

# Inferred giraffe deaths from lightning strikes

Ciska P. J. Scheijen 

Rockwood Conservation, Griekwastad, South Africa

**Correspondence:** Ciska P. J. Scheijen, Rockwood Conservation Fund NPO, PO Box 1348, Kimberley, 8300, South Africa.  
Email: Ciskascheijen@gmail.com

## 1 | INTRODUCTION

In *The Origin of Species*, Charles Darwin (1859) wrote that: 'there must be much fortuitous destruction, which can have little or no influence on the course of natural selection'. His reasoning was that some organisms could be 'the best adapted to their conditions... [but]...destroyed by accidental causes,' such that 'natural selection will be powerless' in these instances. Stochastic factors, such as extreme weather events, can cause fatalities to individuals otherwise well-adapted to their environment.

Specific atmospheric conditions create weather patterns associated with a high probability of lightning, but the predicted location of lightning strikes is essentially random (although modern technology can pinpoint, with limited accuracy, a probable radius). Direct lightning strikes kill approximately 27 people per year in the United States (NOAA, 2020). Wildlife mortalities resulting from lightning strikes have been recorded but the number of records are scarce and do not provide much detail (Anonymous, 2015; Blumenthal, 2014; Gomes, 2012; Oliver, 2003). Diagnosis of lightning strikes is often based on circumstantial evidence (Janzen, 2020). Lightning can kill animals in four ways: (a) direct strikes (hitting the animal directly), (b) side flashes (animal is near an object that is hit by lightning), (c) step potential (a discharge of lightning into the surface of the ground that happens if two parts of the body are in contact with the ground align in the direction of the electric ground current) and (d) touch potential (when the upper body makes contact with higher elevation of the stricken object while another part of the body is still in contact with the ground) (Gomes, 2012).

Given that lightning bolts tend to hit tall objects, especially in open areas, the height of giraffes may make them particularly vulnerable to fatal electrocution. However, they may have behavioural adaptations to reducing chances of mortality from lightning, for example seeking shelter during a thunderstorm or moving to thickly vegetated areas. This report is the first to provide detailed circumstances about lightning directly striking giraffes: fatalities that are 'fortuitous destruction'.

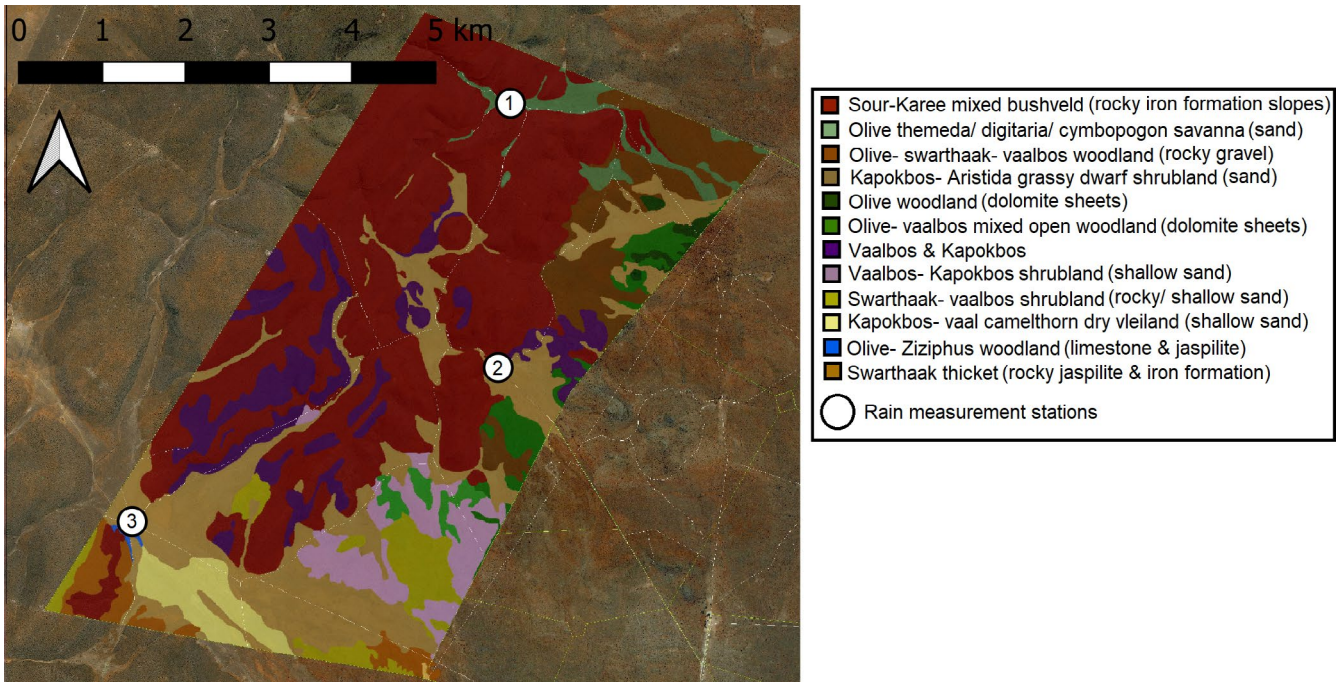
## 2 | METHODS

Observations were conducted at Rockwood (28°34'34.9716"S, 23°24'8.4168"E), a Private Reserve located around 180 km west of Kimberley, South Africa. The study area (3,303 ha) consists mainly of mountain bushveld (Figure 1) as well as plains woodland and plains shrubland (Furstenburg, 2019) and is inhabited by a diversity of large ungulates, including giraffes (*G. camelopardalis*), roan (*Hippotragus equinus*), sable (*Hippotragus niger*), plains zebra (*Equus quagga*), kudu (*Tragelaphus strepsiceros*), springbok (*Antidorcas marsupialis*), red hartebeest (*Alcelaphus buselaphus*), buffalo (*Syncerus caffer*), common eland (*Taurotragus oryx*), gemsbok (*Oryx gazella*) and blue wildebeest (*Connochaetes taurinus*). The climate consists of cold dry winters and hot wet summers. Rainfall is recorded at three locations in the study area (see Figure 1).

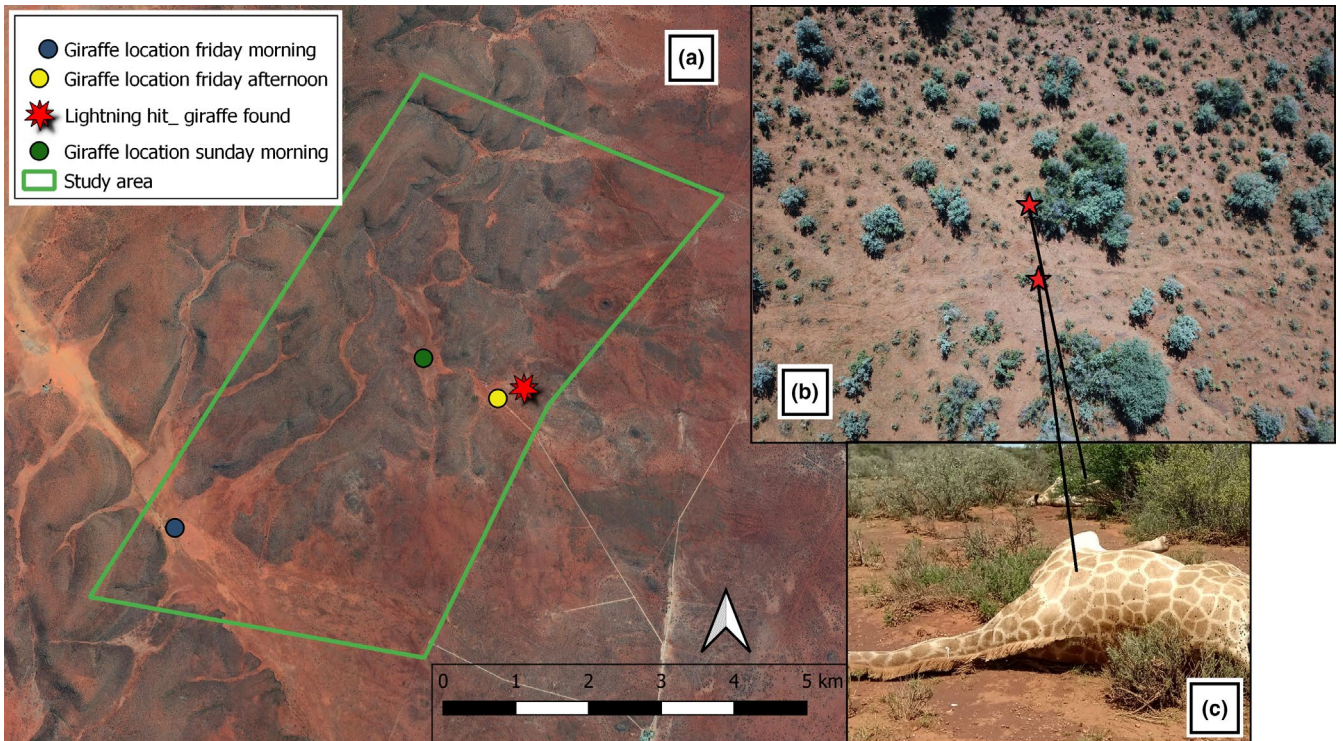
Six giraffes were introduced to Rockwood in September 2017, and another two were introduced in June 2018. All eight giraffes (5 males, 3 females) were between 2 and 4 years old at the time of introduction. The giraffes came from two different Private Reserves. All eight giraffes were monitored nearly every day and were most often recorded in a single herd, that is within a range of <1 km of each other. The giraffes use the whole study area, but range least often in the hills in the mid-west and north-west sections of the Reserve.

## 3 | RESULTS AND DISCUSSION

On 29 February 2020, there was a relatively short but strong thunderstorm at Rockwood. At approximately 16.30, heavy rainfall and lightning began. Two hours later, the storm had ended, and it did not rain again that day. Rain station #2, closest to where the giraffe deaths occurred, recorded 65 mm of rainfall during the storm. The storm caused significant damage to the well-maintained game fences in the two-hour time span. The day before the storm, all eight giraffes were observed together in a single herd in the morning in the south-west part of the reserve (Figure 2a), where snowbush-aristida



**FIGURE 1** Vegetation map of the study area (Furstenburg, 2019), with the three rain measurement stations indicated. Very densely areas are the swarthaak (black thorn) thicket. And there is a very tall olive tree <1 km from the point where the carcasses were found



**FIGURE 2** (a) Study area with the locations where the giraffes have been spotted before and after the storm as well as where the two dead giraffes were found, (b) close up aerial photograph (credit: Wicus Diedericks Junior) of the location where the carcasses were found and C) the two giraffes were found approximately 7 metres apart from each other (credit: Frans Moleko Kaweng)

grassy dwarf shrubland is the dominant vegetation type. By the afternoon, the entire giraffe herd had moved to the central east, where vegetation is similar, but they were relatively close to the edge to

vaalbos, sour-karee mixed bushveld. On the day of the storm, we did not record giraffe locations. One day after the storm, on 1 March in the morning, we observed only six giraffes (not eight) in the centre



**FIGURE 3** Skulls of two giraffes killed by lightning. The elder of the two (left) shows a fracture at the base of the ossicone. The skulls were prepared (flayed and sun dried) by Rockwood ranger Frans Moleko Kaweng

of the reserve, which is highly unusual for this population of giraffes because they rarely fission. On 2 March, we found two giraffes dead, lying approximately 7 metres apart from each other (Figure 2b). Both were near to the point where we had recorded them on the afternoon of 29 February, suggesting that they died during the storm. Both victims were (sub-) adult females.

There were few signs of injury on the body apart from a wound at the base of the right ossicone on the older female (5 years old), and jackal marks on her hind quarters; however, there were no signs of other wounds or of scavenging. Upon examination of her skull, we found a large, distinctive fracture at the fusion of the right ossicone and the right parietal bone (Figure 3) suggesting she suffered a direct lightning strike to the head. There were no large trees nearby and she was lying on her left side (Figure 2c), indicating that she could not have broken her ossicone at the base during her fall to the ground. However, Janzen (2020) states that in 90% of the cases of direct lightning strokes, carcasses showed singe marks. Blumenthal (2014) reports that the giraffe which got struck by lightning showed singe marks, which was not observed with the giraffes discussed in this report.

The second giraffe, approximately four years of age, had no signs of injury. Janzen (2020) found that singe marks are less likely to be present when an animal is electrocuted by a step potential. Both giraffes had a very strong ammonia-like smell, similar to observations reported by Blumenthal (2014). He found that vultures and hyaenas did not scavenge the carcass for five days after a lightning incident killing a giraffe. We found the giraffes 1.5 days after death and did not observe postmortem scavenging on the second giraffe. In fact, the eyes of both giraffes were still intact, even though eyes are usually the first part of the body to be scavenged, typically by corvids.

At another site, 130 km to the east of Rockwood, we found that giraffes walked approximately 13% shorter distances during rain compared to when it was not raining (Scheijen et al. in prep),

suggesting that giraffes adjust their movements in response to rainy weather, associated with lightning storms. In the Rockwood case, the giraffes did not move into densely vegetated areas or areas with tall trees or objects. The area where we found their carcasses was close to the location where they were found the day before the storm, relatively open with grasses, vaalbos (camphor bush) and kapokbos (Afrikaans for snowbush) and no tall trees (vegetation < 2 m) (Figure 1). As giraffes are taller than two metres, they were the highest point of strike in the area. Based on available evidence, we conclude that one giraffe (the older female) was killed by a direct lightning strike, while the other female, found some 7 m away, died likely either from a side flash or step potential.

While giraffes may modify their movement patterns in response to inclement weather, our observations cannot confirm this. The deaths of the two females provide evidence that extreme weather events or 'fortuitous destruction' influence survival: a sudden stochastic event can terminate the life of two individuals. The towering height of giraffes poses a risk by acting like a lightning rod, so the adaptive advantages of a long neck can be overcome by chance events. In the Rockwood case, the older and therefore taller of the two female giraffes suffered a direct lightning strike. Possibly, old male giraffes (taller and bigger than females) while having a reproductive advantage might also have a greater risk of fatality from unpredictable lightning bolts that shorten their reproductive careers. As Darwin surmised, even well-adapted individuals that have demonstrated their adaptive potential by reaching old age are subject to random forces that can end their lives.

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#### CONFLICT OF INTEREST

I declare there is no conflict of interest.

#### DATA AVAILABILITY STATEMENT

This article does not contain data.

#### ORCID

Ciska P. J. Scheijen  <https://orcid.org/0000-0003-0938-8235>

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