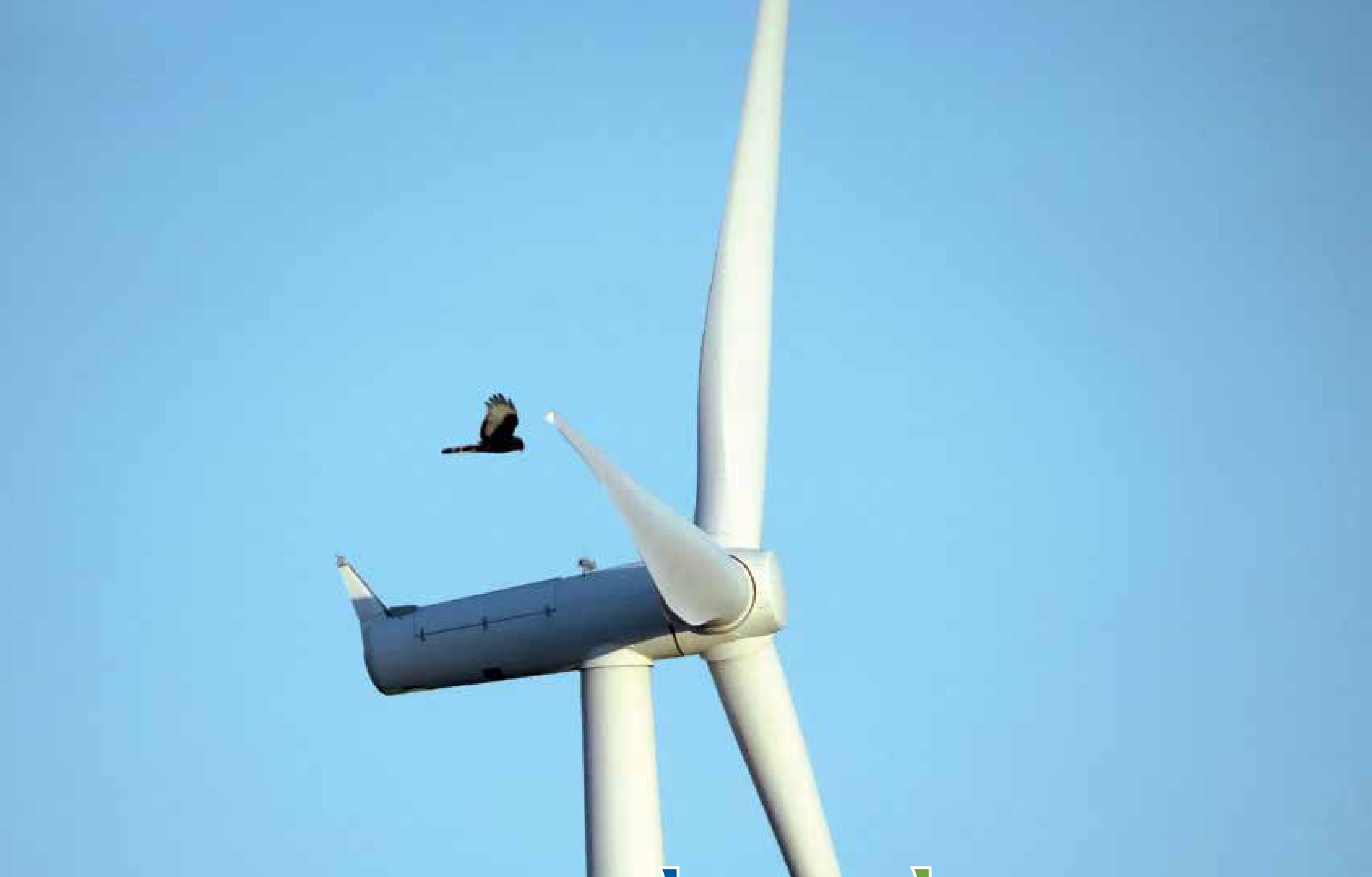


terminal velocity

The long-term costs of endangered birds killed by wind farms

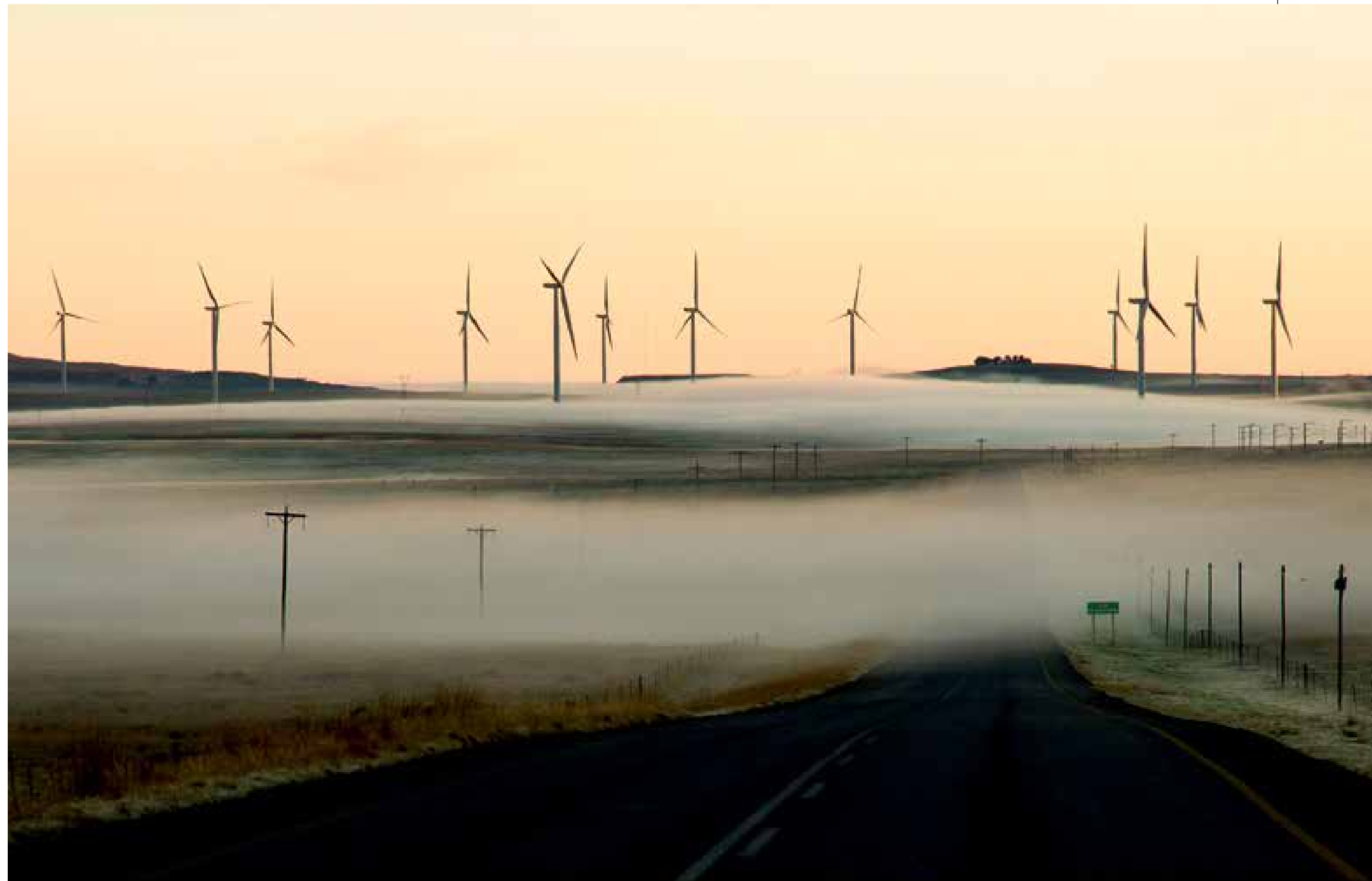
TEXT **ROB SIMMONS, FRANCISCO CERVANTES AND MARLEI MARTINS**

The positive effects of green energy for the future of our little blue planet are indisputable in terms of reducing harmful greenhouse gases. With South Africa moving (albeit slowly) away from coal-fired energy production, the future of green energy in this country looks bright. In February 2022 renewables peaked at producing 19 per cent of the nation's energy needs.

above *Adult Black Harriers near wind farms run the gauntlet of spinning blades as they thread their way past operational turbines.*

As is often the case, there is a negative side to the positives and in the case of wind farming that is the loss of aerial, collision-prone species – birds and bats – and both are frequent victims of turbine blades. For bats, merely passing through the low-pressure vortex close to the tip of the blade as it sweeps through the air at more than 300 kilometres an hour is sufficient to kill them, as it causes their delicate lungs to haemorrhage. Birds, however, fall victim to direct impact with the spinning blades.

What is surprising is that more than a third of the birds killed are raptors, not only in South Africa but in all areas across the globe where wind-turbine fatalities have been studied. There are two probable reasons for this. The first is that raptors spend a great deal of time on the wing – soaring, hunting or simply commuting at blade-swept heights within their large territories or on migration. The second is that, despite raptors' high acuity in seeing far-distant objects, research has shown that they see black-and-white contrast more poorly than humans do. Thus, they may not see a white blade spinning against a bright background, resulting in the collisions that are all too frequent in the raptor-rich skies of the African continent. This is the probable reason that the introduction of a black blade has shown such promising results in eliminating sea eagle deaths on the Smøla Wind Farm in Norway. The blades are simply made more visible.

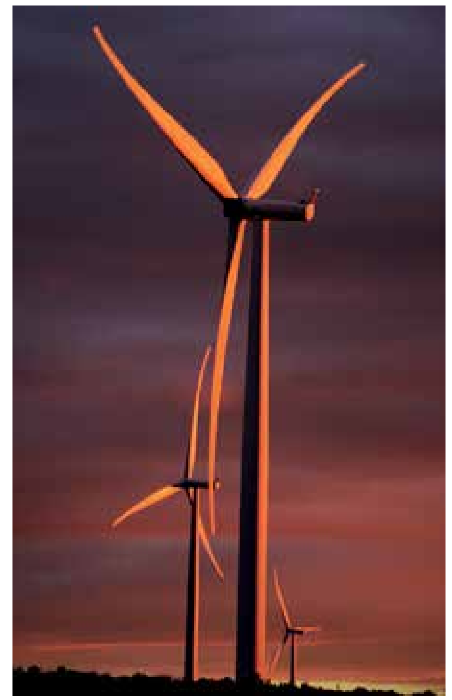


ANDREW JENKINS

In South Africa, an operational turbine kills on average 4.6 birds a year and 36 per cent of all avian deaths are raptor species (Perold et al. 2020). If there are an average of 60 turbines per wind farm and 27 operational wind farms in South Africa by the end of 2022, then about 7500 birds are predicted to be killed this year. Of these, 2700 will be raptors. But simply recording the total number of deaths is not sufficient if we are to reduce the number of fatalities. We also need to know which species are most susceptible and what the long-term effect on their population numbers might be.

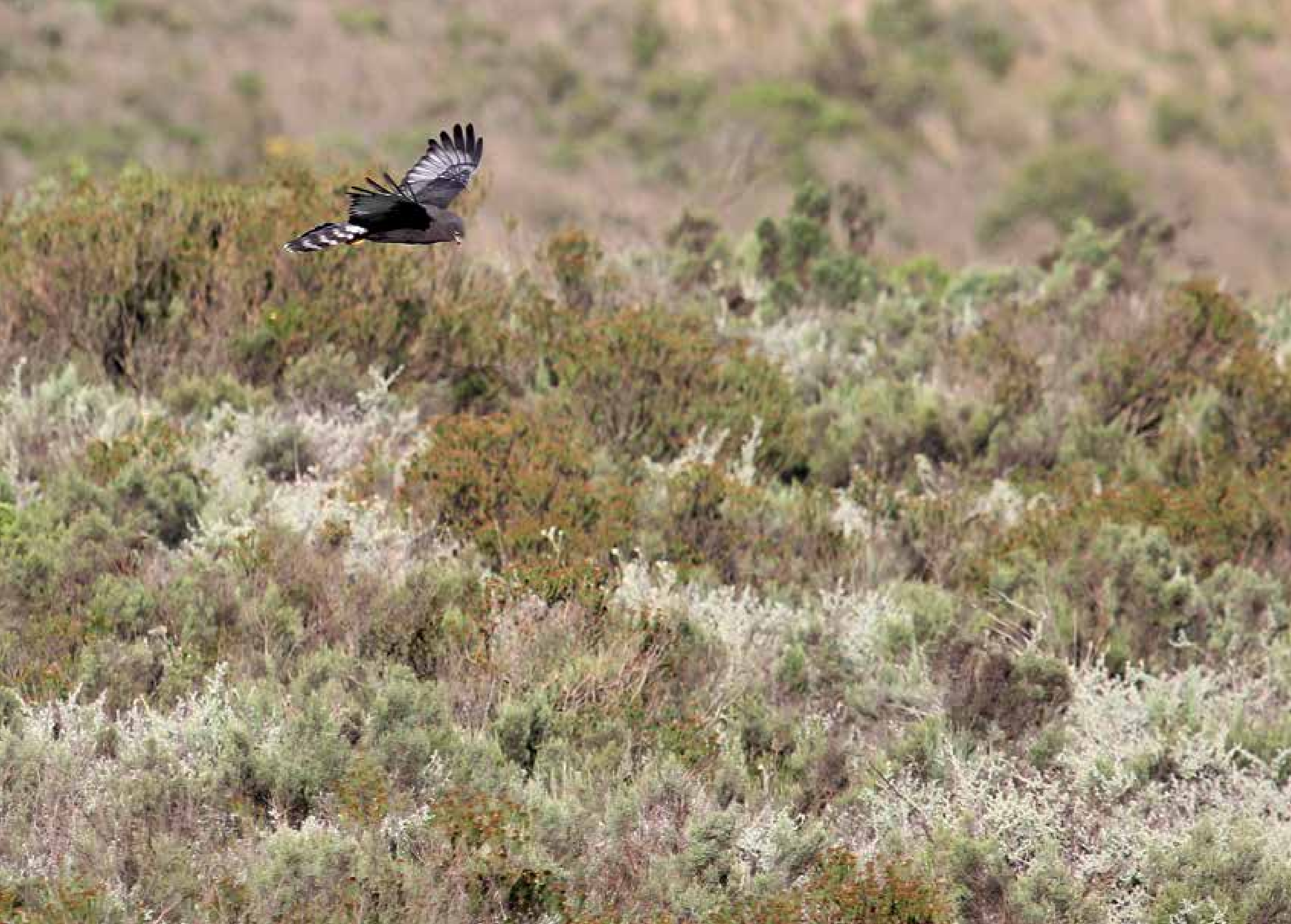
above *Wind farms are sited in many different habitats, but are frequently positioned on high ground to exploit the most wind-rich resources.*

right *Turbines spin day and night at wind farms and birds must navigate the blades in all light levels.*



JULIA SIMMONS (2)

During an intensive three-year study at the Jeffreys Bay Wind Farm in the Eastern Cape, about eight per cent of all birds killed were Threatened species. Taking this project as a reference, of South Africa's estimated 7500 bird fatalities per year, 600 would >



ODETTE CURTIS-SCOTT

be Threatened species. Looking at the species composition of the fatalities recorded in this project and also in the comprehensive review by Perold et al, we see that these include large eagles like Martial and Verreaux's, and smaller species like harriers and snake eagles. These are slow breeders that have low reproductive rates and might be expected to exhibit declines if the adults are killed.

From our Jeffreys Bay study we were surprised to find that Black Harriers, an Endangered species, were regular victims of the turbines. In four years, six birds (all adults) were killed. At least two of these were breeding birds: a male known to be provisioning young in a nest and a female with a brood patch, indicating that she was incubating. This was unexpected because this group of open-country birds is almost never reported as a victim of turbine impacts in other parts of the world, such as North America and Europe (where four species co-occur). The reason for this is that harrier species mainly forage low to the ground in their constant search for small mammal and bird prey and rarely fly at blade-swept heights (approximately 30 to 130 metres above the ground). Other studies have found that some harriers (Montagu's) actively avoid wind farms or slowly move away from operational wind farms (Hen). However, according to as yet unpublished tracking data, Black Harriers do not seem to avoid wind farms, to their cost.

So, what do these worrying numbers of fatalities tell us? What long-term effects could this rate of mortality have on the population dynamics of endangered raptors in general and very rare species, such as Black Harriers, in particular?

We need to bear in mind that, as dismal as the wind farm fatalities sound, for some species they could be of less concern than other anthropogenic impacts. For example, the main threat to the Black Harrier has been habitat loss following the transformation of fynbos and renosterveld; habitats the species is superbly well adapted to and that have suffered extreme declines. Renosterveld, in particular, has lost 95 per cent of its extent in the past 100 years. To save the Black Harrier we first need to manage and prevent further loss and degradation of its habitat. We are fortunate that harrier-warrior Dr Odette Curtis-Scott and her Overberg Renosterveld Conservation Trust are doing exactly this in one of the hotspots of

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harrier breeding, the Overberg in the south-western Cape. Over and above this essential conservation work is the urgent need to understand the consequences of additional mortality on this fragile population.

In a first for the African continent, we recently factored the likely outcome of different levels of additional mortality for the Black Harrier on its long-term population numbers. We did so by employing a readily available data source, the Southern African Bird Atlas Project 2 (SABAP2) and a clever model. Within SABAP2, citizen scientists visit a grid of pentads (each one a 5 minute x 5 minute area of about 7 km x 8 km) covering the whole of South Africa. When observers visit a pentad, they produce a card with a list of species detected. Our model estimated the rate of change of the Black Harrier population from SABAP2 yearly reporting rates (that is, the number of detections/number of cards). We then modelled that rate of change as a function of life-history parameters that we could estimate (age at first breeding, estimated lifespan/survival and annual fecundity).

An important assumption of the model was that when one bird was detected in a pentad in a year, the species was considered to be present for the whole year. Thus, if it was not recorded on other cards from that pentad, it was because it wasn't detected, not because it wasn't present. This helps the model estimate the probability of detection, which is a key component of the analysis.

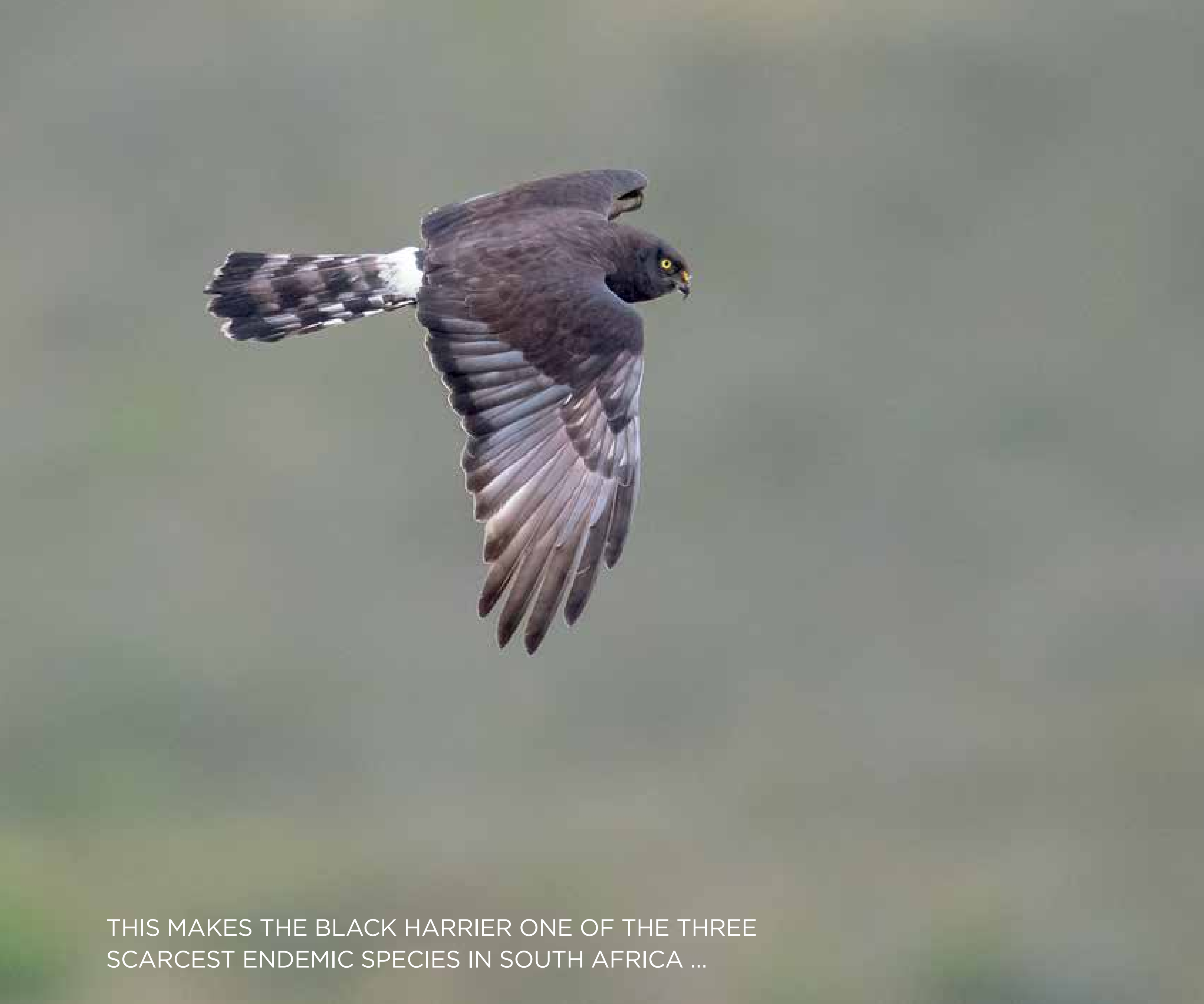
ROB SIMMONS

By knowing the probability of detection and the number of detections, we could estimate the number of individuals present; the more birds that are present in the pentad, the greater chance there is of detection. To estimate the probability of detection reliably, it was important to have the species listed if it was present; therefore we only used those pentads that had a minimum of five cards. This is not a magic number, but we considered it to be a good compromise between having reasonable chances of detecting harriers and not throwing away too many valuable data.

above *Black Harriers are a ground-nesting species and must keep a watchful eye – and ear – out for potential predators.*

opposite *Renosterveld habitat provides nest sites and foraging areas for breeding Black Harriers and unfragmented patches are prime areas for this species.*

In this way, we estimated Black Harrier abundance for each year and, in turn, the yearly rate of change of the population; there was a whopping 2.3 per cent decline. In addition, we could roughly estimate – for the first time >



CHRIS VAN ROOYEN

above *Of the 16 species of harrier around the world, the Black Harrier is among the most striking and scarce.*

opposite *A harrier in the hand is worth two in the veld: Grant Forbes and Rob Simmons ready a female for tracking in the Overberg.*

using quantitative criteria – the likely population size: a meagre 1300 individuals. Taken together with Rudd's and Botha's larks, this makes the Black Harrier one of the three scarcest endemic species in South Africa … not a banner headline that one wants for a species that is in serious trouble.

The most striking result, however, showed that if just three additional adults (or subadults) are killed annually, then the Black Harrier population will decline even faster than it is already and have a 61 per cent chance of going extinct in the next 100 years. If that number rises to five extra fatalities, then the population has a 75 per cent probability of going extinct in less than 75 years. Given that about 1.5 adults are already killed by wind farms each year, spinning blades pose a very real threat to the species.

Ultimately, this is a manageable problem for wind farms and harriers through mitigation. The best modification is to totally avoid siting wind farms in high-use or breeding areas. BirdLife South Africa has recently produced the Black Harrier wind energy guidelines to do exactly that and steer developers away from risky areas to safeguard the species.

The fine sensitivity of the small Black Harrier population to this incremental increase in mortality means three things. Firstly, without immediate intervention harriers are in real danger of going extinct in the not-too-distant future. Secondly, the long-term viability of the population is highly sensitive to the killing of mature individuals (less so to their breeding success or the loss of young birds). Thirdly, the proliferation of wind farms and other infrastructure that could cause additional mortality in the Black Harrier's core breeding strongholds in the south-western Cape should be avoided.

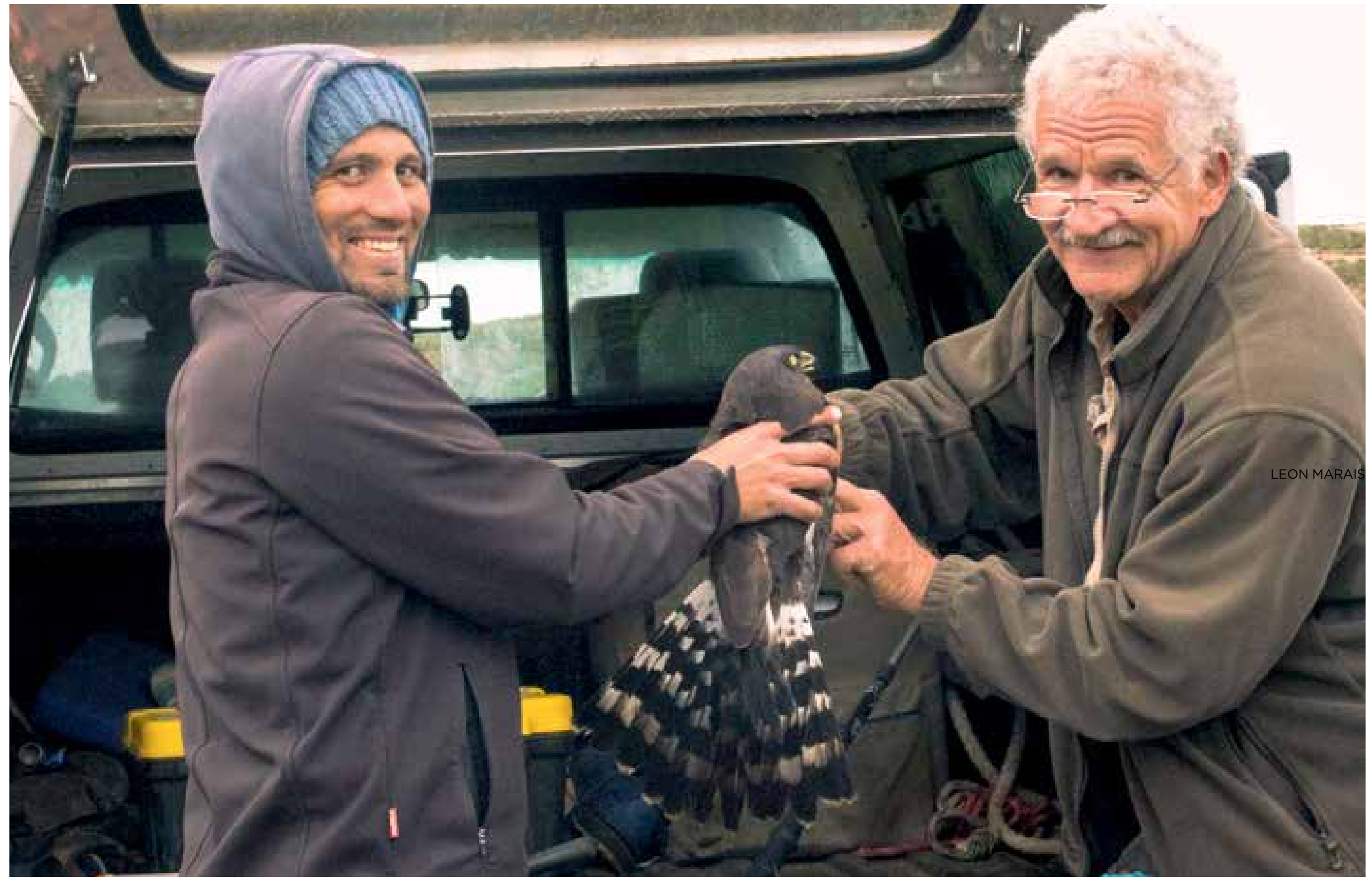
One spin-off of our modelling approach is that with sufficient knowledge of the life-history details of any species with good SABAP data coverage, the population trajectory and size could be estimated from detection/non-detection data. This could allow a greater appreciation of the dangers facing other threatened or particularly rare species in the long term.

It is important to emphasise the fact that it is not wind farms as such that have driven the Black Harrier population to this tipping point, but rather the extensive transformation of the habitat suitable for this specialist species. It is therefore crucial to preserve and rehabilitate what is left of the fynbos and renosterveld, for the sake of this and other endemic species.

Another finding of our study indicates that the Black Harrier's fecundity is closely linked to rainfall. Diminishing rainfall levels caused by climate change could add even more pressure to the population. In this sense, wind farms are needed in order to reduce greenhouse emissions, which brings us full circle.

However, given the current state of the Black Harrier population we must be extremely concerned about any additional losses. Our feeling is that we can have both: wind farms to reduce our dependence on fossil fuels and farms appropriately positioned to reduce impacts on threatened species.

We are extremely grateful to all the citizen scientists who contribute to the data sets, enabling us to better understand the perils facing this beautiful icon of the fynbos and renosterveld. ◆



ODETTE CURTIS-SCOTT

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