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Do swing gates prevent black-backed jackal (*Canis mesomelas*) from entering commercial sheep farms?

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Abstract

Black-backed jackal (*Canis mesomelas*) are responsible for much loss of small livestock throughout Namibia, but especially so in the predominantly sheep farming regions of southern Namibia. Impermeable fences, colloquially termed jackal-proof fences, are used by small-stock farmers to prevent jackals from accessing their land. Access through jackal-proof fences is mainly facilitated by specialist burrowing species, although black-backed jackal are also capable of burrowing under fences themselves. Installing swing gates and maintaining artificial holes are simple ways to encourage burrowing species to use these thoroughfares while minimising the maintenance of fences. A study to determine the effectiveness of swing gates in excluding black-backed jackal was conducted on a farm in southern Namibia over a 5 month period. Nine other species were confirmed to use burrows fitted with swing gates while black-backed jackal were not found to utilise these swing gates at all, although probably will learn to do so over time. The biggest advantage of using swing gates is the decrease in fence maintenance activities which was reduced by almost 90% during this study.

Keywords: black-backed jackal; fences; Namibia; predator control; swing gates

Introduction

Impermeable fences impact on the dispersal and genetic fitness of wildlife, restrict migration as well as prevent access to resources; therefore innovative alternatives to such barriers need to be considered (Coetzee 2016). Although outer boundary fences of commercial small-stock farms in southern Namibia are made "jackal-proof" – i.e. wire-mesh reinforced, dug into the soil and weighed down with rocks – black-backed jackals (*Canis mesomelas*) continue to access farms via burrows typically dug by species such as aardvark (*Orycteropus afer*), aardwolf (*Proteles cristata*) and porcupine (*Hystrix africaeaustralis*). Black-backed jackal are responsible for significant sheep and goat losses (e.g. Drouilly *et al*. 2017) as well as preying on small wild ungulates (Kamler *et al*. 2012). They use holes under/through fences extensively (e.g. 22% of tracks for open holes and 2.5% for open swing gates in north-central Namibia) (Schumann *et al*. 2006) as well as tyre-passages used as wildlife thoroughfares (44% in central Namibia) (Weise *et al*. 2014). Although black-backed jackals are also capable of burrowing under fences if/when required, they typically use existing burrows rather than dig their own (pers. obs.).

The loss of small livestock is a financial burden on farmers (Lucas 2012, Drouilly *et al*. 2017) which is exacerbated by additional fence maintenance costs (i.e. fuel, materials and time). Such added expenses for a marginal business in a drought prone and ever changing economic environment could contribute to farmers targeting, and destroying animals perceived as part of the problem (i.e. burrowing species) with dire long term ecological consequences.

Swing gates, albeit designed for and used successfully to reduce fence damage by warthogs (*Phacochoerus africanus*) while excluding cheetah (*Acinonyx jubatus*) from accessing game farms in north-central Namibia, can also exclude black-backed jackal (Schumann *et al*. 2006). Using vehicle tyres as a wildlife thoroughfare does not prevent black-backed jackal from passing through a fence as these are open structures designed to facilitate the movement of smaller wildlife through barriers such as fences while containing valuable large-bodied mammals (Weise *et al*. 2014).

Installing and maintaining artificial thoroughfares – i.e. swing gates – is a simple way to encourage burrowing species to use existing thoroughfares while minimising fence maintenance otherwise required if animals dig their own burrows under/through fences (Schumann *et al*. 2006, Weise *et al*. 2014). Monitoring and maintenance, however, remain important as burrowing is influenced by environmental factors such as season and soil type, resulting in new holes being opened (Rust *et al*. 2014).

This study investigated whether a practical, cost-effective swing gate mechanism along small-stock farm boundary fences in southern Namibia would a) exclude black-backed jackal, b) facilitate the movement of burrowing species and c) reduce the number of holes dug by burrowing wildlife.

Methods

Study area

This study was conducted on farm Korhaan #254, approximately 70 km south of Grünau in the Karas region (homestead: 28°16'12.7"S, 18°03'44.1"E). The farm is 8,000 ha in size and divided by the B1 highway into two approximately equal parts with this study being conducted on the ca. 4,000 ha east of the highway. The vegetation is classified as typical dwarf shrub savanna (Giess 1971) or Karas dwarf shrubland (Mendelsohn *et al.* 2002) dominated by *Rhigozum trichotomum* shrubs and *Stipagrostis* species grasses. The top soil and rock structure is varied, but dominated by hard shale geology. The mean annual rainfall is between 50-100 mm with a high coefficient of variation of between 60-70% while average minimum and maximum temperatures vary between 6-8°C and >36°C during winter and summer, respectively (Mendelsohn *et al.* 2002). Farm Korhaan is used for small livestock (sheep) farming and the only wild ungulates present are springbok (*Antidorcas marsupialis*) and steenbok (*Raphicerus campestris*).

Boundary fence holes

This study was conducted between 3 May 2015 and 7 October 2015 – a total of 157 days. A total length of 24.7 km of the farm boundary fence was monitored on seven occasions during this period.

All holes encountered during the first fence investigation were documented and closed using rocks only or with a combination of rocks and wire netting and covered with soil. On subsequent visits all holes encountered, whether new or reopened, were documented and closed again with rock/soil or fitted with a swing gate. The placement of swing gates was dependent on the condition of the lowest steel wire strand to which these mechanisms were attached to and the frequency of use – i.e. wildlife activity – through the opening, with more active holes being fitted with swing gates rather than those not viewed as very active.

Burrowing species

Species responsible for the holes dug under the fence were identified from tracks and type of excavation – e.g. aardvark holes are big with tell-tale claw and tail drag marks compared to small scrapes with pug marks left by the African wildcat (*Felis silvestris*).

Swing gates

Custom made swing gates were constructed from scrap metal sheeting and wire (Figure 1). A strip of metal sheet with dimensions of 335 x 55 x 1 mm (length x width x thickness) was used as a 'skirting' through which holes were punched. A

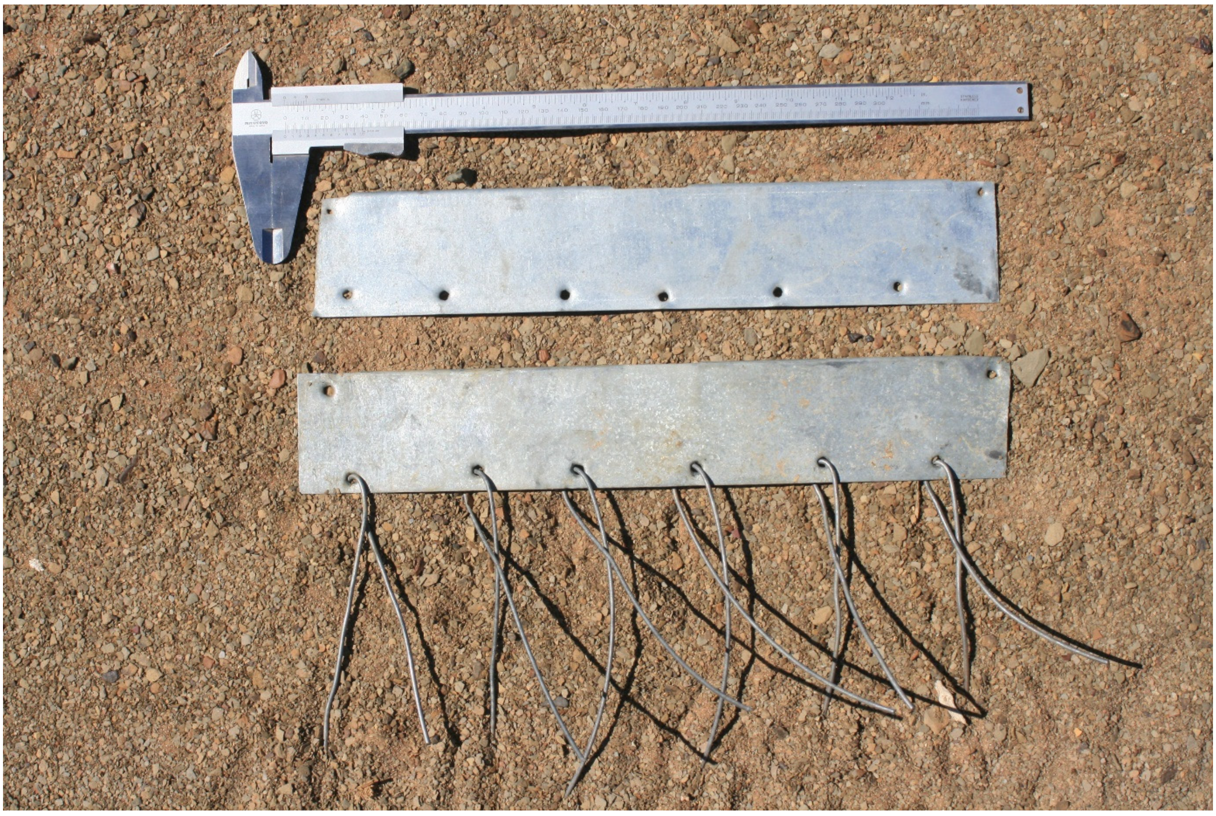

Figure 1: *Custom made swing gate consisting of a metal sheet skirting and wire curtain.*

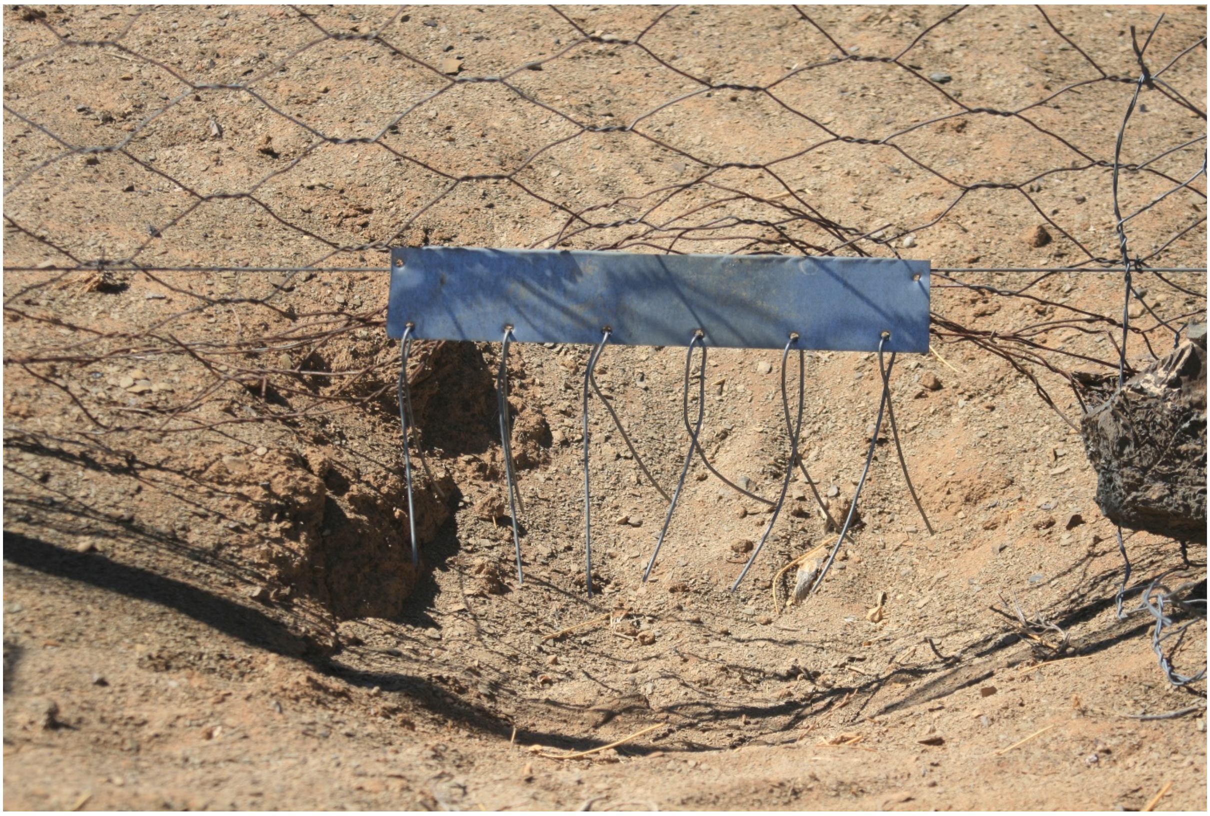

Figure 2: *Swing gate attached to the bottom wire strand of the boundary fence.*

'curtain' of wire strands hung loosely through these holes formed the swing gate action. Swing gates were then attached with a twist of wire to the lowest steel wire strand of the fence (Figure 2). The length of wire strands was determined by the depth of the burrow. Material costs and time to make and install these swing gates from farm scrap metal was minimal and an important consideration for this study. Swing gates were placed at the most active burrows as it was observed that burrowing species tend to frequent the same burrows, probably related to their foraging routes.

Camera trap monitoring

Two Bushnell Trophy Cam XLT trail cameras were placed adjacent to holes fitted with swing gates to document the movement of wildlife through the fence (Figure 3). The cameras were rotated to monitor various holes fitted with swing gates along the fence during the course of the study period. This was done in an opportune manner as dictated by circumstances and does not allow for formal statistical analysis.

Figure 3: *Camera trap set adjacent to a burrow fitted with a swing gate to document wildlife movement.*

Results and Discussion

Boundary fence holes

A total of 73 holes, dug by various species but mainly aardvark and aardwolf, were recorded on 3 May 2015 (Table 1). The number of holes under the fence decreased to 8 by 7 October 2015, an 89% decrease over approximately 5 months. This decrease in southern Namibia (Grünau area) is high compared with a 40% decrease in holes in the Otjiwarongo area (Schumann *et al*. 2006) and a 57% reduction in central Namibia (Weise *et al*. 2014) although similar to Piepmeyer's 70% reduction in burrowing holes in the Daan Viljoen Game Park to the west of Windhoek (Piepmeyer pers. com. 1999, in Schumann *et al*. 2006). This can probably be attributed to the substrate as the soils are typically sandy in the Otjiwarongo area while hard to the west of Windhoek and in the Grünau area. This is supported by Rust *et al*. (2014) who noted an increase in holes associated with sandy soils and/or after rains when the soils were softer.

Table 1: *Boundary fence burrow details during this study.*

Hole and swing gate details	Numbers and distances
Total holes: 3 May 2015	73
Total holes: 7 October 2015	8
Total holes reopened: Rock	31
Total holes reopened: Rock and mesh	28
Total new holes	26
Total length of fence	24.7 km
Average distance between holes: Start	338.4 m
Average distance between holes: End	3,087.5 m
Swing gates installed	22

The average number of holes encountered at the start of the study was one hole for every 338.4 m along the fence which decreased to one hole for every 3,087.5 m five months later (Table 1). This indicates that the main burrowing species (i.e. aardvark and aardwolf) made use of the swing gates rather than dig new holes with associated time and energy requirements. My personal observations suggest that aardvark and aardwolf probably have typical foraging routes which include 'favoured holes' and once these holes were not closed, but rather fitted with swing gates, they continued to use these holes, although the study was not designed to provide the data that would support this assumption. The use of swing gates is confirmed for various species such as aardvark, porcupine and warthog (Schumann *et al*. 2006). The use of tyres as a thoroughfare – effectively an open hole – by at least 18 mammal species, including black-backed jackal (Weise *et al*. 2014), makes the latter method futile when attempting to prevent predators accessing farmland.

Although not significantly different (p=0.96) slightly more holes were reopened when using rocks only as compared to holes closed with rocks and wire netting (31 and 28 respectively). Aardvarks are prodigious diggers and using rocks only or a combination of rocks and wire netting does not deter them from reopening such holes (Table 1). The rock and wire netting combination would probably deter most other digging species though and it is thus advisable to determine which species are responsible for the holes before deciding on the technique of closing these holes.

Burrowing species

Four species as identified from tracks and other tell-tale signs were responsible for reopening old holes (69%) or creating new holes (31%) during the course of this study. Aardvark (55%) and aardwolf (39%) were responsible for 94% of these (Figure 4). Aardvark have also been confirmed as prolific burrowers in other studies (e.g. Schumann *et al*. 2006, Rust *et al*. 2014, Weise *et al*. 2014) that also included porcupine and warthog in their data. Porcupine occur on farm Korhaan (albeit at low densities) with no evidence of them creating holes although potentially they could, but they probably make use of aardvark holes. Aardwolf is a known burrowing species and although present in the Otjiwarongo and Windhoek areas they were not deemed to be as active burrowers as warthog (e.g. Schumann *et al*. 2006, Weise *et al*. 2014). Aardwolf probably have higher densities in southern Namibia, consequently making them the second most active fence burrower observed during this study (Figure 4). Warthog do not occur in the Grünau area.

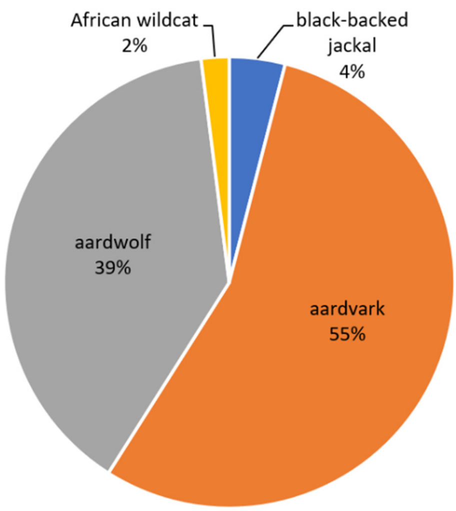

Figure 4: *Species responsible for creating burrows by reopening holes closed with rock and/or rock and mesh under boundary fences between 3 May and 7 October 2015 (n=85).*

Swing gates

A total of 22 swing gates were installed at an average of one swing gate for every 1,122.7 m along the fence (Table 1). The decrease in new holes by almost 90% over five months of investigation suggests that this method is a suitable option to address burrowing activity by indigenous wildlife. Swing gates should however be placed in areas with most or frequent activity for best results and not necessarily evenly spaced along a fence line. This is in accordance with Schumann *et al*.

(2006) who found that fences were damaged more by warthog close to water points. However, aardvark and aardwolf are water independent species (Richardson 1985, Skinner and Chimimba 2005) and the presence of water points is not expected to influence their movements through fences, although this was not tested during the present study.

Camera trap monitoring

Camera traps were only set to identify species using the swing gates and more importantly, to determine whether black-backed jackals made use of these structures. Nine species were confirmed using burrows fitted with swing gates on the farm: aardvark, aardwolf, African wild cat, bat-eared fox (*Otocyon megalotis*), Cape fox (*Vulpes chama*), Cape hare (*Lepus capensis*), porcupine, steenbok and striped polecat (*Ictonyx striatus*) (Figure 5). This is more than the three species (aardvark, porcupine, warthog) confirmed passing through swing gates by Schumann *et al*. (2006), and may be due to the design of the swing gates used on the farm being a lightweight and simple structure mimicking the local fence compared to the formal more robust design used by Schumann *et al*. (2006).

Figure 5: *(a) Cape hare; (b) aardvark; (c) aardwolf; (d) Cape fox; (e) striped polecat; (f) steenbok making use of various swing gates.*

Figure 6: *Black-backed jackal inspecting a swing gate and camera.*

Black-backed jackal are wary of novel items in their environment (Loveridge and Nel 2004). Although black-backed jackals were observed in the vicinity of the swing gates, probably investigating the camera (Figure 6), no images were collected of them using the swing gates. This indicates that during the study period at least, black-backed jackals were wary of the swing gates and consequently avoided those holes.

As black-backed jackal have few absolute dispersal barriers including electrified fences (Kerley *et al*. 2018), the use of swing gates should not be viewed as a panacea to preventing their access to commercial small livestock farms in Namibia. Swing gates have disadvantages as well, for example when the hanging curtain wires become dislodged or stuck in the wire netting, especially when aardvark pass through, the hole is left open. Swing gates do not prevent new holes from being dug by aardvark or aardwolf and allowing access to black-backed jackal; and black-backed jackal will eventually probably learn to use these swing gates as they are a highly flexible predator whose behaviour adapts to its environment (Nattrass *et al*. 2017). Excluding black-backed jackal from commercial farmland, rather than exterminating them along with the burrowing species providing them access to farmland would contribute to biodiversity conservation. Farmland, contrary to popular belief, is viewed as beneficial to some species not found in protected areas (Drouilly & O'Riain 2019). Furthermore, excluding black-backed jackal from farmland would also benefit springbok as their fawns are preyed upon by the species (Klare *et al*. 2010, Kamler *et al*. 2012), and farmers utilise springbok extensively for biltong/venison hunting as an additional source of income (Eloff 2001).

However, the biggest advantage is probably the decrease in fence maintenance activities. Although not quantified during this study, collecting rock, attaching mesh, shovelling in soil, etc. is labour-intensive especially on large farms with extensive boundary fences (pers. obs.). Swing gates also prevent the radical alternative followed by some farmers (pers. obs.) of exterminating aardvark and aardwolf to prevent them from opening holes for black-backed jackal.

It is important to exclude black-backed jackal from livestock farms because once they become resident they exhibit a feeding preference for goats and sheep over similar size wild mammal prey (Drouilly *et al*. 2017). There is no single method of effectively addressing the issue. For best results a combination of techniques, including swing gates but also the active control of these predators once established, should be used to limit black-backed jackal access to farms.

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