrations have become better understood. Although there has been vast progress since Aristotle's time, and neither the mud nor the moon is regarded as realistic non-breeding destinations, there still remain many unanswered questions relating to migration.

While migratory birds have always suffered high *natural* mortalities as they brave mountains, face perilous ocean and desert crossings and turbulent storms on these bi-annual journeys, current research has shown that the total numbers of migratory birds globally have declined significantly in recent years as a direct result of human interference (Sanderson *et al* 2006). Analysis of the main threats to these birds suggests that there are a number of key pressures resulting in these declines, from agricultural pressures which result in habitat degradation and loss, to biological resource use which includes deforestation and unsustainable, indiscriminate hunting. Birds are being affected on their breeding and non-breeding grounds, as well on the stopover sites and entire length of the birds' flyways during their migration. Many of these threats are likely to be exacerbated by climate change, which will alter their preferred habitats still further. (Jetz *et al* 2007; Saino *et al* 2010).

Migratory bird conservation depends on a co-ordinated response on a global scale. As birds do not recognize political, cultural or economic boundaries, this research would be pitched at an international level aimed at conserving the respective species flyways from their origins to destinations. The geographical area covered by a migratory bird over the course of its annual cycle, encompasses breeding and non-breeding grounds and the connection migration route is known as a flyway. These flyways often follow the same routes and therefore a number of species often share analogues flyways, especially those with similar biological traits. Understanding their flyways provides a framework that can help forge international collaboration and focus attention on the strategic needs to migratory birds. The effective conservation of migratory species requires coordinated action along the entire length of its flyway. The Convention of Migratory Species is an international convention which represents the conservation needs of threatened migratory bird species and one of our objectives is to integrate this project into the Strategic Plan for Migratory Species 2015-2023.

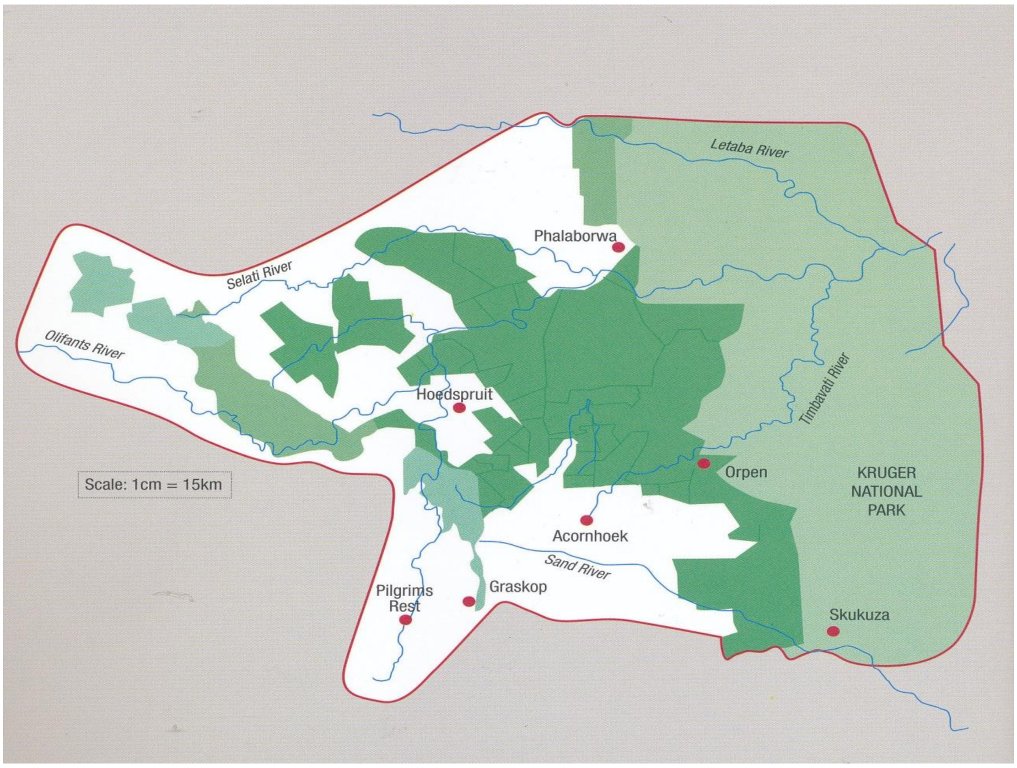


Fig 1: The Kruger to Canyons Biosphere Region of South Africa covers an area of over 2.5 million hectares and has been zoned into core (923 000 hectares), buffer (476 000 hectares) areas, and transition zones (1.1 million hectares). Important Bird Areas in the region include the Kruger Park, the Blyde River Canyon and the Wolkberg. Approximately 400 species are found in this region including around 75 migratory species which occur only in the summer.

3. AIMS

In this project, we intend answering some pressing questions about bird migration and their conservation (Bildstein 2006; Kerlinger 2009; Sanderson et al 2006). The aims of this research programme would include the following themes.

- To track the movements of select migratory species in the region in order to understand their full annual life cycle between their breeding and non-breeding locations and the connecting migration route.
- To assess competition between various migrants and local con-specifics in the region
- To investigate possible effects of climate change on migratory birds to the region.
- To analyze the effects of various land-use practices and habitat transformation on migratory birds in the region.

These aims will be dealt with separately:

4. Improving our knowledge of migratory connectivity by tracking key species using satellite telemetry

4.1. Justification

Knowing where animals go can help scientists in their search for an understanding of key concepts of animal ecology, including resource use, home range and dispersal (Cagnacci et al 2010). Although migratory birds spend different stages of their annual cycle in widely separated and ecologically different areas, it is now clear that these stages are inextricably linked by a complex set of interactions. In order to fully understand their biology, we need to be aware of how events at different stages of the annual cycle interact and affect subsequent events at both the individual and eventually the population level. A sound knowledge of these factors can in turn help to inform sound conservation strategies.

However, migration has always provided scientists with a real challenge as long-distance movements make it extremely difficult to follow individual birds and populations year round, with the result that our understanding of the ecology and evolution of migratory birds has been severely impeded. We may know the geographical ranges of a species at different times of the year, but not the specific migratory routes taken by individuals or populations, or their endpoints. We don't know where birds from specific populations spend the breeding season, what routes they take to get there, what habitats they use, and the challenges they face along the way.

Understanding the full annual life cycle of a bird has long been known to have important value for informing conservation management. although we may know that an individual of a species migrates from point A to point B, we do not know among other things where it goes en route, where it stops, or whether other individuals from the same population all migrate to the same non-breeding location or not. Because changes in both breeding and non-breeding habitats for many migratory species are occurring at an increasingly alarming rate, a more in-depth understanding of migratory connectivity is crucial to preventing their decline and future extinction

4.2. New technologies

Fortunately, in the past decade there has been vast improvement in our ability to collect animal movement data through technologies such as GPS and ARGOS satellite systems. These new and innovative advances in satellite telemetry are now making it possible to fill in many of the gaps in our understanding of the lives of migratory species, and to determine the population and geographical origin of individual birds. They can provide useful information on the conservation and ecology of migratory bird species (Hebblewhite & Haydon 2010; Tomkiewicz et al 2010).

Therefore in this project, we intend employing such lightweight satellite transmitters to select bird species. This will allow us to understand their precise movements and allow us to track their migratory movements and discover their stop-over sites up Africa. The benefits include the ability to collect fine-scale spatio-temporal location data on the chosen research subject. Such information can add to our knowledge of the biology and life-history of the specific species and hence support their conservation.

Another advantage of tracking birds using satellite technology is to gain a better understanding of migratory connectivity in the sense of the geographic linking of individuals and populations between one stage of their life and another. A large gap in our knowledge of migratory species is that we do not have a comprehensive understanding of such migratory connectivity (Webster et al 2002). In migratory birds these links would cover the complete annual cycle of a migratory bird from its breeding grounds, through its migratory route, to its non-breeding grounds. Migratory connectivity looks at how events throughout the annual cycle of migratory birds are interconnected and how a variety of mechanisms, both natural and human-related, operate to regulate and influence these populations.

4.3 The focus of our research:

One of the objectives of this programme would be to make use of satellite telemetry to track the movements of a few select species of migratory birds on their flyway from their non-breeding grounds in South Africa to their breeding grounds in Eurasia.

Research questions would include:

1) What flyway routes do our tracked individual birds follow from their non-breeding grounds to their breeding grounds?
2) What are their main stop-over sites?
3) Do individual birds from the same non-breeding area migrate to same breeding area? And conversely, do birds from the same breeding areas migrate to the same non-breeding areas, or do they spread out over the entire non-breeding range of the species?

4) Do they follow the same routes from year to year?
5) Do individuals always breed in the same area, and return the same historical non-breeding grounds from one year to the next, or is there a level of adaptability in response to weather or environmental pressures?
6) What factors - both natural and human-related - are operating on migratory individuals throughout the annual cycle?

A challenge in obtaining successful results is the high cost of transmitters, which could limit sample size. However, it is hoped that the valuable results obtained from satellite telemetry and their application in understanding and conserving migratory species will justify the relatively high cost of the transmitters.

The information gained from this study will be shared with BirdLife-SA/ BirdLife-International where appropriate as well as research institutions such as the Percy FitzPatrick Institute of African Ornithology, UCT. As it is applicable to South Africa's obligations as party to the Convention of Migratory Species, this research may also be relevant to the Biodiversity Conservation Directorate of the Department of Environmental Affairs.

4.4. Study birds

Due to the relatively high cost of the devices, and the value of using as large a sample size as possible, our initial research will focus on two diverse species of birds (in terms of size, biology and ecological traits) in order to understand their unique/particular flight strategies : (1) Lesser-spotted Eagle; (2) European Roller. We hope that our initial two study species will provide insight into these varying routes and needs. With time we hope to be able to expand the number of species studied.

A. The Lesser Spotted eagle *Aquila pomarina*

Lesser Spotted Eagles breed in eastern Europe, from the Baltic Sea south to Greece and Turkey. Their non-breeding grounds are in east and southern Africa. They are known to arrive in southern Africa from mid October, mostly departing in March. Most migrate west of the Caspian Sea, across Bosphorous and into Africa via the Sinai Peninsula and Nile River (Hockey et al 2005). They have been shown to pass through Israel, Sudan, Uganda, Tanzania, Zambia, Zimbabwe and South Africa on their migration path stopping over at protected areas such as Mpanda Line Forest Reserve in Tanzania, South Luangwa National Park in Zambia, Hwange National Park and Gonaerzhou in Zimbabwe and the Kruger National Park in South Africa (Gerkmann & Meyburg 2009). Within southern Africa they are known to wander widely, apparently following rain fronts. The Lesser Spotted Eagle is not threatened, but marked decreases in counts at migration points as it passes through Israel may be linked to radio-active fallout from Chernobyl. It is also affected by habitat loss, as well as hunting.

What makes it a good study species?

1) **The Lesser Spotted Eagle is listed on the Convention of Migratory Species**
   This species is listed on Appendix 2 of the Convention of Migratory Species. This means that this species is threatened and needs to be monitored. A more comprehensive understanding of the species' migratory routes and the challenges they face during their annual life cycle would allow more informed conservation decisions to be made regarding their conservation.

2) **Could represent other raptor migratory routes**

Much of the information gained through tracking Lesser Spotted Eagles on their passage up Africa, such as migration routes followed, their stop-over / staging sites, and challenges faced during their long-distance journey could give us insights into the life – histories of other similar eagle species, as it likely that these routes, and therefore many of the threats faced on their passage, would be similar.

3) **Contribute to existing and on-going research**

Little is known about habitats used by Lesser-Spotted Eagles, although recent research by the German Birds of Prey Working Group has provided useful baseline data. For example they have primarily been shown to favour croplands, deciduous woodland and deciduous shrub-land (Gerkmann & Meyburg 2009). Most of the results of this research however are from birds tracked from Europe. It could be constructive and insightful to track the birds on their return journey from South Africa and compare the results with Gerkmann & Meyburg.

B. European Roller *Coracias garrulous*

The European Roller is a striking species with strong conservation (and cultural) significance. There are two subspecies of European Roller; the nominate *C.g. garrulus* breeds from Morocco, south-west and south-central Europe and Asia Minor east through north-west Iran to south-west Siberia, while *C.g. semenowi* breeds in Traq and Iran, east to Kashmir and north to Turkmenistan, south Kazakhstan and northwest China. European Rollers spend their non-breeding season in sub-Saharan Africa, frequenting southern Africa - and the Kruger to Canyons Biosphere Region - from October to April.

The numbers of European Rollers globally are known to be in decline. For example in the past century it has disappeared completely from a number of countries in Europe where it formerly occurred, including Germany, Denmark and Sweden. This species is now classified as Vulnerable in Europe and in the EU (Birdlife International 2004a, b) and as a result of its fairly rapid declines across its global range, it is considered globally Near Threatened (IUCN 2008). The main threats to the species in Europe include the loss of suitable breeding habitat and nest sites due to agricultural practices, the use of pesticides which kills their invertebrate prey and reduces food availability. Numerous birds also fall victim to indiscriminate hunting along their migration routes. This has led to an International Species Action Plan for the European Roller being drawn up in an effort to improve their conservation status on their breeding grounds (Kovacs et al 2008).

As yet no factors in southern Africa have been specifically identified that may negatively affect populations here, other than changing weather patterns which may leave large areas of their non-breeding range unsuitable to support them, and so may alter their movement patterns. However, more in-depth research would be useful in confirming this, and tracking rollers along their migration routes would provide valuable insights into potential challenges faced en route.

What makes the European Roller a good study species?

1) **Contribute to improving knowledge of its migratory connectivity by filling gaps in knowledge in its non-breeding range and along its flyway.**

   The numbers of European Rollers globally are known to be in decline, and in response to their poor conservation status, numerous dedicated research and monitoring projects are being conducted in countries across Europe and Asia within the breeding range of the rollers in an attempt to restore depleted populations. However, no research is being carried out in its southern African non-breeding areas, and numerous questions regarding the birds local and long-distance movements, as well as pressures on its migration route, have yet to be clarified. Our research would aim to complement the research taking place on its northern breeding grounds. Through collaborative efforts we would contribute towards a more comprehensive/

detailed understanding of the birds annual life cycle, working together to fill in all the pieces of the migratory connectivity puzzle – vital for its effective conservation.

2) **The European Roller could represent other small migrants**

While satellite telemetry is a very effective means of tracking a bird's annual movements, the weight of the transmitter means that this method is mainly limited to larger birds that can cope with the extra weight. Because of this, the majority of studies to date have been restricted to larger birds such as raptors and storks. However improved technology suggests that it is now possible to apply these devices on European Rollers (at 130 grams the European Roller is just large and stocky enough to be able to cope with/support the weight of a PTT Argos transmitter weighing 5 grams. The 'Coracias Research' Group have successfully applied these devices on European Rollers in Spain.)

In addition to helping us understand the annual life history/migratory connectivity of the European Roller itself, the results of tracking such a relatively small bird could also give valuable insights into possible migration routes and stop-over sites used by many other migratory species, especially those 'with similar biological and ecological traits' to the roller. Different species are known to share analogous flyways, as the huge energetic costs of migration are such that birds need to follow the shortest route possible, while also taking into account resources en route, weather patterns and geographical feature and obstacles. By identifying the keys routes, stop-over sites and challenges faced by migrating European Rollers, it is possible/ that these would be shared by a number of other smaller migratory bird species.

5. Niche partitioning between European Rollers and resident conspecfics

There are several examples of closely related migrant species and their resident con-specifics in southern Africa. These include the migratory Steppe Eagle (*Aquila rapax orientalis*) and the resident Tawny Eagle (*Aquila rapax*); the migratory Eurasian Golden Oriole (*Oriolus oriolus*) and African Golden Orioles (*Oriolus auratus*) and the resident Black-headed Oriole (*Oriolus larvatus*) and the migratory European Cuckoo (*Cuculus canorus*) and the resident

African Cuckoo (*Cuculus gularis*) (Hockey et al 2005). The migratory European and Carmine bee-eaters and the resident Little and White-fronted Bee-eaters.

The question of co-existence and competition of migrants with residents in their non-breeding season and their role in shaping the evolution of present avian communities is much debated. When migrant birds arrive on their non-breeding grounds which already support their local, resident con-specifics, what is the outcome? Are there sufficient resources to support the additional birds without much displacement of the residents? Is competition fierce? Do the migrants settle in areas not occupied by residents?

Palearctic migrants are thought to coexist with resident species in sub-Saharan Africa by foraging in more open habitats and by being more flexible and opportunistic in their foraging behaviours and utilization of resources than their Afrotropical counterparts (Salewski et al 2003). They may forage in more peripheral parts of the vegetation and with a higher foraging speed. According to Leisler (2008), the main characteristic of migrants is the use of resources which are sporadic in space and time. The majority of migrants occur in seasonal savannas and open woodland, using temporarily and locally abundant food sources generally unused by residents. There is weak evidence that niche shifts of residents are induced by the arrival of migrants, and overt interspecific interactions seem to be infrequent.

Furthermore, the role that competition plays in avian communities problematic for several reasons. For example it is difficult to detect competition in the field. There are also several scenarios about the role of competition in shaping communities, including factors that may have been important in their evolutionary past but impossible to detect at present. (Salewski et al 2003).

The focus of our research

Many bird species are challenging to study as they are either secretive and prefer dense bush where they are difficult to see (like the warblers, flycatchers etc), or like the numerous migratory raptors cover vast distances making them difficult to follow and monitor. Others, such as the bee-eaters live a predominantly aerial existence and so are also challenging follow and monitor. Rollers on the other hand are very co-operative by research standards as they are fairly sedentary, and are usually highly visible as they usually perch conspicuously in the open waiting for prey. This makes them relatively easy to observe and monitor.

In southern Africa there are 5 species of roller in the roller complex (family Coraciidae). Two species are resident (Lilac-breasted roller and Racket-tailed roller), one is a partial migrant (Purple Roller), one is an intra-African migrant (Broadbilled Roller), and one is a Palaearctic migrant (European Roller). In the Kruger to Canyons Biosphere Region the Broadbilled and Racket-tailed rollers are uncommon, and because of their low densities will not be considered in this study. The Purple Roller is classified as a partial migrant, and movements are thought to be mainly local, with local influxes in winter (Hockey et al 2004).

We will use the Kruger National Park as a case study / study site, Where both the Lilac-breasted and Purple rollers are commonly seen in their preferred habitat, and are often seen in close proximity to each other. We will record the absolute and relative densities of various roller species will be assessed. Densities of Lilac-breasted and Purple Rollers will be assessed before the arrival of European Rollers in October, as well as once their migratory con-specific arrives. Habitat preference according to ecozones, microhabitat and openness will be analyzed. Roller numbers will be correlated with rainfall patterns and differences between seasons will be assessed. In so doing, we will be able to detect possible competition between these species, and gain an understanding of the factors that may have shaped these avian communities.

The resident Lilac-breasted roller is a common species in the region. It would be interesting to know whether they are displaced by the European Roller in the summer months.

6. MIGRATORY BIRDS AND CLIMATE CHANGE

The life cycles and behaviour of most animals are closely linked to the changing seasons, and for migrant birds changes in day length, temperature, and wind are important factors that signal when they should begin their long migrations to and from their breeding and wintering grounds. Sunlight, temperature and precipitation also influence the timing and availability of food sources such as flowers, seeds and insects that must be available when the birds arrive at their stop-over sites and final destinations.

Because of this, recent climate change has sparked an interest in the timing of biological events (Jonzen et al 2007; Rubalini et al 2005). Some have suggested that migratory birds may become ecologically mismatched and that failure to respond to climate change can have severe negative impacts on their populations (Saino et al 2010). One of the pivotal conservation questions in the debate on the ecological effects of climate change is whether species will be able to adapt fast enough to keep up with their changing environment (Simmons et al 2004; Visser 2008).

There are several conservation concerns regarding migratory birds and climate change. For example, breeding migrants to the region may find themselves in a situation where their typical arrival month is too late for their food, which has already emerged as a result of warmer spring temperatures (Simmons et al 2004). Alternatively as rainfall determines the flush of seeds, insects and small mammals, delayed and unpredictable rainfall could seriously affect the numbers of palearctic birds. In addition, existing threats such as the ecological condition of stop-over sites and change in land-use in a bird's non-breeding range are likely to be exacerbated by climate change (Jetz et al 2007; Saino et al 2010).

The effects of global warming are already having a major effect on the life-cycles of birds and their survival. According to the Intergovernmental Panel on Climate Change, between 20 to 30% of all species are at an increased risk of extinction if average temperatures increase more than 2.5 degrees. Projections based on anticipated climate change suggests that many birds will experience substantial pressures under climate change, resulting in range contraction and shifts (Sorte & Jetz 2010) In general the macro bio-geographical effect of climate change on bird distribution is expected to be substantial (Simmons et al 2004). For example, the South African Important Bird Area network is likely to become far less effective for conserving endemic birds under climate change (Coetzee et al 2009). However in order to refine our understanding of the effects of climate change, the appropriate time and geographical scales for each species and population concerned needs to be studied (Ahola et al 2004).

Birds that depend on very specific habitats for at least part of their life cycle could very well become extinct if their already limited habitat disappears. Jiguet et al (2007) found that habitat specialists were declining at a much higher rate than generalists, a sign that habitat quality is decreasing globally. Reproduction in many organisms breeding in seasonal environments, e.g. migratory birds, is dependent on the exploitation of a short but rich food supply. If the seasonal timing of the food peak advances owing to climate change, then one would expect the bird to track those changes, hence, initiate migration and breeding earlier (Jonzen et al 2007) . Also single-brooded species might be more sensitive to advances in food peak due to climate change, as it increases the risk of mistiming their single-breeding event. Species with high natal dispersal experience smaller population declines than species with low natal dispersal.

Temperature and precipitation in African regions are likely to affect departure decision in species through their indirect effects on food availability and the build-up of reserves for migration (Gordo et al 2005). Migrants wintering in sub-Saharan Africa may have accumulated a 'thermal delay', thus possibly becoming mismatched in their seasonal timing of migration. Species with greater 'thermal delay' have shown larger population declines (Saino et al 2010). Miller-Rushing et al (2008) found that changes in migration cohort or population sizes may account for a substantial amount of variation in previously documented changes in migration times. This implies that recording population size as well as arrival and departure dates only could be useful.

However, defining and monitoring the specific effects of global warming on animal populations can be extremely complicated, as changes in species numbers and distribution may be effected by multiple factors and threats all operating together.

In terms of future research, Simmons et al (2004) suggest that it would be useful to identify species which are most sensitive to climate change and could thereby serve as potential indicators of the speed of change. This would include migrant species. It would be important to separate global climate change effects on species distributions, fragmentation or population decline from more direct man-made effects such as habitat degradation. The following information gaps have been identified by Simmons et al (2004) as a focus for further research which could be applied in the Kruger to Canyons Region. These include:

(1) Whether predicted warmer temperatures will lead to a drop in bird numbers in general,
(2) Whether timing of breeding will move forward as spring temperatures become warmer,
(3) Whether long-lived species such as eagles will decline

(4) Whether species with specialized feeding associations will have higher extinction probabilities than with generalist species.
(5) Whether there is a shift towards sedentariness in response to climate warming for species that usually migrate.
(6) How rainfall trends effects migrant numbers

The focus of our research

Based on the above, it would be valuable to analyze the migratory birds to the Kruger to Canyons Biosphere Region and look for emerging patterns. With a focus on arrival and departure dates, the migratory species dataset can be partitioned into generalists versus specialists; breeding versus non-breeding migrants; distribution patterns in terms of land-use; flight performance, possible competition with resident con-specifics and phylogenetic relationships.

We will record the arrival and departure dates of many of the migrant species to get an idea of timing of migration. As well as building up our own annual records, these could supplement records kept by other institutions. Birds arrive in different parts of the country at slightly different times, so records kept in our local area could add value to those in areas further afield.

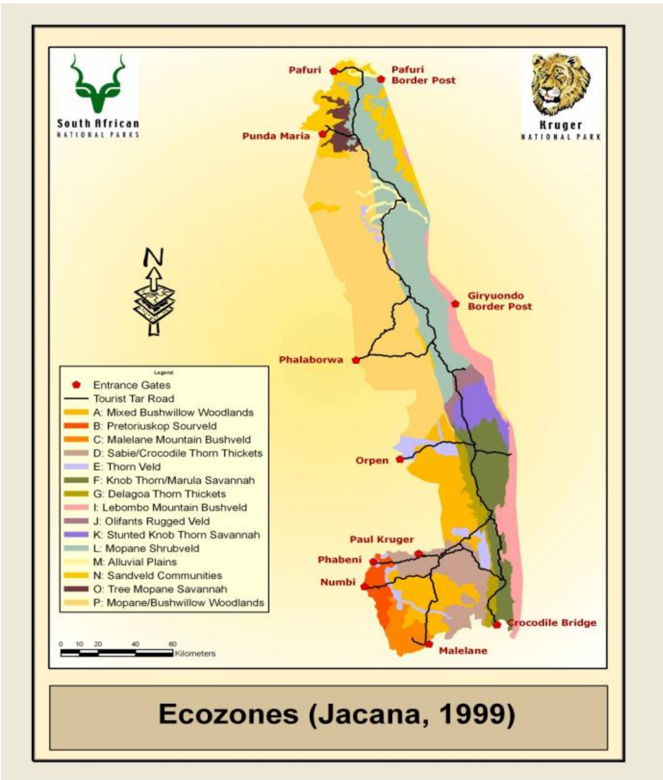
By consistently following and monitoring the movements of a select group of migratory species over the years using tracking devices, we will be able to gain insight into their annual movement patterns, both local and long distance. These patterns could help us better understand whether they follow well defined, fixed migratory routes each year, or do their routes vary, possibly in response to resource availability or weather patterns. It can also inform us how strong their site fidelity is – i.e. do they always migrate to the same breeding sites and non-breeding areas, or do these vary.

The data obtained from tracking devices on migratory birds could provide useful information on the strength of a populations migratory connectivity by providing insight into their annual movement patterns, both local and long distance. This could be a potential indicator of the degree to which birds are able to respond / adapt to changing environments, and hence the effects of climate change.

7. LANDUSE AND HABITAT FRAGMENTATION

In the future we also intend to also look at land-use practices in the Kruger to Canyons Biosphere Region and how these affect migratory birds. Land-uses range from strict protection and conservation in protected areas to development outside protected areas. As such it creates a suitable mosaic of habitats and land-uses to also test hypotheses on the value of protected areas, habitat use, habitat loss and habitat fragmentation and its impact on migratory birds occurring in this region (McIntyre, S. & Hobbs, R. 2001; Tscharntke et al 2005; Watson et al 2005).

As core areas, we aim to focus on the so-called ‘Important Bird Areas’ in the region as designated by BirdLife-SA, i.e. the Kruger National Park, the Blyde River Canyon and the Wolkberg Forest Belt. The transition areas will include areas designated for agriculture, forestry and mining, corresponding to different degrees of naturalness. We will try to deduce the effects of human settlement and human densities on birds in the respective ecozones in the region. In so doing we will try to establish which areas are most under threat using birds as indicators of habitat transformation.



Ecozones (Jacana, 1999)

The Kruger National Park forms part of the lowveld bioregion which comprises of a number of vegetation types or ‘ecozones’. In order to prioritize conservation efforts, it would be interesting to know the relative importance of such ecozones to migratory birds in this bioregion.

8. Budget

Categories	Unit cost	Total annual cost
Personnel Salary: Programme co-ordinator Salary: Researcher Expert consultants	R 25 000 month R15 000 month	R40 000 mnth X 12 R480 000 year R20 000
Travel Estimated 800km/ month @ R6.07km	R4 856 month	R58 272 year
Equipment and supplies 5 X 28g Bubo 2 satellite transmitters Teflon tape 5 X 5g PTT transmitters Use of ARGOS satellite annually @R10 000	5 X R17 675 5 X R308 5 X R34 500 R10 000	R88 375 R1 540 R172 500 R10 000
Office / administrative costs Printer cartridges, printer paper, stationary, telephone calls etc	R800 month	R9 600 year
Workshop / training course costs	R10 000 year	R10 000 year
Publications	R1 000 year	R1 000 year
Total		R851 287

For more information or should anybody be interested in supporting this programme please contact:

Rael Loon

38 Tawny Eagle Road, Raptors View, Hoedspruit 1380

Tel: 015 793 0919; Cell: 084 811 4314;

Email: rmloon@icon.co.za

Website: www.TheWildernessAssociation.net

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