

# Birds and Environmental Change: building an early warning system in South Africa



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### **SANBI's Birds and Environmental Change Partnership**



Although ornithology and birding have a relatively long and popular tradition in southern Africa, they have not been adequately harnessed as a window into the urgent problems of the day. The South African National Biodiversity Institute, SANBI ([www.sanbi.org.za](http://www.sanbi.org.za)), started the Birds and Environmental Change Partnership to focus South Africa's bird research, monitoring and conservation more strongly on the impacts of environmental change drivers, especially climate and land use changes. The Partnership underwrites the citizen-science atlas and monitoring projects and long-term datasets that are highlighted here, facilitates Red Data assessment, and conducts focused research on climate change vulnerability and adaptation ([www.fitzpatrick.uct.ac.za/docs/climate.html](http://www.fitzpatrick.uct.ac.za/docs/climate.html)). Contact Phoebe Barnard at SANBI's Climate Change and BioAdaptation Division, [p.barnard@sanbi.org.za](mailto:p.barnard@sanbi.org.za)

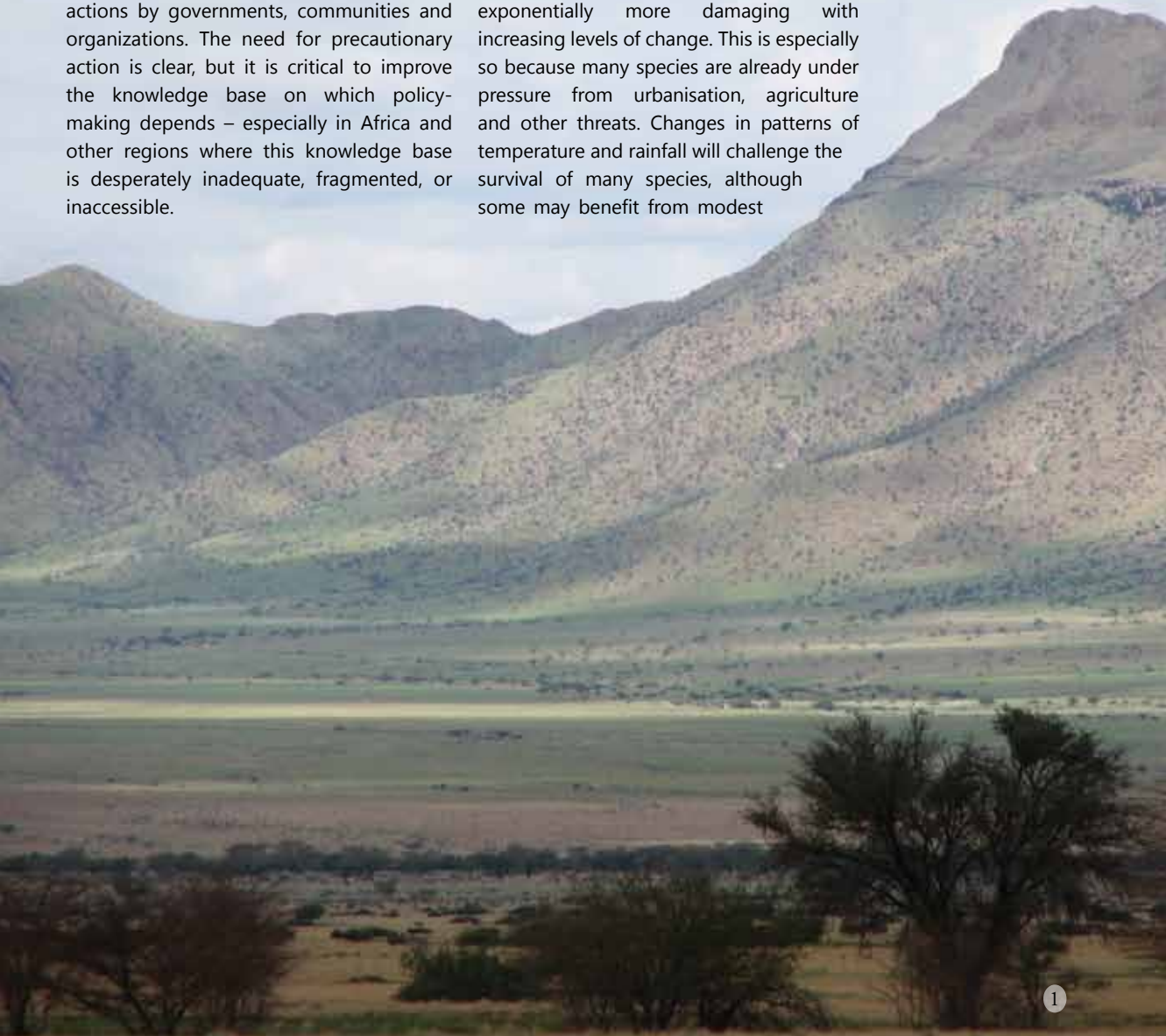
# ***Climate change and biodiversity***

Climate change directly affects every major human development issue – energy, food, health, transport, housing, disaster management, poverty and sustainable development, to list a few. Our global response to the climate change challenge will have environmental, economic, social and political repercussions for decades, even centuries to come.

In the last five years, the science of climate change and its potential impacts has deepened to the point where we now know more than enough to support a portfolio of actions by governments, communities and organizations. The need for precautionary action is clear, but it is critical to improve the knowledge base on which policy-making depends – especially in Africa and other regions where this knowledge base is desperately inadequate, fragmented, or inaccessible.

Ecosystems and species underpin the well-being and productivity of human societies. Healthy ecosystems can help human society adapt to the adverse effects of climate change. Many species can provide early warning of such effects and of other unsustainable environmental change. A focus on ecosystems and species is an essential component of the knowledge base necessary for sound climate change response options by society.

The impacts of climate change on our natural environment are likely to become exponentially more damaging with increasing levels of change. This is especially so because many species are already under pressure from urbanisation, agriculture and other threats. Changes in patterns of temperature and rainfall will challenge the survival of many species, although some may benefit from modest



change. The intensity and frequency of severe weather events – storms, floods, droughts – and, in many areas, wildfires, are also likely to increase. Collectively, these changes will take species outside the realm of their evolutionary experience of the last few hundred thousand years.

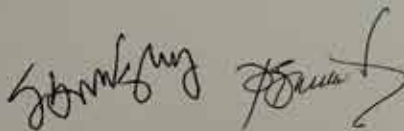
Most of the evidence for climate change impacts on species and ecosystems comes from the northern hemisphere, where there is a long history of ecological research. The current and potential future impacts of climate change on African ecosystems and biodiversity, by contrast, are poorly known. Although we can learn much from the north, the tropical and subtropical regions of Africa are distinct in many ways, and research on how they may respond to climate change has been surprising and insightful. We must ask focused questions about what climate change will mean for Africa's varied environments, and which kinds of human responses can minimise adverse impacts.

While global change has grave direct effects on ecosystems, more complex threats will arise from the ways in which human society responds to the climate change challenge. For example, renewable energy aspirations may drive land use for bioenergy production. This may have serious impacts on agriculture and food security in many regions, which in turn could have significant implications for the use of land and sea for food production. With respect to adaptation, sea level rise will affect hundreds of millions of people in coastal areas, but those areas with healthy and diverse ecosystems should form an important buffer from the most severe impacts of climate change. Managing these threats and opportunities will require uncommon vision, commitment and sound investment decisions.

## ***Why focus on birds?***

Birds are certainly not the only group of species affected by global change, nor even the most affected. But they are certainly among the most visible and evocative to us as a society, and are thus an important window into the broader changes in ecosystems. Most of us, whatever our culture, have stories about birds and their roles in nature. Just as the mining industry once used canaries to indicate air quality in mine shafts, the status and trends of bird populations are powerful indicators of the health of our planet. From top predators like albatrosses and falcons, to fast-breeding and range-expanding opportunists like crows and ibises, the magnifying glass we hold up in this booklet should focus a ray of light and information on global change impacts.

Certainly, we do not yet know enough to say that the trends in bird populations and distributions highlighted here are all driven by climate change. But climate change does not operate in isolation from land use and other changes, and impacts on biodiversity are not academic. The power of these analyses lies in the immensely valuable long-term data sets on bird populations reported here, of the sort that establish a convincing evidence base for action now and into the future, especially for a developing country of the South.



*Guy Midgley and Phoebe Barnard  
Climate Change and BioAdaptation Division  
South African National Biodiversity Institute*



# The wetter the better: blue cranes

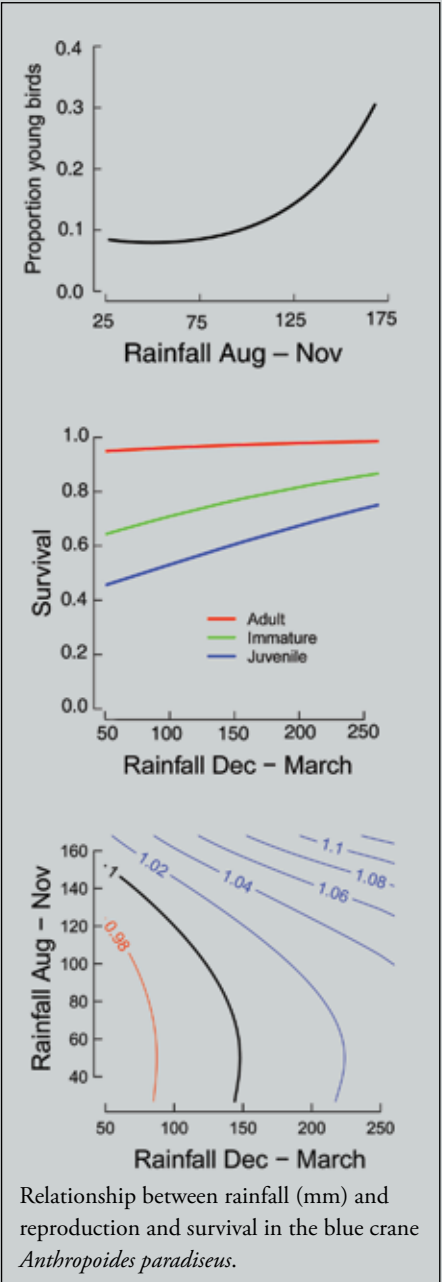
Understanding how weather affects survival and reproduction in birds should lead to a better understanding of their vulnerability to climate change.

This is clear from a study of the relationship between rainfall in South Africa's eastern Nama Karoo region and survival and reproduction in South Africa's national bird, the blue crane *Anthropoides paradiseus*<sup>1</sup>.

The results clearly showed that rainfall was correlated with reproduction and survival. Interestingly, it was not only important how much rain fell, but also at what time during the year it rained. August to November is the time when blue cranes mate and lay eggs, and rainfall during that time was related to reproductive success (first panel). Between December and March, the young birds fledge and start foraging. Rainfall during that season was related to the survival of fledglings (second panel). Blue cranes should occur in areas where the climate allows reproduction to balance mortality. Combining the effects of rainfall on survival and reproduction, we can therefore predict the overall effect of rainfall on blue crane populations (third panel). The contour lines represent population growth, and areas in the graph for which population growth is >1 are predicted to support cranes.

What does climate change mean for blue cranes? We expect that a drying climate will make life even more difficult for the birds in those areas that are already only marginally suitable for them. However, shifts in rainfall seasonality – for example, more rain in spring and less in summer – could affect breeding and survival in different ways, and their overall effect on the blue crane population should be monitored.

<sup>1</sup>Altwegg, R. & Anderson, M.D. 2009. Rainfall in arid zones: possible effects of climate change on the population ecology of blue cranes. *Functional Ecology* 23: 1014–1021.



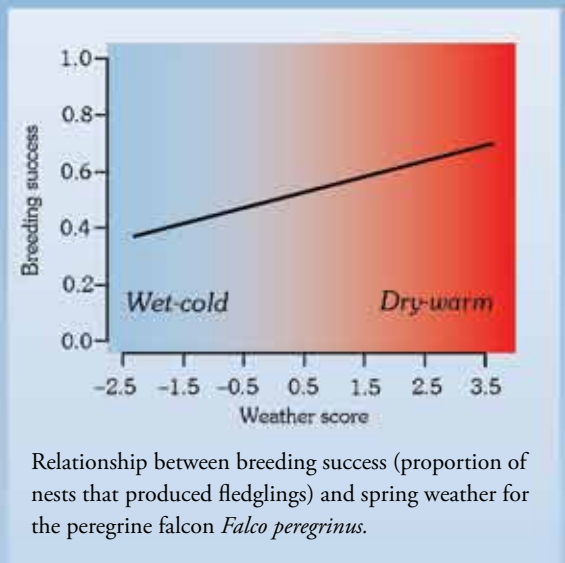
## High and dry: peregrine falcons



Although “the wetter the better” seems to apply to blue cranes, the opposite may be true for other birds. Over the last few decades, the number of peregrine falcons *Falco peregrinus* around Cape Town at the southern tip of South Africa has increased. Could climate change be at least partly responsible?

Researchers looked at the effect of rainfall and temperature on the survival and success at breeding of these small falcons. Survival was not related to weather, but reproduction was. The birds bred far more successfully during warm and dry seasons than during wet and cold ones, when nests are sometimes flooded or parents have to abandon their breeding attempt because times are hard.

A predicted effect of climate change is that Cape Town’s weather will become warmer and drier and from this perspective, the future of the peregrine falcon looks rosy. But to be confident of this, we need to look at the effect of warmer and drier weather on the falcon’s prey species.



Relationship between breeding success (proportion of nests that produced fledglings) and spring weather for the peregrine falcon *Falco peregrinus*.



### The case for monitoring birds of prey

Top predators such as birds of prey, also known as raptors, are good barometers of environmental health. Monitoring changes in raptor populations and in the number of species in different areas can provide important insights into the status of habitats and biodiversity. The development of a coordinated population index for South Africa, based on a national raptor road count scheme, is planned but has not yet been resourced. Meanwhile, two organizations are monitoring and conducting research on vultures, migratory kestrels, harriers, falcons, eagles and owls. These are the Endangered Wildlife Trust’s Birds of Prey Working Group, and the Western Cape Raptor Research Programme based at the Percy FitzPatrick Institute of African Ornithology at the University of Cape Town.

# Time to leave: barn swallows

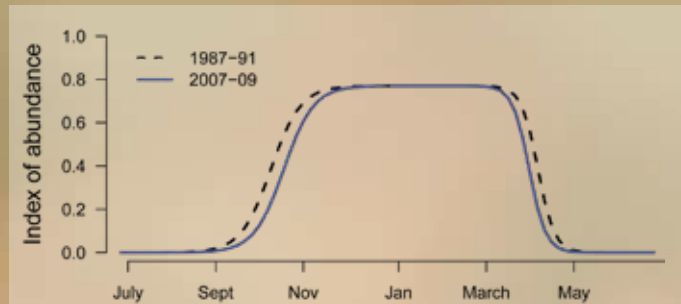
The first and second Southern African Bird Atlas Projects, SABAP1 and SABAP2, are unique among projects that collect data for mapping bird distributions. Not only do they allow us to produce the usual static distribution maps, they also enable us to track bird movements in space and time.

Weather and climate can affect bird migration in many ways, and some effects are most readily seen at the southern end of migration routes. By collecting data through entire years, SABAP1 and 2 have gathered much information on the timing of arrival and departure of birds that migrate to South Africa. Exploratory analyses of the data reveal intriguing results.

Large numbers of barn (or European) swallows *Hirundo rustica* spend the northern hemisphere winter on the central plateau of South Africa (Gauteng province), but fly to Eurasia to breed. Their arrival at the breeding grounds is timed to coincide with warming temperatures and the availability of insects for their young. But an effect of climate change is that spring in much of Eurasia now arrives earlier than it used to. Although barn swallows now arrive earlier at their breeding grounds, in many places they are still missing the start of spring. This could be because they are not leaving their wintering grounds early enough, but the atlas data indicate that this is not the case.

On average, barn swallows now leave South Africa 11 days earlier than they did a decade and a half ago. This should allow them to take advantage of the earlier Eurasian spring and thus stand a better chance of successfully raising chicks. After breeding, the swallows now arrive back in South Africa on average 9 days later than they used to. This could be because some birds are now taking the opportunity to breed twice rather than only once per season.

It is not yet clear whether barn swallows are reacting to changes in the South African climate, Eurasian climate, or both. An effect of recent climate change could be that now, swallows that spend less time overwintering and more time breeding are more likely to



Abundance of barn swallows *Hirundo rustica* in Gauteng province, South Africa during the Southern African Bird Atlas projects (SABAP1, 1987–1991 and SABAP2, 2007–2009).

breed successfully. As a result the offspring of such swallows might now make up a larger proportion of the population than they did 20 years ago.

It is relatively easy for short-lived, fast-breeding species such as the barn swallow to adapt to change. Long-lived, slow-breeding species may find it harder to cope, and it is these species that may have the highest risk of extinction due to climate change.

## Second Southern African Bird Atlas Project, SABAP2

SABAP2 is a follow-up to SABAP1 (1987–1991). Bird atlas projects describe the distributions of birds by dividing a geographic area into a grid and obtaining bird lists for each grid cell. SABAP2 works with over 17 000 5'×5' grid cells covering South Africa, Lesotho and Swaziland. Bird lists are compiled by citizen scientists trained according to the project's fieldwork protocol, and fieldwork is conducted throughout the year. Incoming data are automatically updated every five minutes on the project website (<http://sabap2.adu.org.za>). Comparisons of SABAP1 and SABAP2 data will answer questions relating to the impacts of climate change on bird distributions and the timing of migration.



# Taking the gap: Africa's "feathered locust"



The red-billed quelea *Quelea quelea*, also known as Africa's "feathered locust", is an agricultural pest and perhaps the most abundant bird in the world.

Over the past 20 years it has increased its range in South Africa. A comparison of data from the first and second Southern African Bird Atlas Projects (SABAP1, 1987–1991 and SABAP2, 2007 ongoing) shows that we are now more likely to see these birds in many parts of South Africa than we were 20 years ago.

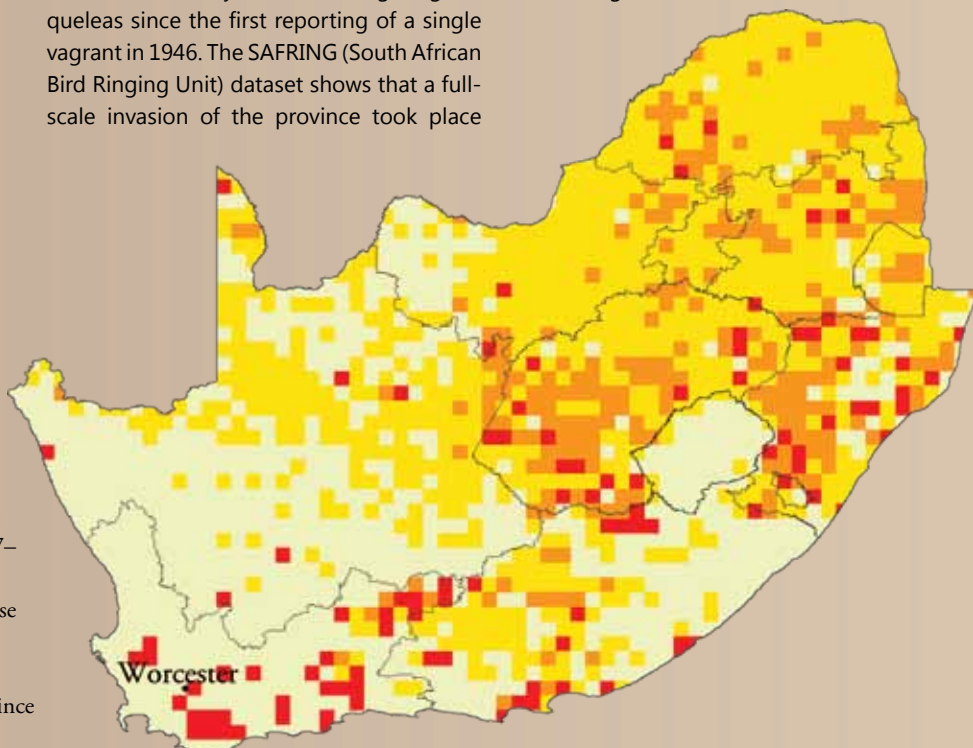
In the Western Cape province, where the species is of economic concern due to the damage it can do to seed crops, there has been a steady increase in sightings of queleas since the first reporting of a single vagrant in 1946. The SAFRING (South African Bird Ringing Unit) dataset shows that a full-scale invasion of the province took place

in 2007, with particularly large numbers of birds recorded on the Cape Peninsula and in the wheat-producing Overberg region. The influx was not only by dispersing juveniles. Adult males in breeding plumage were often observed and by April 2009, breeding by queleas in the province was confirmed: an estimated 350–600 nests were found near Worcester.

Climate change might improve conditions for red-billed queleas in the Western Cape. The increasing number of resident queleas in this region is worrying, and intelligent management of the species will rely on information provided by continuous monitoring.

Increases in abundance, and occupancy of new areas, by the red-billed quelea *Quelea quelea* over the last twenty years:

- distribution 1987–1991,
- substantial increase in abundance since 1987–1991,
- newly occupied since 1987–1991.

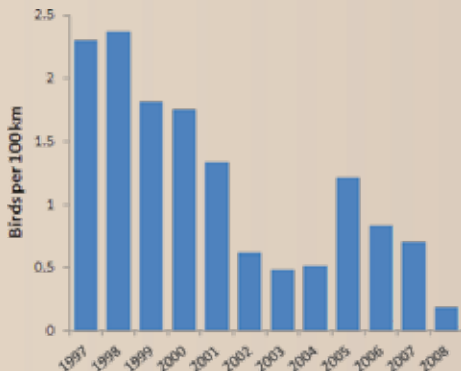


## South African Bird Ringing Unit, SAFRING

SAFRING (<http://safring.adu.org.za>) provides bird ringing administrative services in more than 14 African countries. Ringing provides a cost-effective way to estimate survival rates of birds and to monitor bird movement and the timing of life-cycle events such as migration and breeding. Survival, movement and timing are all affected by climate change and should therefore be continuously monitored. Bird ringers in southern Africa are mostly citizen scientists who collect ringing data at their own expense. Much of this data is held in the SAFRING database and is available for analysis on a regional scale.



# Nowhere to go: southern black korhaans



Number of southern black korhaans *Afrotis afra* seen in winter per 100 km of vehicle routes in the Overberg region during Coordinated Avifaunal Roadcounts (CAR).

## Coordinated Avifaunal Roadcounts project, CAR

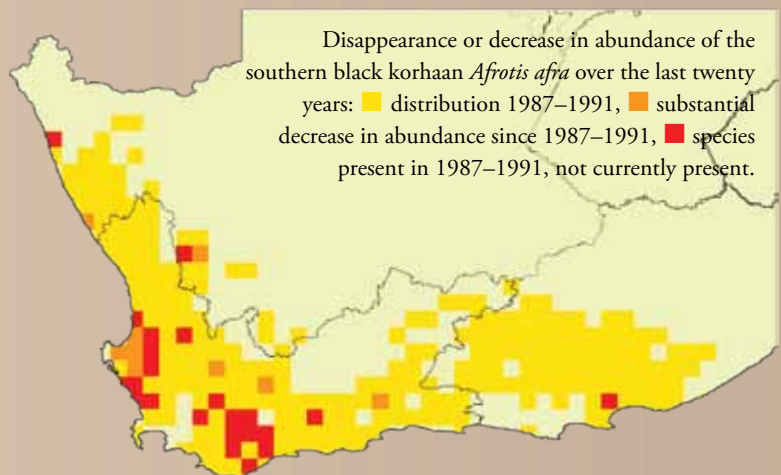
CAR monitors populations of large terrestrial birds by means of road counts – observations using vehicles covering fixed routes. The CAR network covers over 19 000 km biannually and monitors more than 30 species of birds. The road counts rely heavily on participation by trained members of the public. Farmers monitor over half the routes and this contributes towards bird-friendly land management practices on private lands. CAR data (<http://car.adu.org.za/>) provides information on habitat use and bird population trends, and the relationship of these to agricultural practices.

Southern black korhaans *Afrotis afra* are small bustards that occur only in southern and western South Africa, where they are largely restricted to specialised fynbos and karoo habitats. The birds rely on natural vegetation for protection, and avoid cultivated areas unless there is cover nearby.

Data from the first and second bird atlas projects (SABAP1 and 2) indicates that the distribution of these birds has shrunk by about 20% in the last 20 years. Although korhaans still occur in parts of the karoo and fynbos biomes, they are now harder to find there than in previous years. In some areas, they have disappeared altogether.

The southern part of the southern black korhaan's range has been especially heavily altered by agriculture. In the wheat-producing Overberg region, for example, there appears to have been a dramatic decline in the korhaan population over the last decade.

Species of plants and animals confined to the south and west of South Africa are most likely to be affected by climate change. This is because the habitats to which they are best adapted are likely to shift even farther south and west, contracting as they come up against the coast and eventually disappearing. Birds that are relatively widespread and numerous may be able to weather threats that are causing their ranges to shrink. But southern black korhaans, with their relatively low numbers and reliance on restricted habitats, may have difficulty coping with such changes.



## Shifting resources and starving seabirds

In the same way that birds of prey are sentinels of the health of the terrestrial environment, so seabirds reflect the health of the marine environment.

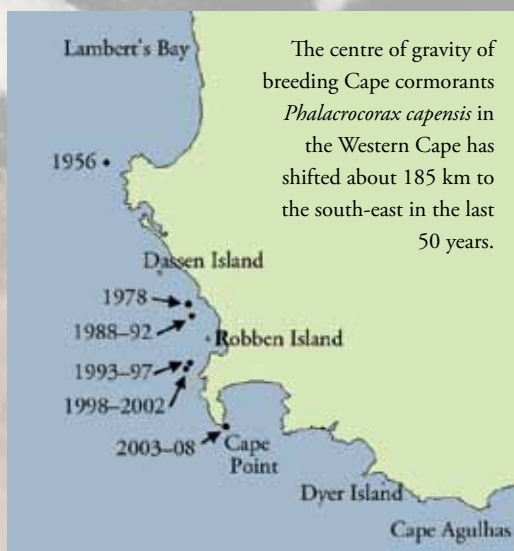
African penguins *Spheniscus demersus*, Cape cormorants *Phalacrocorax capensis* and swift terns *Sterna bergii* are all seabirds that breed on islands off south-western South Africa, and prey on sardines *Sardinops sagax* and anchovies *Engraulis encrasicolus*. Over the past decade, the centre of gravity of the distribution of these fish has moved eastwards, from north of Cape Town to east of Cape Agulhas. The three types of seabirds have responded to this shift in different ways<sup>1</sup>.

Between 1987 and 2005, the number of African penguins breeding in the Western Cape province was heavily influenced by the availability of sardines and anchovies – the more fish, the more breeding penguins<sup>1</sup>. After 2005, the number of breeding penguins dropped and reached an all-time low in 2008. It seems that the eastward movement of the fish has now almost placed them out of reach of the penguins, with devastating consequences.

African Penguins are tightly bound to specific breeding sites, but Cape cormorants and swift terns are more nomadic and are better able to respond to shifts in the distribution of their prey. Over the last five decades, the centre of gravity of the distribution of these cormorants has moved from near Paternoster on the west coast, to Cape Point – a south-eastward shift of about 185 km. Most swift terns breed on only one or two islands

each year and prior to 1997, 96% of swift terns in the Western Cape bred north of Cape Point. Since 1997, more and more terns have chosen Dyer Island near Cape Agulhas to breed and in 2006, 66% of the population bred on Dyer<sup>2</sup>, the closest potential site to the centre of gravity of the fish distribution.

Although overfishing has influenced some of these distributional changes, seabird species that rely on prey other than sardines and anchovies have shown similar changes over the same time period, suggesting that other environmental factors are also at play.



<sup>1</sup> Crawford, R.J.M., Sabarros, P.S., Fairweather, T., Underhill, L.G. & Wolfaardt, A.C. 2008. Implications for seabirds off South Africa of a long-term change in the distribution of sardine. *African Journal of Marine Science* 30: 177–184.

<sup>2</sup> Crawford, R.J.M., Tree, A.J., Whittington, P.A., Visagie, J., Upfold, L., Roxburg, K.J., Martin, A.P. & Dyer, B.M. 2008. Recent distributional changes of seabirds in South Africa: is climate having an impact? *African Journal of Marine Science* 30: 189–193.

### Marine and Coastal Management

The Earth's climate is a complex interaction between air, ocean and ice. Seabirds rely on the oceans for food and thus have the potential to be excellent indicators of climate change. Marine and Coastal Management (MCM), at the Department of Environmental Affairs, is the authority that monitors, manages and protects South Africa's marine and coastal resources, including its island-breeding seabirds. MCM holds a long-term database that can be used to interpret trends in seabird populations and breeding success relative to natural and human-induced environmental changes.

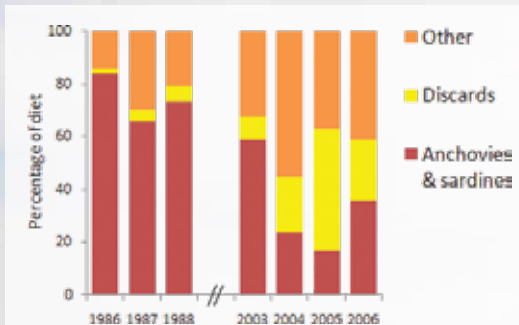
# Survival of the fattest: Cape gannets

Like African penguins, Cape gannets *Morus capensis* breeding on the west coast of South Africa have been hard-hit in recent years. Between 1997 and 2005, the number of breeding pairs plummeted from 60 000 to 36 000.

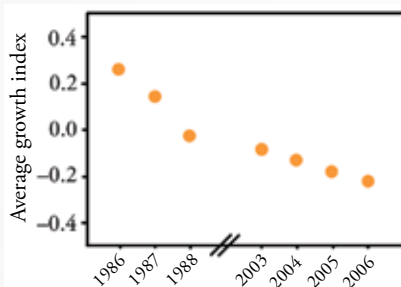
There is good evidence to suggest that, as for the penguins, this decline is related to a shift in the distribution of the gannets' favourite food. In the late 1980s, the proportion of anchovies and sardines in the

diet of Cape gannets was between 66 and 84%, but this decreased to just 16–35% in the mid-2000s<sup>1</sup>.

When their preferred prey is hard to find, Cape gannets turn their attention to fish that is discarded by fishing vessels. The hake fishery produces huge amounts of discards – unwanted bits of hake and other fish. By the end of the 1990s about 7000 tons of hake were discarded annually off the west coast of South Africa.



Change over time in the contribution of various fish types to the diet of Cape gannets *Morus capensis*.



Average growth for Cape gannet *Morus capensis* chicks in seven breeding seasons.

Unfortunately for gannets, hake is a low quality food – essentially “junk food” – compared with oil-rich sardines and anchovies. The quality of the food eaten by adult gannets affects how well their chicks grow. The growth of chicks at Malgas Island was measured in the late 1980s and in the mid-2000s. Growth indices were significantly higher in the early years, and the greater the percentage of sardine and anchovy in the diet, the better the growth<sup>1</sup>.

The recent increased reliance on hake<sup>1</sup> means that chicks no longer grow as well as they should. Chicks that are fatter during the nesting period and soon after they learn to fly are more likely to survive than thinner chicks. The decrease in the Cape gannet population is a direct result of reduced chick growth and survival.

<sup>1</sup> Mullers, R.H.E., Navarro, R.A., Crawford, R.J.M. & Underhill, L.G. 2009. The importance of lipid-rich fish prey for Cape gannet chick growth: are fishery discards an alternative? *ICES Journal of Marine Science* 66. DOI:10.1093/icesjms/fsp210.



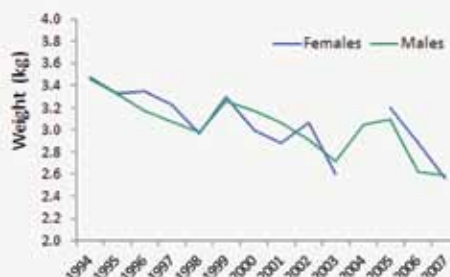
# ***The Prince Edward Islands: a window into the Southern Ocean***

The waters of the Southern Ocean drive the circulation of other oceans and influence patterns of temperature and rainfall world-wide. The Prince Edward Islands group, South Africa's only subantarctic territory, provides a window into conditions in this ocean.

The islands provide an important breeding ground for many threatened seabirds, and place them in reach of the highly productive oceanic frontal systems that provide them with food. Recent trends in the numbers and breeding success of seabirds at Marion Island, the larger of the two islands in the group, appear to reflect oceanic changes that may have global consequences.

Since the early 1990s, numbers of adult rockhopper penguins *Eudyptes chrysocome* breeding at Marion Island have dwindled<sup>1</sup>. Adults arriving at the beginning of the breeding season weigh less than ever before – a function of poorer feeding conditions in the parts of the ocean where they spend the non-breeding season. The poorer condition of adults is reflected by a drop in the number of chicks that they raise and an overall decrease in the population of these birds<sup>1</sup>.

When breeding, some of the seabirds at the Prince Edwards depend on a reliable and close supply of food. They can thus be hard-hit by localized environmental changes.



Decline over time of weights of rockhopper penguins *Eudyptes chrysocome* on arrival at Marion Island at the start of the breeding season.

## **Percy FitzPatrick Institute of African Ornithology**

The Fitztitute (<http://www.fitzpatrick.uct.ac.za/>) is one of South Africa's six Centres of Excellence in Science and Technology. Over the fifty years since its inception, the institute has focused on research, teaching and public awareness of science. It is based at the University of Cape Town, whose conservation science research has been rated the most internationally significant of any southern hemisphere university. The Fitztitute's M.Sc. course in Conservation Biology has graduated more than 200 students from around the world. The institute is increasingly undertaking research into environmental problems and the exploitation of biological resources, and advises government and the private sector on these issues.





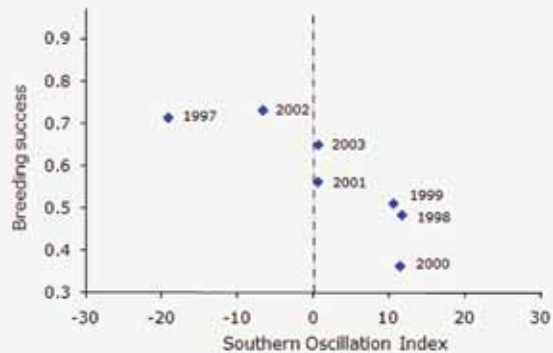
## The Prince Edward Islands

The islands are South Africa's only subantarctic territory. Situated in the south-west Indian Ocean, they are an important centre from which to monitor weather and understand climate change. They also provide breeding and moulting sites for up to five million top predators. The island group is accorded South Africa's highest level of environmental protection through its declaration as a Special Nature Reserve (equivalent to the World Conservation Union's Protected Area Management Category Ia). In 2007 the islands were declared the world's first subantarctic Ramsar Wetland of International Importance.



At Marion Island, the population of Crozet shags *Phalacrocorax [atriceps] melanogenis* crashed by 68% in less than 20 years, and this was accompanied by a change in the composition of the diet of the birds<sup>2</sup>. This is thought to be associated with changes in the position and intensity of oceanic fronts, particularly the shift closer to the island of the Subantarctic Front, which sweeps nutrients out of reach of near-shore feeders.

In contrast, the numbers of wide-ranging feeders such as albatrosses have remained relatively stable. Nevertheless, even these birds are influenced by changes in oceanic conditions. For example, the breeding success of grey-headed albatrosses *Thalassarche chrysostoma* is correlated with the Southern Oscillation Index<sup>3</sup>, a measure of the strength of fluctuations in the sea surface temperature of the Pacific Ocean.



Breeding success of grey-headed albatrosses *Thalassarche chrysostoma* at Marion Island is higher in years when there is sustained warming of parts of the Pacific Ocean (negative SOI values, often associated with El Niño events), and lower in years when there is sustained cooling (positive SOI values, often associated with La Niña events).

<sup>1</sup> Crawford, R.J.M., Makhado, A.B., Upfold, L. & Dyer, B.M. 2008. Mass on arrival of rockhopper penguins at Marion Island correlated with breeding success. *African Journal of Marine Science* 30: 185–188.

<sup>2</sup> Crawford, R.J.M., Cooper, J., Dyer, B.M., Wolfaardt, A.C., Tshingana, D., Spencer, K., Petersen, S.L., Nel, J.L., Keith, D.G., Holness, C.L., Hanise, B., Greyling, M.D. & du Toit, M. 2003. Population, breeding, diet and conservation of the Crozet shag *Phalacrocorax [atriceps] melanogenis* at Marion Island, 1994/95–2002/03. *African Journal of Marine Science* 25: 537–547.

<sup>3</sup> Ryan, P.G. & Bester, M.N. 2008. Pelagic predators. pp. 121–164 in Chown, S.L. & Froneman, P.W. (eds). *The Prince Edward Islands: land–sea interactions in a changing ecosystem*. African Sun Media, Stellenbosch.



# Monitoring the Arctic from Africa: curlew sandpipers

Many of the shorebirds that spend their non-breeding seasons in South Africa breed in the arctic tundra and taiga, mostly in Siberia. It is extremely difficult to measure breeding success or population trends of these species at their breeding grounds, because nests are scattered over a vast region and their positions are influenced by localized weather conditions. South Africa, at the southern limit of the migration path from Siberia, provides an easy and cost-effective opportunity to gather insights into the breeding success and population trends of these shorebirds far from their breeding sites.

Of all shorebird species, the curlew sandpiper *Calidris ferruginea* has the smallest breeding range in relation to its non-breeding range. Wetlands International estimates that about one million of these birds breed in a narrow band of tundra habitat in Russia, far north of the Arctic Desert. On arrival at the breeding grounds the sandpipers must find partners, lay eggs and then raise their chicks. The timing of arrival is a critical component of the annual cycle. The hatching of the eggs must coincide with the narrow window of time when insects and other prey emerge and food for the young chicks is abundant.

After breeding, curlew sandpipers migrate southwards to Africa, Australasia or India. At many South African wetlands, these are the most abundant waterbirds. However, the Coordinated Waterbird Counts (CWAC) project shows declines of curlew sandpipers at almost all wetlands in the country. At Langebaan Lagoon, where they are most numerous, their numbers declined by 40% between 1975 and 2009. Similar declines have been noted in Australia.

The decline in curlew sandpipers in South Africa might well be linked to the effects of global warming at the breeding grounds of the species, 15 000 km or 130 degrees of latitude away. The tundra is one of the planet's most sensitive ecosystems and the breeding ranges of many species are predicted to shrink as the boreal forests to the south move northwards in response to climate change. Long-distance migration of shorebirds such as the curlew sandpiper is likely to be one of the early casualties of climate change in the tundra.

## Coordinated Waterbird Counts, CWAC

The Coordinated Waterbird Counts (CWAC) project is South Africa's initiative for monitoring waterbirds at wetlands. It has steadily expanded since its birth in 1991 and is now a comprehensive national programme. Over 400 wetlands are in the project database. Most are surveyed regularly in midsummer and midwinter (<http://cwac.adu.org.za>). Some wetlands have been overtaken by development or have become too polluted to support significant numbers of waterbirds, and counts at these have ceased. Counts at other wetlands have halted as the citizen scientists involved can no longer meet the costs of surveying.



# Science by the people, for the people

In many of the studies reported in this booklet, the role of “citizen scientists” has been pivotal.

As an example, the second bird atlas project, SABAP2, involves about 600 participants across South Africa, Lesotho and Swaziland, mostly volunteer amateur naturalists or citizen scientists. By learning the data-recording system used for the project, these people are being trained in the methods of scientific data collection. This large team of fieldworkers allows the simultaneous collection of scientific data at many places in southern Africa. It is a strategy that works. It is science by the people.

Our vision is that our citizen scientists will not just regard their participation in scientific projects as a hobby which provides information for some esoteric “greater good”, but will locate their contribution within the context of global climate change and the threats to biodiversity posed by land-use change and pollution. They will understand that no matter how small, their contribution is a valuable piece in the jigsaw puzzle of biodiversity conservation. They will also grasp that this puzzle is not static, but is changing under the stresses of human developments and global climate change – hence the need for repeated and repeatable data collection over a long time period.

Ideally, our citizen scientists will understand that the pictures of the state of biodiversity they help us to build are used to influence recommendations to government regarding conservation policy and actions. Their participation ultimately improves the quality of life for all South Africans by improving the health of the environment. In other words, citizen scientists will be ambassadors for biodiversity: science by the people is science for the people.

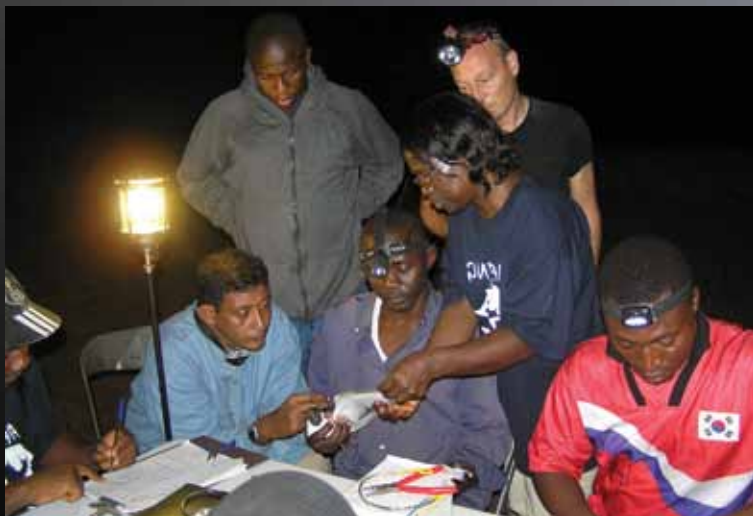


Teachers and learners of Winterton Primary School counting a CAR route.

## **BirdLife South Africa**

(<http://www.birdlife.org.za>)

BirdLife is a non-profit, public benefit environmental organization. It is responsible for the basic training of many citizen scientists in the skill of bird identification. Members of the public with a curiosity about birds join one of the 40 affiliated bird clubs across South Africa. There, their interest is stimulated and developed. Ultimately, they are recruited as participants in one or more of the projects described in this booklet, and develop into citizen scientists. BirdLife South Africa also plays a key role in bird conservation, using the information generated by these projects to undertake conservation advocacy and to promote the protection of bird biodiversity.



Trainee bird ringers getting to grips with bird ringing techniques. Bird ringing is a valuable tool in monitoring adaptations of birds to climate change.



## Free for all: bird biodiversity data

One of the challenges faced by the Animal Demography Unit (ADU) is to make its biodiversity databases accessible to researchers, managers and anyone else who might find them useful, for example tourism operators.

The projects described in this booklet produce very different types of information. How does one integrate bird ringing, atlas and census data?

A new online facility at <http://udp.adu.org.za> allows users to ask two key questions: "What species occur in a region?" and "Where does a species occur?" The two queries that are generated simultaneously interrogate all ADU bird databases, searching "by region" or "by species".

Using the first query, users can select regions of interest and define the scale of the query, down to an area of five minutes of latitude by five minutes of longitude. The query searches all ADU project databases and returns a summary of relevant information held by each project. It provides a list of species recorded by all projects for each area, and indicates the quantity of data available.

For many users, this list of species represents the endpoint of their search. But other users will want to dig down deeper. For example they may wish to find out whether there are enough records with data about mass, measurements or moult of birds to make it worthwhile applying to SAFRING, the bird ringing unit, for more detailed information.

Using the second query, the user can produce maps of the overall distribution within South Africa of species of interest. More importantly, this query can identify those

### Animal Demography Unit

The ADU (<http://adu.org.za>) is based at the Department of Zoology at the University of Cape Town. The unit curates, analyses, publishes and disseminates information about changes in animal populations. Citizen scientists are the eyes and ears of the ADU and their participation is key to the success of the unit's projects. For example, the time and resources contributed by volunteers to SABAP2 (page 5) are estimated to be 20 times the value of the formal funding received by the project.

The data submitted by citizen scientists is used to produce conservation assessments of species. These feed into "state of the environment" reports and ultimately influence conservation policy. Previous ADU projects include SARCA (Southern African Reptile Conservation Assessment: <http://sarca.adu.org.za/>) and SAFAP (Southern African Frog Atlas Project: [http://adu.org.za/frog\\_atlas.php](http://adu.org.za/frog_atlas.php)) and ongoing ADU projects include SAFRING (page 6), CAR (page 7), CWAC (page 12) and the Southern African Butterfly Conservation Assessment (SABCA, <http://sabca.adu.org.za>).



sites at which large amounts of data – ringing information, or bird counts – have been collected. It is also possible to run the query for a particular time interval, so that one can quickly visualize whether or not there is sufficient data to be able to detect changes in distributions over time. The second query allows for the rapid and efficient planning of detailed studies.

