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THE DIAMOND ROUTE
NEWSLETTER

WWW.DIAMONDROUTE.COM APRIL 2018

GROUNDBREAKING RESEARCH TO HELP SAVE THE GIRAFFE FROM EXTINCTION

Leni Martin describes the scene as some novel research on giraffes gets under way – with De Beers Group playing a key role.

The view from a drone above, as samples are taken from a giraffe

Burly arms thrust upwards against the giraffe's neck, giving the animal impetus to scramble to its feet. The 30 or so people standing back to give it space applaud briefly as it canters away, but there's no time to reflect on success. The chopper pilot is already reporting another giraffe nearby and lands quickly to pick up the vet who will dart it.

The remaining people sprint to the vehicles that are soon dashing across the veld towards their next subject.

Less than 40 minutes after darting the first giraffe, the capture team in the leading pickup race to guide the second giraffe as it falls on to its side. They restrain its legs, raise its neck on a wedge-shape platform to help its breathing, and cover its eyes and close its ears with cotton wool to minimise stress.

More than a dozen people are scurrying around, taking the animal's temperature and measuring its hooves, testes, scrotum and ossicones (the giraffe horns). A figure with a clipboard records the measurements. Others are collecting ectoparasites, hoof clippings, blood samples, hair, faeces, and finally the big one: semen. It's the first time ever that semen has been collected from a giraffe in the wild.

All the while, a crew is filming the whole event for a documentary. Above the scene, their drone is making its own recording. An observer could be forgiven for thinking that this large team had done this many times before; few would believe this was only the second giraffe they were collaring.

At the giraffe's head, team leader Dr Francois Deacon monitors its breathing, watching for signs of distress, liaising with the wildlife veterinarians, calling for water to keep the animal cool, and instructing bushes to be sawn down to clear a path for the giraffe's getaway.

The three-person collaring team puts the finishing touches to fitting the halter-like GPS collar snugly but not tightly between the giraffe's ossicones. Weighing only 600g, the collar is less than one per cent of the giraffe's body weight.

After only 15 minutes, the veld is cleared of all paraphernalia and the data collection team moves back towards the vehicles. And the second giraffe rises, unsteady as a calf taking its first steps, before cantering away.

It happened nine more times before nightfall, and again and again on the days following, until the collars were used up and there were no more hours in the helicopter's fuel tank.

The giraffe-collaring exercise took place on De Beers' Rooipoort Nature Reserve in South Africa's Northern Cape Province on a scale never seen before. The company is playing a pivotal role in saving giraffe from extinction.

Under the aegis of the University of the Free State's (UFS) Faculty of Natural and Agricultural Sciences and Dr Deacon's leadership, the specialists had come together to find answers to basic questions about giraffe biology – and to more complex ones about conservation programmes and the management of giraffes.

It was an ambitious effort. When the team's tents had gone up in a large circle and flags had been distributed to mark the nationalities of their occupants – German,

Dutch, British, American and, of course, South African – Dr Deacon had worried that there would be too many people and they'd get in one another's way.

In fact, each member – biologist, grassland scientist, GPS/GIS specialist, acoustic specialist, zoologist, wildlife veterinarians, reproductive physiologist, endocrinologist, soil scientist, animal behaviourist, geneticist, biochemist, animal welfare advocates and bioengineers – had a role to play.

Almost unnoticed, Africa's wild giraffe population has dropped by roughly 40 per cent in the past 30 years, so the kind of exercise undertaken by the UFS-led team has a certain urgency, and particularly in view of the multitude of gaps in current knowledge about the species.

There are, for example, many questions about reproduction. Postdoctoral fellow Tanja Wolf from Germany will study the faecal samples collected to get a better handle on females' oestrous cycles and when males reach reproductive age, as well as DNA to establish which males are siring the calves and whether dominance is a factor. She will stay on the reserve for a full year to continue her research, as will PhD student Ciska Scheijen from the Netherlands, studying levels of stress experienced by giraffes.

Biochemist Professor Gary Osthoff of UFS will compare milk taken from pregnant females with milk taken from nursing cows to establish any changes in quality and composition, while master's students Amaria Janse van Rensburg and Jamie Paulse will look at the giraffes' parasite loads and body condition, along with preferred habitats and their vegetation quality.

Animal behaviourist Fred Bercovitch, among others, will study what the all-important GPS collars reveal about the movements and home range use of both males and females, with Professor Nico Smit examining the habitat qualities and Hennie Butler focusing on the behaviour and thermoregulation.

And then there's that groundbreaking collection of semen samples by reproductive physiologist Ilse Luther. The prospects are exhilarating, and it wasn't long before Ilse was sharing her excitement with the entire team back at camp, where a trailer had been set up as a mobile lab.

Valuable research has already been done on giraffes. Dr Deacon has previously captured some 40 of them successfully and collected important data. But most of the avenues being explored as a result of this exercise are novel and will contribute a vast amount to the body of knowledge about giraffes.

And with that knowledge will come not only insights into how populations can be managed (especially in South Africa where they live in fenced, fragmented reserves), but also a more precise understanding of the factors that regulate giraffe demography and reproduction.

Importantly too, with each capture, techniques are improved and the risk to the giraffe is lessened. On this exercise, every giraffe got to its feet none the worse for the experience, and all the cows were reunited with their calves.

Find out more at:
www.ufs.ac.za/templates/archive.aspx?news=10285&cat=1

The team chases a darted giraffe.

The giraffe is eased down to the ground.

Samples are taken and figures are recorded.

The team prepares for the next capture.

MONITORING WHITE-BACKED VULTURES – 25 YEARS ON…

Environmentalist Angus Anthony reflects on a quarter century and more of studying vultures at the Dronfield Nature Reserve.

The international survey team in October 2017.

The white-backed vulture at Dronfield has been the subject of continuous studies for the past 25 years. However, the use of Dronfield by nesting vultures goes back a lot further.

Vultures were first noted nesting on the nature reserve in 1965 by Keith Forrester (later to become De Beers' Company Secretary). Professor Peter Mundy studied this colony between 1973 and 1975 as part of his PhD research on the comparative biology of southern African vultures. So the vultures have a long-standing association with Dronfield.

A chick is retrieved from a nest…

The main emphasis of the latest study has been to determine breeding success, nest-tree utilisation and fledgling dispersal and to determine whether individuals return to breed on Dronfield.

Two surveys are conducted each year. The first, in winter, identifies all nests and records any breeding activity. The second, in mid-October, weighs, rings and tags the chicks in the nests, and measures wing length.

Up to 100 active nests were visited over a weekend in the October 2017 survey. This was only achievable with a serious team effort, and thanks to the willing help from many quarters. In the early days, members of the Wildlife and Environment Society of South Africa and bird clubs assisted. Then the UK-based Hawk Conservancy Trust became involved, and the trust introduced Grand Parc Puy du Fou from France to the Dronfield vultures.

A conservative estimate suggests that more than 500 people have been involved in these 'ringing weekends', as they have become known.

One volunteer from France who helped in October said: "We have great memories of our weekend with you all last October, and our friends and acquaintances are still amazed at our knowledge of vultures in Africa, after just one weekend with you. We certainly have a very different view about vultures now, and their vital role in nature."

For the UK and French team members (who fly many vultures, eagles and owls in their conservation awareness programmes), it is all about seeing these vultures in their natural environment, along with regular sightings of the martial eagle, secretary bird, fish eagle and Cape eagle-owl.

Among the key findings from the past 25 years are:

- The breeding success has averaged 58.8 per cent over 25 years, but has varied from a low of 33 per cent in 2012 to a high of 76 per cent in 1997.
- There have been 1,839 breeding attempts, producing 1,079 fledglings of which 1,007 were ringed and/or tagged.
- The breeding population has increased from an average of 55 breeding pairs to 98 breeding pairs. It is not clear why this has happened, but it could be the change in land use from intensive cattle farming to extensive game farming, which requires less activity in the field.
- At least 27 colour-ringed or wing-tagged fledglings have returned to Dronfield to nest, and the current ages of these birds range from four to 16 years.

Important questions remain, covering: pair bonding of breeding birds, nest-site fidelity and why the breeding population has increased when other areas show a decline in breeding numbers. We hope to answer these questions in the years to come.

…and returned, tagged.

THERE'S ALWAYS SOMETHING TO PIONEER

So says Namdeb's Environmental Manager Ursula Witbooi. Here, she talks about her career so far.

What Ursula Witbooi and her team do has regional, national and international implications, and she knows she has a responsibility to leave a lasting, positive legacy.

"There is always something to pioneer, something to think innovatively about," she said. "Nothing stays in maintenance mode. This is the fun part. The not so fun part, and also the greatest challenge, is keeping the balance between conservation and mining.

"As Environmental Manager, I have to ensure that all risks and aspects related to our activities, products and services are managed in a systematic way. Our legislation is becoming more and more stringent, and as an extractive industry we need to be completely aligned and keep abreast of potential risks, as well as develop mitigation plans to retain our licence to operate."

Ursula first connected with De Beers Group via her husband Raymond. He was recruited by the company in 2000 and, after their marriage in December that year, she followed him to Oranjemund in the south-west of Namibia.

Ursula completed matric at the De Duine Senior Secondary School in Narraville, Walvis Bay, and then went on to complete a BSc in zoology and botany at the University of Stellenbosch, and an honours degree in botany at the University of Port Elizabeth, followed by a master's in marine botany at the University of Namibia.

After her first degree, she worked as a tutor in the Faculty of Science at the University of Namibia, and later as a junior lecturer in the same faculty in the Department of Botany.

"When I joined Raymond, there were no environmental positions available at De Beers. I found a temporary position in the HR department and even worked in the Employee Relations section for a while, which afforded me the opportunity to gain insight into how the mine operates and some of its processes," she said.

In June 2002, Ursula was appointed to a permanent position as a senior environmental officer. "With my lecturing background, a significant part of my job entailed environmental awareness and training," she added.

"I became familiar with the ISO 14001:2004 system. A few years later, I was promoted to Environmental Assessment Coordinator where I spent time in the strategic projects environment and gained competence in executing the Environmental Impact Assessment process. This is where I was also exposed to public scoping and external stakeholder engagements."

In December 2013, Ursula was appointed to the post of Environmental Manager at Namdeb.

She describes her team as incredible and diverse – from their cultural and academic backgrounds to their years of experience. She explains that it is this diversity that strengthens her team as they work in very unique surroundings, spanning land, intertidal and offshore environments. It is a massive scope where the members of the team have to be ready to deal with the different challenges of each of these environments.

"What we do at company level at Namdeb has greater implications regionally, nationally, in the group and internationally," she said. "We are in a position to add value through scientific research, assisting young Namibians or developing sustainable solutions to natural resources that we consume daily. We have a responsibility to leave a positive legacy. Thinking about it makes me strive to do the right thing."

Ursula is a nature lover who enjoys walking and camping with Raymond and their two boys, Michael, 16, and Reinhardt, 11 – and she likes to be creative. "Deep down, I like to create things and apply my creative mind whenever I get the time to do so," she said.

"My husband sets the pace for embedding values, principles and discipline in our children, equipping them with strength and knowledge to progress through life. Listening to how our children relate various stories to us in their own child-like way reminds me of what is real, true and matters in life."

Ursula with her husband Raymond and sons Michael (right) and Reinhardt.

NO BEES MEANS NO FOOD

Anika Steynberg from the University of Pretoria looks at how temperature, humidity and pesticides affect the survival of honeybees.

This paper was first presented at the 8th Annual Oppenheimer De Beers research conference in October 2017.

The global population is increasing at an astonishing rate, which adds greater pressure on farmers to produce more successful agricultural yields.

This is challenging, and especially so in Africa where climatic conditions are becoming warmer and drier. Farmers therefore turn to alternative methods of controlling the success of their agricultural yields, which leads to an increased use of pesticides.

Pesticides are known to have very bad effects on honeybees, ranging from affecting muscle functions to disrupting neural pathways and, ultimately, death.

One of the most frequently used pesticide groups is Neonicotinoids, which have long been used in agriculture, and South Africa is one of the largest importers of them. These pesticides pose a great threat to our key pollinators, and in combination with the changing → *continued overleaf*

climate, the effects might well get worse, ultimately resulting in a global food crisis.

African honeybees *(Apis mellifera scutellata)* are particularly vulnerable to the effects of these pesticides, because of their wide distribution across Africa, which also means that the honeybees are exposed to a whole range of different climatic conditions.

It is therefore important for us to understand how our honeybee subspecies will manage in a changing environment, which ultimately has an impact on our food security.

Honeybees are highly sensitive to climatic changes, and strive towards keeping the internal hive conditions reasonably constant. They are, however, exposed to temperature and humidity extremes during their daily activities.

Honeybees are highly sensitive to changes in climatic conditions.

Temperature is important for a number of physiological processes, such as larval development, brood care and adult survival. Humidity also plays an important role within the hive, not least for aspects such as controlling the microbial and parasitic activity, and for concentrating nectar.

In our experiment, honeybees were collected and exposed to different temperature and humidity combinations (low, medium and high temperature and humidity) for a relatively short period, resembling fluctuations in temperature and humidity. They were also exposed to sublethal doses of pesticides to determine the effect of pesticides on their survival under these different temperature and humidity combinations.

An increase in the magnitude and frequency of extreme weather events is forecast for the future. We therefore selected somewhat extreme combinations of climatic conditions to predict what the possible effects on honeybees would be, if they were to experience temporary fluctuations in climatic conditions similar to those combinations used in this study.

The study results showed that there was no significant effect of pesticides on the survival of honeybees under these specific conditions (temperature and humidity combinations). But we did find that temperature and humidity had a significant impact on honeybee survival.

Honeybees seemingly struggled to cope under high temperature and high humidity conditions, and therefore the lowest survival rates were recorded under these conditions, while the highest survival rate was recorded for honeybees exposed to low temperature and low humidity combinations.

One particularly interesting observation was the survival rate recorded under high temperature and low humidity conditions, which can be associated with areas such as the Karoo and Kalahari. Survival rates varied significantly under these climatic conditions, which translates into a greater uncertainty in how honeybees in Africa will respond.

Even though pesticides were not shown to be detrimental to honeybee survival under these conditions, the long-term effects that they might have on honeybee health cannot be ignored.

More research is required to determine the exact ways in which honeybees are affected by pesticides under these climatic conditions (as the pesticides do not affect the survival, but from opportunistic behavioural observations the pesticides did have serious effects on other functions).

The reality is that climatic conditions are changing and, although this research gives us a glimpse into what might happen to our honeybees, we do not know for sure how this may affect them. It is therefore very important for us to protect our honeybees, and to investigate whether they may display some local adaptations, or whether they will be unable to cope with these changes to factors that play such intricate roles in honeybee survival.

The use of pesticides in the agricultural industry could affect the survival of honeybees.

PYGMY FALCONS: UNWELCOME BUT FASCINATING GUESTS

Dr Robert Thomson from the FitzPatrick Institute of African Ornithology at the University of Cape Town encounters the ultimate abuse of hospitality on the Oppenheimer Generations' Tswalu Kalahari reserve.

This paper was first presented at the 8th Annual Oppenheimer De Beers research conference in October 2017.

Faecal mats - a sure sign of pygmy falcons using weavers' nests.

Nests of the sociable weaver are an iconic feature of the Kalahari. These massive nest colonies almost demand our attention. They still hold many secrets and unknowns, but one thing we do know is that sociable weavers and their colonies are a vital part of the Kalahari ecosystem.

These colonies are used by a range of different animal species. One species that depends entirely on sociable weavers is the diminutive (50g–60g) pygmy falcon. In their southern African range, these falcons roost and breed exclusively in sociable weaver colonies.

This is a highly unusual 'committed relationship', where the predatory falcon moves in uninvited to the active weaver colonies. The falcons are terrible guests, and the weavers frequently protest against their presence, and with good reason.

Our research is uncovering the extensive costs to weavers of hosting pygmy falcons. This aspect is still research in progress, but our observations suggest that weavers, in particular chicks, are often preyed on by the falcons – the ultimate abuse of hospitality.

With their impact on the weavers, it is important to understand the biology of the falcons. Little is known about them, however, with only a single study on aspects of the biology and ecology of the species from almost 50 years ago. A better understanding of the ecology and life history of the falcons, and how they interact with other species that use the weaver colonies, is desperately needed. My research group and I have undertaken a long-term study to try to fill this knowledge gap.

Our study site, a small part of the extensive Tswalu Kalahari reserve, contains about 300 sociable weaver colonies. Finding the approximately 35 colonies that house pygmy falcons would be extremely time-consuming, but we benefit from the quirky behaviour of the falcons: they defecate at the entrance of the chambers in which they sleep or breed.

These 'faecal mats' are conspicuous and show us clearly whether a colony is occupied by pygmy falcons. However, the function of these faeces at the chamber entrances is still unknown, and is something that Billi Krochuk studied as part of her BSc honours thesis.

Our observations suggest that the faecal matter is actively pasted at the chamber entrance, and is not just a consequence of poor toilet training. We have a number of ideas that may explain this behaviour, and Billi tested the first few.

Firstly, white faeces at a chamber entrance may alter the temperature of the chambers. Architects often place white surfaces at entrances to keep temperatures in the buildings cooler. Our initial data shows little impact of the faeces on temperature, but we still need to test this during extremely hot summer conditions.

Secondly, we wondered whether the faeces may contain some anti-bacterial or anti-fungal properties, which would help in nest hygiene. However, Billi's tests clearly showed no properties of this kind in the faeces. For the moment, the function of faeces at the chamber entrances remains a mystery.

During our tough but enjoyable work on the falcons, we often noticed multiple falcon adults sitting in a tree of an active territory. These groups have led to speculation about the type of breeding system that the pygmy falcons may have.

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A group of adult pygmy falcons. *Photos on this page: Robert Thomson*

Falcon females are the colourful sex in this species, suggesting a polyandrous system where a single female mates with multiple males, and some anecdotal observations have supported that speculation. However, to gain clear answers, we need to monitor the population in detail by having known individuals and closely tracking all breeding attempts.

Our project has ringed about 400 falcons since 2011, and we continue to re-trap these birds to find out more about their movements. Since 2015, we have also been colour ringing the individuals. This helps us to identify and monitor known individuals from a distance and lessens the need to trap birds annually.

This ringing has allowed us to observe that about 20 per cent of active falcon territories are occupied by a group of adults, whereas the remaining 80 per cent have only the breeding pair of a female and a male.

We found pygmy falcon groups are amazingly diverse. As was initially expected, these groups can comprise a female and multiple-males, but sometimes the groups have a male and multiple-females, and then occasionally the groups are comprised of multiple-females and multiple-males. Given this diversity, what individuals are making up these groups?

Pygmy falcons, like about nine per cent of other bird species, show facultative cooperative breeding. Our ringing data shows that these groups often include the breeding pair and some of the previous year's offspring.

These 'teenagers' delay their departure from their birthplace, and stay at home for a year or two. This strategy can frequently be beneficial both to the parents and the youngsters. The parents may get help in raising future chicks and chasing off predators, such as the ever-present Cape cobras and boomslangs that forage in the weaver nests.

The youngsters benefit from gaining access to resources, and in some cases may inherit the territory in the future. They also help raise their brothers and sisters, which carry 50 per cent of their own genes.

But pygmy falcons are full of surprises, and group make-up is diverse. Groups can also contain immigrants: these are birds that originate from other territories. These immigrants may sometimes join delayed offspring in the group, or can form a group with the main pair.

Benefits for immigrants would be similar to those of delayed offspring, except that they would not be related to any future offspring they raise. Male immigrants may, however, be able to copulate with the breeding female, and gain paternity of some of the chicks.

Nevertheless, we still do not know what the drivers of group formation are in the pygmy falcon. However, Dr Diana Bolopo has uncovered some of the consequences: groups do not raise more offspring, but produce on average better quality offspring in terms of chick size and condition.

Insights into the biology of pygmy falcons are slowly being revealed by our project. This little raptor is fascinating and, fortunately for us, more questions about the unusual aspects of its ecology are constantly emerging. Features of the species have undoubtedly been shaped by co-evolution with its weaver hosts, and potentially other Kalahari animal and plant species that closely associate with the weaver colonies.

A pygmy falcon strangles its victim. *Photograph: Willem Kruger*

SPARROW-WEAVERS SHOW THE BENEFITS OF COOPERATION IN THE KALAHARI

Pablo Capilla-Lasheras and Dr Andrew Young, from the University of Exeter, investigate a biological puzzle on the Oppenheimer Generations' Tswalu Kalahari reserve.

This paper was first presented at the 8th Annual Oppenheimer De Beers research conference in October 2017.

A white-browed sparrow-weaver at its nest.
Photographs: Pablo Capilla-Lasheras

From humans to insects, social species occur throughout the animal kingdom. In animal societies, individuals often sacrifice their own reproduction to assist in the reproduction of other group members.

The fact that some individuals forgo reproduction to help others has represented a long-standing puzzle in biology and has attracted significant scientific attention. Despite this interest, the causes and consequences of social behaviours are not fully understood.

The benefits of cooperation are especially patent for species living in harsh environments where, for instance, rearing offspring may critically profit from the presence of helping members in the group. Indeed, cooperative bird species occur in harsh environments more frequently than non-cooperative species.

Recent research suggests that this global distribution of birds is the consequence of cooperative species being more capable of invading harsh environments than non-cooperative species. These findings highlight a simple question yet to be answered: what are the advantages of cooperation that allow social species to invade harsh environments?

To answer this question and others related to the evolution, costs and benefits of cooperation, our team of researchers at the University of Exeter (UK) has studied, since 2007, 40 social groups of the white-browed sparrow-weaver *(Plocepasser mahali)*. This research takes place in the Tswalu Kalahari Reserve.

Using this social species as a study model, the project aims to improve our understanding of the ecological and physiological causes and consequences of cooperative behaviours.

White-browed sparrow-weavers live in small groups of up to 14 individuals in which one dominant pair monopolises reproduction. Subordinate individuals, often relatives of the dominant pair, cooperate in a range of social activities from provisioning the young to territorial defence.

The sparrow-weavers are considered rainfall dependent breeders. However, little is known about when rainfall is important for sparrow-weaver females to start reproduction and about the interplay between rainfall and the social environment. Understanding these two questions would shed light on the benefits of cooperation in a highly unpredictable, harsh environment.

To date, the project has generated a remarkable data set encompassing more than 900 breeding attempts and having detailed information about the lives of more than 1,700 birds. Using this data set, we have determined that white-browed sparrow-weaver females lay new clutches in response to rainfall within a temporal window of 28 days. The more rainfall in this period, the higher the rate of clutch production in every social group.

Interestingly, after low or medium levels of rainfall (between 5mm and 25mm), there seems to be an average optimal group size in which females maximise the rate of clutch production. When heavy rainfall occurs, however, females lay clutches at equal rates, regardless of the size of the group they live in.

These results highlight the importance of rainfall predicting the onset of reproduction in white-browed sparrow-weavers but do not indicate any clear beneficial effect of group living in the rate of clutch initiation. Living in large social groups is not associated with females laying clutches at higher rates. In fact, when low levels of rainfall occur, females in large groups lay clutches at lower rates than when they are in small groups.

The next step of the project will involve the investigation of other reproductive traits – for example, clutch size or nestling survival – in order to understand the effects of the social environment and rainfall through the whole life cycle. The final aim of this research is to understand the benefits of cooperation and shed light on the invasive potential facilitated by the appearance of sociality.

White-browed sparrow-weavers depend on rainfall to breed.