



# Life below water and life on land

**SDG 14:** Conserve and sustainably use the oceans, seas and marine resources

**SDG 15:** Sustainably manage forests, combat desertification, halt and reverse land degradation, halt biodiversity loss

# Wildlife solutions for a crowded planet

**A centuries-long war has been ongoing in the Western Cape province of South Africa – a war that pre-dates apartheid, the South African war and the militaristic rise of the Zulu Kingdom. It is a battle between humans and baboons over territory and food; just one example of conflict between people and wildlife on our crowded planet.**

Most of the Cape Peninsula, which used to be the baboons' natural habitat for foraging and breeding, has been taken over by the growing population of humans, and baboons have been pushed into the peripheries, particularly into mountainous areas, where food is scarce.

"The baboons have been marooned by a rising tide of humanity," says Justin O'Riain, professor in the Department of Biological Sciences and director of the new Human-Wildlife Institute. "They are trapped on the higher reaches of mountainous areas – like small islands in the seas of human settlements – and even there, humans occasionally spill over into the land set aside for them and other wildlife. When they are forced to descend during lean times, they encounter dense residential areas with their easy pickings, which sets the scene for chronic levels of conflict."

It is to help find a balance between human and wildlife needs that the new Human-Wildlife Institute was formed. It will pull together expertise from a range of disciplines, firstly to understand the drivers of conflict, and then to engage with managers and policymakers to devise sustainable solutions for local, national and global conservation conflicts.

"We used to study interactions only between humans and wildlife," explains O'Riain, "and through collaboration with colleagues in the humanities, we have learnt the importance of understanding the conflict that exists between humans on how best to approach long-standing conflicts between people and wildlife."

## A complex world of conflicts

O'Riain first tasted the complex world of conflicts in conservation when his students got involved with the study of the chacma baboon crisis in the Cape Peninsula more than 10 years ago.

"Our initial interest was purely biological; however, we soon discovered that the biggest battles were in the boardrooms, as different philosophies and approaches were contested for managing the population. One of the core problems was the public's lack of understanding of



the baboons' situation. Through applied research and public engagement, we could empower communities to become informed and actively contribute to policy change."

They also provided expert advice on baboons for management plans, protocols and policy documents, and soon recognised that they also needed to bring other experts on board. "When you have a sociologist, economist, biologist, philosopher and psychologist all working together," says O'Riain, "you begin to see long-term solutions, when previously there was only a wicked problem."

The team worked closely with the City of Cape Town, South African National Parks and CapeNature and published data that has informed both policy and management interventions to reduce conflict on the Cape Peninsula. "Such was the success of the collaboration," he says, "that the ethos has permeated provincial and national policy."

The team has since been involved in a number of other human-wildlife conflict challenges in the Western Cape, most notably in the drylands of the Karoo, where Associate Professor Beatrice Conradie, director of the Sustainable Societies Unit in the School of Economics, and Nicoli Nattrass, professor of economics at the Centre for Social Science Research, were breaking new ground on one of South Africa's oldest problems – predators and livestock.

### The leopard and the lamb

In the Karoo, land is mainly used for low-density livestock farming, which allows indigenous wildlife to persist, including predators such as leopard, jackal and caracal.

"This has produced one of the most pervasive and complex conservation conflicts in South Africa. It threatens the sustainability of livestock farming, impacts adversely on wildlife welfare and fuels conflict between government, non-governmental organisations, society and academics on both the causes of, and appropriate management responses to, predation in arid farmlands," says O'Riain.

It is here that the researchers have revealed the value of an interdisciplinary team for tackling complex problems. From farmers' stoeps to remote Karoo town halls, they are shedding new light on the murky intersection of sociology, politics, economics and biology in the drylands of South Africa. "Any one of us working alone would be severely limited in our understanding of the collective challenges," says O'Riain, "but together we provided a new approach, firstly to understanding the extent of the challenges facing small livestock farmers, and secondly

providing alternatives that will benefit wildlife, domestic animals and the people of the Karoo."

### The SKA conservation challenge

The internationally acclaimed Square Kilometre Array (SKA) project poses another interesting conservation challenge.

"The project has acquired a large number of private farms to create a contiguous 'quiet' area within which the radio telescopes are being constructed," says O'Riain. "This land, which has been used for farming for more than 400 years, will now be returned to a more natural state. We will partner with the South African


Environmental Observation Network to monitor the response of mammals to this changing landscape. We also aim to explore how the presence of a newly established conservation area within a small farming area will impact on levels of conflict between predators and livestock."

The Human-Wildlife Institute has also been invited to provide biodiversity data throughout the proposed fracking (shale gas development) footprint, as part of a joint venture with the South African National Biodiversity Institute, the Department of Science and Technology and the Council for Scientific and Industrial Research. "This represents one of the most ambitious biodiversity assessments ever to be undertaken in Southern Africa and will link with the National Research Foundation's Foundational Biodiversity Inventory Partnership Programme." It will provide important information of how land use impacts on biodiversity and will complement current research on the farms of the Karoo.

**"When you have a sociologist, economist, biologist, philosopher and psychologist all working together ... You begin to see long-term solutions ..."**

### Coastal conflicts

The institute will not be limited to terrestrial systems and has established links with shark researcher Dr Alison Kock. Apex predators on land and in the ocean are particularly vulnerable to persecution, because they not only compete with us for food, but occasionally include us on their menu.

"Our current research on white and seven-gill sharks extends from the basic biology of both species to the impacts on people associated with rare attacks," says O'Riain. "While we have a good understanding of shark ecology in False Bay, we are in urgent need of a better understanding of the economics and human dimension of shark incidents if we are to keep Cape Town as a city committed to non-lethal management of the apex predator on our doorstep." 

*By Birgit Ottermann. Image by Dan Mitler, Flickr.*



## Smartphone app empowers small-scale fishers

**Small-scale fishers have a low carbon footprint and play an important role in the food security, economy and culture of coastal villages; yet they remain a marginalised group in South Africa – lacking rights, a say in the management of their resources, and empowerment in the market chain. Dr Serge Raemaekers is working with fishers and government to develop a smartphone application that will empower the fishers, and possibly completely change the power dynamics in their sector.**

If you take a look at the menu of your average restaurant in just about any coastal town, you'll find more or less the same variety of fish: hake from an industrial fishery, calamari imported from places such as Argentina, Mozambican or Asian prawns; and then linefish, possibly caught by small-scale fishers, but sourced through a series of middlemen. What you generally *won't* find, according to Raemakers, a lecturer/researcher in the Department of Environmental and Geographical Sciences, is high-quality, fresh linefish, sourced directly from local small-scale fishers.

This disempowerment and marginalisation suffered by small-scale fishers began long before the apartheid days, says Raemaekers, and has continued into the democratic dispensation, as post-1994 deliberation regarding fisheries was strongly dominated by industry

and organised labour. Both groups resisted the redistribution of resources to traditional, small-scale fishers – who at that time were not well organised – and the post-1994 fisheries policies reflected this bias.

In 2004, a group of small-scale fishers turned to the Equality Court to fight for their right to earn a living through fishing. The fishers were successful in the court battle; and in 2007, government embarked on a five-year participatory process, which culminated in the development of a small-scale fisheries policy focused as much on human rights and socioeconomic development as on fish stocks and sustainability. "This policy is a radical paradigm shift," says Raemaekers, who served on the government-established national task team responsible for drafting the new small-scale fisheries policy. "The development of the policy was an intensive

participatory project, but it doesn't stop there. The next challenge lies in implementation."

### Abalobi app

It was thinking about the challenges of policy implementation that led Raemaekers, together with Abongile Ngqongwa, a fishery manager from the Department of Agriculture, Forestry and Fisheries (DAFF), and fisher and community worker Nico Waldeck, to the idea of creating a smartphone application (app) to be a one-stop shop for small-scale fishers to record their catches, engage with government at the co-management table, enhance their safety at sea and explore different value-chain opportunities. The app is called 'Abalobi', the isiXhosa word for small-scale fishers, as referred to in the policy.

"There are two major problems with the small-scale fishing sector that spurred us on to work on the development of Abalobi," says Raemaekers. "The first is the big gap between scientific knowledge and local fisher knowledge. The very contextualised local knowledge does not make its way into fisheries management; but also, the scientific understanding of fish-stock models does not always gel with the local knowledge owned by fishers." Part of what Raemaekers and his team hope to achieve through Abalobi is to build trust between the relevant role players, including government and scientists, creating relationships where groups can work together to complement different knowledges and local data, and to achieve greater understanding of fish resources and of how best to implement policy.

### Stuck in a system of servitude

A second gripe for Raemaekers is that small-scale fishers are mostly 'price-takers', stuck in a system of servitude in which they are just working to pay back last year's loans. "These fishers don't often get a good price for their catch. Even though this is potentially the most sustainable and socially just fishing practice in our inshore waters, these small-scale fishers are not empowered in the value chain."

Simple information-sharing and communication between fishers could free them from this trap. As part of the Abalobi project, chat (smartphone-based instant messaging) integration was developed that allows fishers – who had previously had no contact with each other – to communicate with one another.

Raemakers tells a story of a group of fishers in Struisbaai, part of the pilot programme, who used this tool to set a minimum price for their linefish – before the first boat came into the harbour. "It sounds so simple," he says, "but for these fishers, it was a total shift in the power dynamics. They all worked together, and got a better price." There are knock-on effects, too.

As fishers from different parts of the coastline start communicating, they also begin sharing information and skills to help one another. These fishers may never have met, but they are in the same sector and working towards the same goal.

Abalobi, which is still in the pilot stage, has a number of planned modules. One of the core modules currently being pilot-tested is Mobile Catch Reporting, through which both fishers and government monitors capture data and access easy-to-understand dashboard analytics. At the moment, these processes are separate: the fishers capture their information about a catch, and they own that data. They decide who can see it and how it is to be used. At the same time, government monitors are also capturing data. "The plan is to have regular workshops for engagement between government and fishers, to discuss the data – what the differences are, and why," explains Raemaekers. "We are embarking on a process of building trust, co-producing knowledge and working together to ensure responsible governance of the sector."

### Transdisciplinary endeavour

Other modules include a focus on safety at sea, connecting fishers to markets and consumers, and building a knowledge hub for fishers to keep on top of the latest trends and regulations. On Abalobi, Raemaekers has been working closely with both the fisher community and the DAFF. The key for him is that this is not an academic exercise, but a community-owned and -led open-source project. "This is a really transdisciplinary endeavour," he says. "Abalobi not only brings together scientists, government, industry and community, but also encompasses natural sciences, social sciences and information technology.

"This is not about a team of IT people developing yet another app. Abalobi is a project by the small-scale fishing community themselves, to own the process of implementing the policy they fought for." The Abalobi project ([www.abalobi.info](http://www.abalobi.info)) is currently funded through Raemaekers' NRF research grant, with support from DAFF's small-scale fisheries directorate. The project will require dedicated funding to enable a full-scale roll-out. 

"The very contextualised local knowledge does not make its way into fisheries management."

By Natalie Simon. Image by Michael Hammond.

# Peace parks and people's rights

**Southern Africa's peace parks have given animals a regional passport to move freely across international borders. Wildlife migration routes have been restored, and previously fragmented ecosystems reconnected. And yet the people who used to call those regions home are not enjoying the same liberties. Instead, they have been disconnected from their environment and heritage, and their clans remain separated by political borders.**

"We have unified policies around wildlife and management, but are reluctant to do the same for people," says Maano Ramutsindela, professor of environmental and geographical science. "Every peace park should be obligated to contribute to the communities on both sides of the border in a meaningful way."

A geographer by training, Ramutsindela has always been fascinated by the social side of geography.

"I am very interested in how geography impacts on people (whether it be where they live, land issues or access to resources) and how it is often involved in the creation of spaces of conflict and violence. One of my first interests in conflict was actually the drawing of provincial and municipal borders – a conflict that is still ongoing today. Every time there is a demarcation, there is conflict!"

Ramutsindela developed an interest in peace parks as they were changing the geography of the region, transcending colonial borders and reuniting ecological systems. "What attracted me as a researcher to the peace parks project was that it was recreating space; not just for the animals, but also for the people of the region. Moving people from one space to another impacts on their identity and how they live."

As an example, he mentions the apartheid government's policy of restricting people to living in certain areas: "Over time, people got used to that new space and started to believe that it was 'normal' – the way they really should be living. But what happened to their resources?"

When you take away people's resources, whether it be through political ideology, conservation or other means, they have to adjust to a new way of living; and



this holds consequences for both the people and the environment itself.”

According to Ramutsindela, the peace parks project came at just the right time, as it brought together all the questions he was grappling with.

“The mission of transfrontier conservation areas (peace parks) in southern Africa is very noble. It aims to promote biodiversity, sustainable development and peaceful co-existence. However, not enough thought was given to the impact these new spaces would have on the people who previously inhabited them,” says Ramutsindela.

### Empowering local people

“While the animals gained habitat, the locals in these remote areas lost theirs, and received very little in return. The few who can read and write can work in the peace-park projects, or as tour guides; but the ordinary people who would have otherwise used the land to feed their families are left impoverished and desperate. These are the same people who until very recently witnessed the violence, torture and killings inflicted by South Africa’s apartheid government on the country’s borders – atrocities that have never been addressed properly.”

Ramutsindela remarks that these same violent tactics are now used to combat rhino poaching and defend the peace parks. The Kruger Park, which is the core of the Great Limpopo Transfrontier Park between Mozambique, South Africa and Zimbabwe, has rapidly militarised, in a desperate attempt to save endangered rhinos from poachers.

“While saving the rhino is a very important conservation effort, we must also start empowering and including the local people. If we keep ignoring them, we are sending out the message that they don’t matter – that we only care about the animals and the environment. Frustration and anger will increase, which in turn will fuel the conflict in an already unstable region.”

The majority of the communities in those remote areas are very poor; and on losing their land, have no way to provide for their families. As a result, it is said that they are easily tempted to get involved in illegal activities such as harbouring poachers for quick money.

Ramutsindela warns that this has become a vicious circle. “As the poaching crisis intensifies, more land is acquired to create buffer zones against the poachers. As a result, more people are losing their land and livelihood ... and so the conflict continues.”

He suggests that local people be given some basic rights and responsibilities, via benefit-sharing schemes that have minimum guarantees. “Some kind of ethical code is necessary. If people have some rights to the land and earn some benefits, they will appreciate



conservation efforts, as well as develop a sense of dignity and purpose.

“In Namibia, for example, the government has given local people wildlife rights. They don’t own the land, but at least they have access to the land and the animals, while also looking after them – they are part of the conservation process.”

Ramutsindela also believes that the semi-nomadic lifestyle of ethnic groups such as the Nama and San should be recognised, by allowing them to migrate freely across the borders. “The San’s habitat, for example, has always been the Kalahari. Open it up for them!” (The Kalahari stretches over parts of Botswana, Namibia and South Africa.)

He remarks that people in general are very unwilling to express criticism when it comes to conservation and (especially) the peace parks.

“Though it is a great project, it has had unintended consequences, and we should not be afraid to address those, and ask the difficult questions. We need to bring about more peace in the parks. We have succeeded in redefining the borders for wildlife; now we must do the same for the communities that are still divided by those borders. Involving and improving the lives of the local people will help to increase stability in the peace-park regions, and reduce the potential for future conflict.”

*By Birgit Ottermann. Feature image by [Wegmann](#), Wikimedia Commons. Image of researcher by [Michael Hammond](#).*

# How plants dupe dung beetles into burying their seeds

**A Cape restio (*Ceratocaryum argenteum*) produces large, hard nuts that smell and look remarkably like dung. They are often buried by dung beetles, though they provide no food for the dung beetles or their larvae – a classic example of biological deception, and possibly one of the best examples of faecal mimicry for seed dispersal anywhere in the world. They were recently described by biologists in a paper in *Nature Plants*.**

Deception is a very interesting biological phenomenon, as it involves a co-evolutionary arms race between one species (the deceiver, or mimic) that benefits from resembling another species (the dupe, or model), with no advantages for – and sometimes even to the evolutionary disadvantage of – the latter. Some of the most striking examples of deception in plants are those that deceive insects into pollinating flowers without any reward.

Some orchids, for example, produce colourful flowers that contain no nectar to reward pollinating insects. These plants rely on sensory exploitation (insects are attracted to colour in general), and in some extreme cases, mimic other rewarding plants that occur in the same place, thereby duping insects into pollinating their nectarless flowers.

Deception for seed dispersal, however, is far less common. Some plants produce hard red or black seeds (such as the so-called 'lucky beans') that look like berries; but these do not seem to fool birds, and are hardly ever eaten or dispersed. Also, such seeds are often poisonous, and their bright colours act more as warning colouration than as an attraction to fruit-eating birds. Dung beetles being duped into dispersing 'dung-like' *Ceratocaryum* nuts may therefore be the best example globally of faecal mimicry for seed dispersal.

The scent of *Ceratocaryum* nuts is very strong. "I have nine-month-old seeds in a paper bag in my office that are still very pungent," says Jeremy Midgley, a professor in the Department of Biological Sciences, who discovered the deception. Steve Johnson, a professor




at the University of KwaZulu-Natal (UKZN) who did the chemical analyses for this study, was amazed at both the complexity of the scents emitted by *Ceratocaryum* seeds, and their similarities to antelope dung. “It still remains to be seen exactly which chemical is the most attractive to the dung beetles,” says Johnson.

“I have long had an interest in seed burial by certain Cape rodent species, and was convinced that the enormous size of *Ceratocaryum* seeds would make them attractive to rodents – either to eat immediately, or to bury,” says Midgley. Together with MSc student, Joseph White and small-mammal expert, Dr Gary Bronner, both in the Department of Biological Sciences, he began investigating whether free-ranging small mammals were interested in *Ceratocaryum* nuts.

“We used motion-sensing trail cameras to observe small-mammal interactions with the nuts under field conditions, and it seemed that they were disinterested or even repelled by the seeds. When small mammals did crack seeds open, it was clear they were interested in the nutritious inner parts of the seeds,” says White.

The most surprising result from their field experiments was the discovery of dung beetles dispersing *Ceratocaryum* nuts. “Through both camera trapping and direct observation, we saw dung beetles being attracted to the nuts, rolling them away and then burying them, by pulling them down from below,” comments Bronner. “Previously, we had observed the same behaviour by another dung beetle species in the Cederberg, where *Ceratocaryum* plants do not occur; suggesting that this phenomenon may be quite general and widespread in fynbos.”

“I wonder what would happen if we put these nuts out in the savanna?” ponders Midgley. “Would they fool savanna dung beetles?” Dung beetles do inadvertently disperse some seeds – for instance, those already in the dung of fruit-eating mammals, which the beetles bury to nourish their offspring. But this is not deception, as the beetles gain a reward. With *Ceratocaryum* nuts, however, dung beetles are duped into dispersing and burying nuts with no reward, but with an energy cost.

“This type of dispersal is probably quite rare, because it depends on the right ratio of dung to dung beetles. Too much dung, and the nuts will not be buried – because beetles have too much of a choice; too little dung, and there will be a similar lack of burial, owing to too few dung beetles. We still have much to learn about the dynamics of such faecal mimicry,” concludes Midgley. 

By Carolyn Newton. Images by Joseph Douglas, Mandla White.



The beetle



The seed



The dung dupe

**VIDEO:** Watch camera-trap footage of the small mammal *R. pumilio* dehusking *Ceratocaryum* nuts.

**VIDEO:** Watch camera-trap footage of a dung beetle burying a *Ceratocaryum* nut.

# Scientists uncover the genomic blueprint of bat-wing development

**Linked studies identify gene regulatory switches that turn bat genes on and off at crucial times during limb development, with implications for understanding how differences in the size, shape and structure of limbs are generated in mammals in general, including humans.**



An international team of scientists from the University of Cape Town (UCT) and the University of California, San Francisco (UCSF) has, for the first time, identified both genes and gene regulatory elements that are essential in wing development in the Natal long-fingered bat (*Miniopterus natalensis*), a species widely distributed in east and southern Africa.



Bats are the only mammals capable of powered flight – an ability that evolved about 50 million years ago. The structure of the bat wing, as noted by Charles Darwin in 1859 in *On the Origin of Species*, is widely used among biologists as an example of both evolutionary novelty (the appearance of a new trait) and vertebrate homology (shared ancestry between two seemingly different structures) – in this case, the wing of the bat and the forelimb of other mammals.

### Mining the origin of flight in mammals

The path of bat evolution is unclear, says Professor Nicola Illing, co-senior investigator based in the Department of Molecular and Cell Biology: “The fossil record does not show the transition from tree-climbing mammals with short, free digits to ones that have elongated fingers supporting a wing. We have had the privilege of being able to use the tools of modern genetics to decipher how genes are turned on and off during bat embryonic development, to transform a mammalian forelimb into a wing.

“While some attempts have been made to identify the molecular events that led to the evolution of the bat wing, these have primarily been done on a ‘gene by gene’ basis,” said co-senior investigator Nadav Ahituv, a UCSF professor of bioengineering and therapeutic sciences and faculty member of the UCSF Institute for Human Genetics.

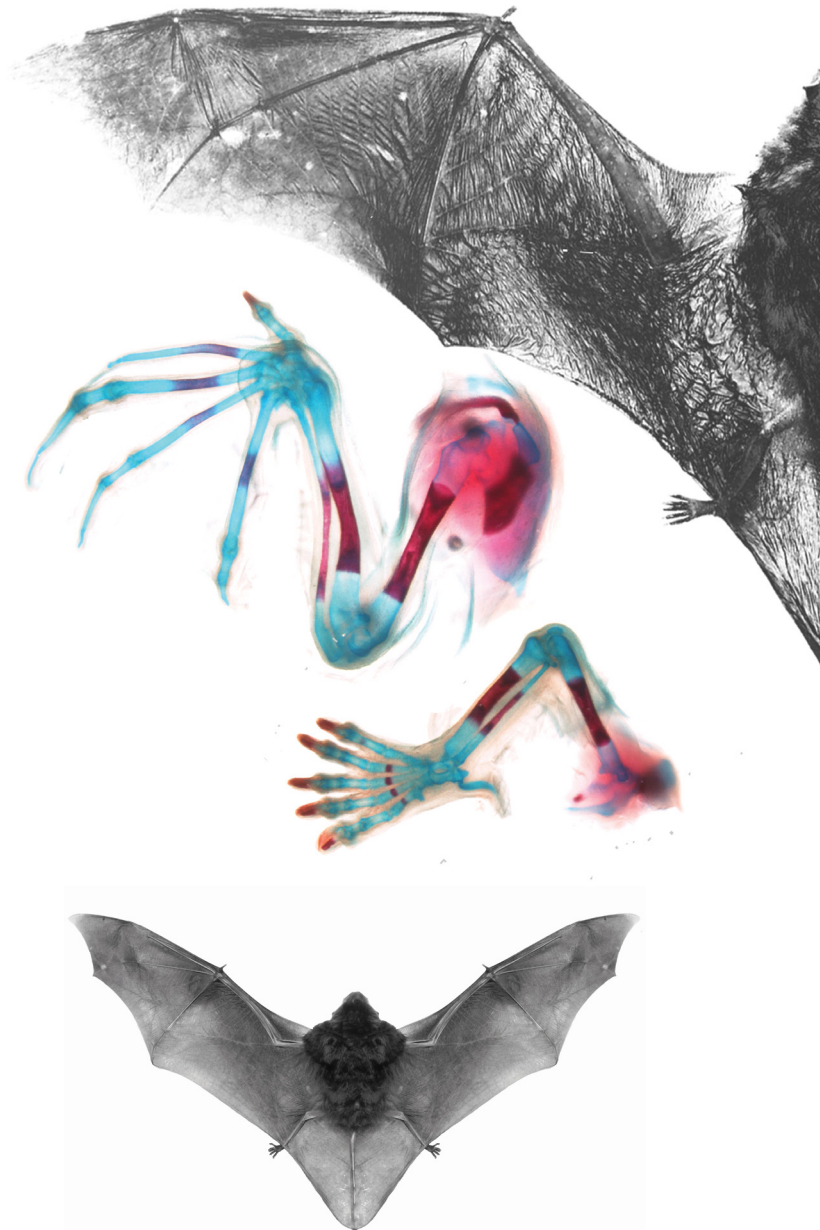
“This work lays out a genome-wide blueprint for the causes that led to the development of the bat wing, a key evolutionary innovation that contributed to bats becoming the second most diverse order of mammals.”

### Over 7 000 genes identified

The researchers identified over 7 000 genes that are expressed differently in forelimbs compared to hind limbs, at three key stages of bat-wing development. They found that many signalling pathways are activated differentially as well, including pathways important in limb formation, digit growth, long-bone development and cell death.

It took bats millions of years to evolve wings. This research shows that they did this through thousands of genetic alterations, involving both genes used by all animals during limb development, and genes whose usage in limb development may be unique to bats.

“This gives us our first detailed picture of the genomics behind bat-wing development,” said Ahituv. “Importantly, this work identified not just which genes are expressed at what stage of growth, but the genetic switches in the genome that are responsible for turning those genes on and off.”



“It is gratifying seeing this work come to fruition after a decade of research,” says Illing.

Ahituv agrees: “This work will increase our understanding of how alterations in limb development could lead to limb malformations in humans. Potentially, it could eventually help contribute to the development of tools and techniques to prevent such malformations.”

*Read more about this research in The Washington Post, or access the original research papers in the [Nature Genetics](#) and [PLoS Genetics](#) journals.*

*Shortened version of [UCT/UCSF media release](#). Images supplied by Nicola Illing (UCT) and Nadav Ahituv (UCSF).*

# Flight risk

**The martial eagle project continues to make strides in determining the causes driving the decline of Africa's largest eagle in protected areas such as the Kruger National Park.**

Rowen van Eeden, a PhD student at the Percy Fitzpatrick Institute of African Ornithology and his supervisor, Dr Arjun Amar hypothesise that perhaps the most important factor driving these declines is the high mortality of juveniles beyond protected areas, when they disperse in search of vacant territory.

The long-range dispersal of juveniles has now been well established using GPS tracking devices, confirming previous findings from re-sightings and recoveries of ringed juveniles that revealed that martial eagles often disperse far from their natal site. The tracking data show that after leaving their natal territory, young martial eagles traverse areas of up to 6 500 square kilometres, and many immature birds from Kruger spend more than half of their time outside protected areas. Here they face a suite of threats that could limit the pool of birds available to recruit into the park.

Even more worrying, however, is the discovery that at least some adult birds, which were assumed to be more sedentary than immatures, also travel considerable distances and frequently venture beyond Kruger. Many of these mobile adults are presumably 'floaters', birds waiting for a territory to fall vacant. For instance, one adult female ranged far into Mozambique, where she was killed.


Sadly, this was not an isolated incident. In April 2016, a 4.6-kilogram female martial eagle was fitted with a GPS tag in Kruger Park. Her capture and the attachment of the tracking device were recorded by a film crew documenting the study for a British television programme, narrated by well-known TV presenter Steve Backshall. A few weeks later, the bird ventured into Mozambique, and shortly afterwards, her signal stopped moving, 160 kilometres from where she had been tagged.

Van Eeden and a colleague set off to the bird's last known location, in a remote corner of Mozambique, currently in the midst of renewed civil unrest. They battled through dense bushveld, in an area with few roads. Eventually, an hour-long walk into the bush led them to a small game trail, where – after searching through the long grass – they found the remains of the eagle. Its tail was sticking up between two bushes, and its neck was trapped

in a snare that had probably been set to catch small antelope. Most people in the small villages in the area rely on cattle herding, subsistence farming and hunting to survive.

The death of a second adult martial eagle from Kruger in rural communities in Mozambique is cause for grave concern, especially as only eight adults have been tagged with GPS transmitters. Without GPS tracking, this cause of mortality would go undetected.

A healthy population relies on having adults available, to occupy vacancies created by the deaths of breeding birds or to challenge ageing territory holders. A large number of non-breeding adults probably signals a relatively stable population. We don't know enough about the population structure of martial eagles in Kruger, but the unnatural deaths of adult floaters may be even more important in terms of affecting population dynamics than the mortality of immature birds.

The findings confirm that even the largest protected areas may be insufficient to conserve wide-ranging predators; and that conservation efforts to safeguard them are needed beyond park boundaries. 

*By the Percy FitzPatrick Institute of African Ornithology, originally published in [African Birdlife](#).  
Image by [Bernard Dupont](#), [Wikimedia Commons](#).*

