Vulture rescue and rehabilitation in South Africa: An urban perspective

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ABSTRACT
South Africa is home to 9 vulture species, of which 7 are endangered. While the cause of the population declines remains largely speculative, a vast amount of effort has been dedicated towards the protection of populations by ensuring sustainable and safe food sources for the various colonies. Limited focus was placed in the past on efforts related to the rescue and rehabilitation (R&R) of injured birds and the release of these birds back into the wild. This paper provides an overview of the causes, the impact and success of 3 organisations involved in R&R efforts of vultures in the Magaliesberg mountain range and surrounding areas over a period of 10 years. Study material included 162 Cape griffon (CGV) and 38 African white-backed (AWBV) vultures. Datasets include the number, sex and age of birds received, the reason the vultures were brought in for R&R, surgical interventions performed and outcomes of rescue efforts. The CGV dominated the rehabilitation attempts. Results further show that a large number of apparently healthy birds were presented for veterinary treatment. The R&R data clearly indicate that the major cause of injuries was birds colliding with overhead pylons, as a high number of soft tissue and skeletal injuries were observed. The study also shows that successful releases of rescued birds are possible. It is concluded that urbanisation has had a major negative impact on vultures around the Magaliesberg mountain range.

Keywords: African white-backed vulture, Cape griffon vulture, Gyps, Magaliesberg, rehabilitation, rescue, vultures.

INTRODUCTION
Vultures are characterised by their large size, large featherless heads, curved beaks and are known for being high fliers3,11. They are further differentiated from other raptors by being predominantly carrion feeders that only resort to predation in times of extreme food shortages5,13,17. Being scavengers, vultures are important components of healthy ecosystems where their major contributory ecological role is to devour carcasses thereby preventing the spread of diseases8,14,17,24. The family is made up of the old-world (accipitrid) and the new-world (cathartid) vultures with the former, also known as griffon vultures, being the true descendants of the vulture species. The latter, such as the condor and black vulture, have evolved from the stork family5,30. Despite their important role in ecosystem health, vulture numbers throughout the world have declined at a rapid rate with southern Africa being no exception, having 7 of the 9 species listed in the Red Data Book4,5,12,14,15,17,24,29.

Of the 9 vulture species in southern Africa, the Cape griffon vulture (Gyps coprotheres) (CGV) and the African white-backed vulture (G. africanus) (AWBV), are the most abundant, with the latter being near-endemic only to this region5,30. The CGV is currently listed as vulnerable and the AWBV near-threatened with the latest estimates placing the AWBV at 270 000 individual birds in Africa and the CGV at approximately 4000 breeding pairs in southern Africa2. While the AWBV and CGV are of markedly different size (5.5 kg versus 9 kg), the species share a number of similarities that include lifetime pairing, breeding once a year with on average the production of 1 egg per year2. Phylogenetic studies suggest that the 2 species are genetically closely related25. Unconfirmed reports from Namibia suggest interbreeding between the 2 species to produce hybrids (Rare and Endangered Species Trust (REST), Namibia, pers. comm.). The only major difference between the 2 species is their nesting sites as the CGV nests on cliff faces while the AWBV prefers nesting in trees.

Both species face major threats within the southern African region that include poisoning, electrocution, power-line collisions, habitat destruction, insufficient food resources, disruption of breeding sites and the illegal collection of body parts for traditional medicine24,30,31,17,20. In an effort to prevent the decline in the number of birds, various initiatives to contribute to the conservation of the species were put in place. One of these initiatives is the so-called vulture restaurant, which in collaboration with the local farming community provide carcasses to vultures to supplement their food resources7,20. Other efforts include educational material such as posters and booklets advising farmers on the use of eco-friendly products and creating awareness around vulture poisonings, attempts by the national energy provider (ESKOM) to research and erect vulture-friendly pylons, the promotion of vulture ecotourism and the rescue and/or rehabilitation (R&R) of injured or poisoned birds collected in the field. This paper focuses on the causes, the impact and successes of rescue and/or rehabilitation (R&R) efforts of birds as a valid component of vulture conservation in southern Africa in a semi-urban environment.

MATERIALS AND METHODS

Study area
The study area in Pretoria and the Magaliesberg range is semi-urban and under intense housing development, e.g. a major golfing estate is present 1.5 km from a major breeding area on the Magaliesberg cliffs (Figs 1 and 2). This area is home to 10 % of the total CGV population and includes approximately 400 breeding pairs on the cliffs2. AWBV's are not known to breed within the study area.
Participating organisations

The 3 organisations that contributed data to this study are the De Wildt Cheetah and Wildlife Trust (De Wildt), the National Zoological Gardens of South Africa (NZG) and the Vulture Programme of the Rhino and Lion Wildlife Conservation NPO (R&L). While undoubtedly vulture rehabilitation is occurring throughout the country, there was a concerted effort by these organisations to dedicate vulture conservation in the region. For the purposes of this study, rehabilitation was defined as the process of restoring sick or injured birds to a normal life by therapy and ensuring fitness prior to final release back into the wild. Rescue is similarly defined as rehabilitation, except that these birds were not released into the wild. The former was ascertained as a result of the tagging process which allowed for the resighting of released birds. To obtain an understanding of the management of the birds during rehabilitation, a description of each of the facilities follows:

De Wildt Cheetah and Wildlife Trust (De Wildt)

De Wildt focuses on cheetah conservation and breeding. In addition, endangered species such as the African wild dog and vultures are part of the collection. Vultures at this facility include CGVs (n = 50) and AWBV's (n = 8) that are housed in five 5 m × 10 m × 3 m (L × B × H) aviaries. The facility has housed birds for nearly 20 years, with animal record keep-
ing extending back to 2002. Data are captured into a purpose-built Office Excel (MS Office) spreadsheet. Individuals of both vulture species were presented to the facility for rehabilitation and were either collected by De Wildt staff from the Magaliesberg colony and surrounding areas or received from outside organisations where more advanced veterinary care was lacking.

Veterinary care of injured birds was provided by a full-time veterinarian at an on-site veterinary clinic. Injured birds were housed in individual pens until released into the wild. For specialised veterinary procedures, assistance was provided by the Exotic Animal Clinic at the Onderstepoort Veterinary Academic Hospital (OVAH) run by the Faculty of Veterinary Science of the University of Pretoria. In most cases, after receiving specialist care, vultures were returned to De Wildt facility for after-care.

National Zoological Gardens of South Africa (NZG)

The NZG has a record of housing, conserving and exhibiting wildlife that extends over 100 years. The facility has a large aviary (30 m x 20 m x 5 m) (L x B x H) housing both CGV and AWBV. The aviary mimics a natural environment with a number of natural trees as well as a raised cliff with ledges suitable for breeding. Birds presented to the facility for rehabilitation originated from collections made by NZG staff and the public from the Magaliesberg colony and surrounding areas. In addition, the organisation accepted AWBVs as well as CGVs from their satellite facility in Lichtenburg which has an active vulture restaurant extending back to 2002. Data are captured into a purpose-built Office Excel (MS Office) spreadsheet. Individuals of both vulture species were presented to the facility for rehabilitation and were either collected by De Wildt staff from the Magaliesberg colony and surrounding areas or received from outside organisations where more advanced veterinary care was lacking.

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Results

Vulture Programme of the Rhino and Lion Wildlife Conservation NPO (R&L)

The R&L was established in 2006 with the aim of adding an important conservation component to vulture rehabilitation, especially investigating the survival rate of newly released rehabilitated vultures. The facility has a number of different enclosures of various sizes, all of which are fitted with perches. The largest of the enclosures (40 m x 9 m x 7 m) (L x B x H) was sponsored by Eskom and enables the birds to fly to some extent to increase their fitness prior to release. Birds presented to the facility for rehabilitation were either collected by staff from the Magaliesberg colony or surrounding areas whereas mainly AWBVs requiring more advanced veterinary care were accepted from other organisations.

The facility also has 6 enclosures (3 m x 3 m x 6 m) (L x B x H) for the housing of individual injured or sick birds while recuperating. All veterinary treatments are provided by the OVAH or the Veterinary Department at the Johannesburg Zoological Gardens. All birds kept or released are identified using patagial tags on each wing (Fig. 3). The tags have visible numbers as well as contact details to facilitate monitoring. This facility follows a strict release protocol by returning birds they personally collect to the wild within 7 days of recovery after receiving treatment.

Data collection

Data collected include the number, sex and age (adult, subadult and juvenile, nestlings) (Table 1) where possible for all birds received for rehabilitation. Injuries were classified as soft tissue or skeletal injuries (fractures), exhaustion or poisoning. Surgical interventions where necessary were described as amputations (removal of 1 or both wings), fracture repair (surgical pinning), birds that died during surgery (anaesthetic death) and birds euthanased for ethical or welfare reasons. The outcome of rehabilitation was assessed as the number of birds released. Data were collated from the patient records maintained by the respective organisations over the specified 10-year period and presented as the number and percentage of birds handled by each organisation.

The same method for determining the age of vultures widely used by the vulture fraternity (although not statistically validated), was applied by all 3 facilities. This method makes use of external characteristics listed in Table 1. The De Wildt and R&L birds were sexed according to the general morphological characteristics of the head (non-validated method). Females have a narrow head (as seen from the lateral canthus of the eyes) with egg-shaped dome at the top of the skull, while the males have a more triangular, flattened head with more prominent eye sockets (Fig. 4). The NZG makes use of laparoscopy and more recently DNA technology using Polymerase Chain Reaction (PCR) to determine sex. Genomic DNA was isolated from blood collected in EDTA tubes using the Qiagen DNAeasy Blood and Tissue kit. Amplification of the CHDI gene was conducted using primer sets: 2580F: 5'-GTCTCGTGTCTACAGA-3' and 2718R: 5'-ATT GAAATGTATCCAGTGCTTG-3' . PCR amplification was carried out in a total volume of 25 µl and included a no-template control as well as positive controls for a male and female bird of known sex. PCR was conducted with Promega goTag DNA polymerase®, which has a 1 x buffer containing 10 mM Tris® HCl (pH 9.0), 50 mM potassium chloride (KCI) and 0.1 % Triton® X 100. The final reaction conditions were as follows: 1 x PCR buffer, 1.5 mM MgCl2, 200 µM of each 2 deoxynucleotide triphosphate (dNTP), 5 pico mol (pmol) of each of the forward and reverse primer, 0.25 units (U) Taq DNA polymerase and 10 ng genomic DNA template. PCR cycling were as follows: Denaturation for 2 minutes (min) at 94 °C, followed by 30 cycles of denaturation for 30 seconds (s) at 94 °C, primer annealing for 30 s at 50 °C and extension for 2 min at 72 °C, followed by final extension at 72 °C for 10 min. PCR products were added to tracking dye and were separated by electrophoresis in a 2 % agarose gel for 45 min at 100 volts in 1 x Tris-Borate-Edta buffer (TBE).

Results

A total of 163 CGVs and 38 AWBVs were received during the specified period by the 3 organisations. Age distribution for the CGV showed that 43.5 % were adults, 1.2 % subadult, 44.7 % juveniles and 9.4 % nestlings. The AWBV had a very similar distribution of adults and juveniles at 41.18 % and 47.6 % respectively. The sex ratios was evenly distributed for the CGV, and skewed towards males for the AWBV (Table 2).

De Wildt attempted rehabilitation of 85 (52.5 %) of the CGVs, mainly adult males (Table 2). The majority of the CGVs (n = 33) collected were recorded as power lines or pylon injuries which resulted in soft tissue injuries and in more severe cases, in fractures and ultimately amputations (Tables 3 and 4). In total, 26 of the 33 CGVs presented from power-line injuries required more advanced surgical intervention (Table 4). It is also interesting to note that a large proportion of birds were presented for minor reasons such as apparent exhaustion (n = 27) or birds picked up following heavy rain (n = 22). A total of 17 (52.5 %) AWBVs were

collected, most of which were adult males (Table 2). Of these, 10 were presented as a result of power-line injuries and the rest were mainly healthy with the exception of 1 chick which had fallen from a nest (Table 3). A large percentage of the AWBVs presented with injuries that required surgical interventions. This high incidence is most likely attributable to birds requiring advanced veterinary care that were collected from outside the Gauteng and North West Provinces by rehabilitation agencies. One bird was brought in for organophosphate poisoning. This specific vulture was treated with fluids and atropine and eventually recovered. In total 40 (47.1 %) CGVs and 3 (17.6 %) AWBVs were ultimately released and the rest remained in captivity (Table 5).

The NZG received a total of 32 (19.8 %) CGVs comprising 94 % adult birds of which most were males. Injuries were mainly due to suspected pylon collisions as the birds were found on the ground in close proximity to power lines (Tables 2 and 3). The NZG released 2 CGVs following treatment (Table 5). The AWBVs presented to the NZG were mainly healthy birds received from welfare organisations (Tables 2 and 3). One of the AWBVs was diagnosed with skeletal abnormalities (cortical thinning with decreased radio density) that were consistent with a calcium deficiency. The other was brought in due to a pylon injury and the 3rd was rescued after being kept as an exotic pet. The latter had its wings clipped and was not able to fly. There is no history as to how the wild bird ended up as a pet. None of the AWBVs required surgical intervention for their rehabilitation (Table 4).

The R&L accounted for 45 (27.8 %) and 10 (26.3 %) of the CGVs and AWBVs respectively, comprising mainly juveniles and nestlings. Of this a large number were received after rainy conditions which also explains the high percentage of unknown sexes for the CGV at R&L (Table 2). Although 66 % of the CGVs were received due to an inability to fly, no detectable anatomical injuries were found on clinical examination (Table 3). These birds recovered within 2–3 days after having been fed. Seven birds had to be euthanased due to severe wound contaminations and severe complications (myiasis and bacterial infection) (Table 3). In 1 incident 6 AWBVs were presented for suspected arsenic poisoning. These birds originated from a colony of 15 birds of which 9 were found dead (dead birds are not included in this study). Arsenic poisoning was diagnosed from necropsy results which showed haemorrhagic
gastroenteritis, clinical signs of excitability of the live birds and recovery following treatment with penicillamine. The R&L released a total of 21 of the 45 (46.7 %) rehabilitated CGVs and 7 of the 10 AWBVs (70 %) (Table 5).

DISCUSSION

The aim of this study was to describe the efforts to rescue and/or rehabilitate vultures in the Magaliesberg area of South Africa by 3 organisations. Although the AWBV is the most abundant vulture species in southern Africa, rehabilitation was dominated by the CGV within the 3 centres. This most likely reflects a difference in the behaviour of the 2 species, in that the AWBV nests in trees, and the CGV on cliffs. The Magaliesberg mountain range running through the greater Pretoria area and Gauteng region provides ample nesting opportunities for the CGV.

In total, 63 (38.9 %) CGVs and 10 (26.3 %) AWBVs were rehabilitated, while 68 (42.0 %) CGVs and 25 (65.8 %) AWBVs were retained in captivity. The reason for the greater skew towards retaining a bird in a captive environment stems from the huge responsibility and effort that rehabilitation requires. For rehabilitation, the

Fig. 3: Adult Cape griffon vulture with a patagial tag on the right wing, metal ring on the right leg and a telemetric tracker on the back. The picture illustrates the ease of identification that the patagial tags offer over conventional rings, especially at distance.

Fig. 4: Illustration of the morphological differences between male (A1 & A2) and female (B1 & B2). Female heads are typically longer (B1) and narrow (B2), while the male heads are shorter (A1) and broader (A2).
The study was the large number of apparently healthy birds presented for treatment after heavy rains. The flight feathers of the birds appear to be water-logged and these birds are unable to take off after heavy rains, which is believed to have resulted from a combination of the birds being overweight from the constant feeding at vulture restaurants (14 kg has been recorded for this region for CGV dry weight) and the feathers soaked with water. The latter is not an oddity as the popular press commonly reports waterlogged feathers as a major obstacle to flight.

When the increased weight from excessive caloric intake is combined with the flight behaviour of vultures, an interesting aerodynamic challenge is faced by birds – already being heavy fliers, vultures are predominantly reliant on thermal currents for take-off, soaring and mobility in an attempt to conserve energy to compensate for their weight to energy/aerodynamic requirements for flight. The added burden of being overweight in combination with the additional weight of the water interferes further with their flight characteristics. Unfortunately this also translates to non-flight in the absence of thermal currents, which restricts soaring to mid-mornings when the first thermals arise, i.e., vultures are rarely seen soaring on days characterised by overcast and cool conditions. Healthy vultures presented on rainy days also suggest that the birds were grounded and unable to fly as opposed to being injured or dehydrated. This highlights an added danger that vulture colonies have to face because of a close association with human habitation. It is likely that this would not occur in the wild and that the birds would normally return to their roosts if provided with sufficient time to fly again.

Another explanation for their non-flight may be mild poisoning that resulted from

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**Table 2:** The number, age and sex of birds that were presented for rehabilitation. Values in brackets are percentages.

<table>
<thead>
<tr>
<th>Organisation</th>
<th>n</th>
<th>Sex</th>
<th>Age</th>
<th>Compromised*</th>
<th>Poisonings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gyps coprotheres (CGV)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DeWildt</td>
<td>85 (52.47)</td>
<td>38 (63.33)</td>
<td>34 (61.82)</td>
<td>13 (27.66)</td>
<td>37 (52.11)</td>
</tr>
<tr>
<td>R&amp;L</td>
<td>45 (27.78)</td>
<td>5 (8.33)</td>
<td>9 (16.66)</td>
<td>31 (65.96)</td>
<td>4 (5.63)</td>
</tr>
<tr>
<td>NZG</td>
<td>32 (19.75)</td>
<td>17 (28.33)</td>
<td>12 (21.82)</td>
<td>3 (6.25)</td>
<td>30 (42.25)</td>
</tr>
<tr>
<td>Total</td>
<td>162</td>
<td>60</td>
<td>55</td>
<td>47</td>
<td>71</td>
</tr>
</tbody>
</table>

| Gyps africanus (AWBV) |   |     |     |              |            |
| DeWildt | 17 (44.74) | 9 (47.37) | 3 (27.27) | 5 (62.50) | 7 (33.33) |
| R&L     | 10 (26.32) | 5 (26.32) | 4 (36.36) | 1 (12.50) | 3 (14.29) |
| NZG     | 11 (28.95) | 6 (26.32) | 4 (36.36) | 2 (25.00) | 11 (52.38) |
| Total   | 38 | 19 | 11 | 8 | 21 |

R&L: Rhino & Lion Wildlife Conservation Non-Profit Organisation; NZG: National Zoological Gardens of South Africa.

*Birds unable to fly due to unknown causes.
their feeding on a contaminated carcass. The 1 group of toxins that could explain the clinical signs observed are the organophosphors, which are known to be inducers of muscle weakness. For the past 20 years the NZG has received a number of raptors, ranging from owls, hawks, eagles and 1 vulture (n = 28) which presented either in a state of collapse or with mild symptoms of incoordination and general weakness. Symptomatically it was suspected that these birds had ingested poison, but this was never confirmed by laboratory tests. Some birds recovered well with treatment and feeding and others died, but post mortem results were inconclusive of poisoning. A white-backed vulture that had collapsed and had head tremors recovered dramatically after it was treated with atropine. It is therefore speculated that general weakness in vultures could be due to ingestion of low doses of a toxin.

The rehabilitation data clearly indicate that pylons were the major cause of injuries as demonstrated by the high number of soft tissue and skeletal injuries observed. It is speculated that this may be due to the inability of the birds to see power lines, as seen in other bird species, combined with the likelihood that they are unable to gain sufficient altitude rapidly enough to avoid power lines near their foraging sites. In total, 61 (38 %) CGVs and 16 (42 %) AWBV were presented with these injuries. These observations therefore tend to support the earlier reported observations that the population declines of the CGV may be attributed to pylon injuries, but this is not necessarily the only cause.

Concerning the higher number of releases of rehabilitated vultures by the R&L and De Wildt, it is clear that successful release of the rehabilitated birds is possible. More importantly, it emphasises that contrary to popular belief, vultures do not immediately imprint on handlers. When the release data of R&L were evaluated for any correlation between duration within a capture enclosure to release (results not shown), none was found. Nonetheless, the release data need to be interpreted with care, as success is defined within a few days. The GPS trackers also to a large extent overcome the shortcomings of patagial tags that may not be sighted as a result of death, non-movement through a monitoring point or loss of the tag.

**CONCLUSIONS**

With the huge inputs and dedication by various organisations, there is now a better understanding of the causes, impact and success of R&R of vultures. Of concern are the rehabilitation figures from De Wildt and R&L, which account for more than 120 birds out of a colony of just under 380 breeding pairs (17 % of the total population required medical attention) recorded over the last 10 years. This study provides 1st evidence of the impact urbanisation has had on vultures from the Magaliesberg and surrounding areas. While the data clearly indicate that rehabilitation efforts are required, they may not necessarily be having their desired

Table 4: Number of birds in which surgery was attempted by the different organisations. Values in brackets are percentages.

<table>
<thead>
<tr>
<th>Organisation</th>
<th>n</th>
<th>Amputations</th>
<th>Fracture repair</th>
<th>Died during surgery</th>
<th>Euthanased due to poor prognosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>DeWildt</td>
<td>26</td>
<td>15 (83.33)</td>
<td>11 (57.89)</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>R&amp;L</td>
<td>11</td>
<td>1 (5.56)</td>
<td>3 (15.79)</td>
<td>0</td>
<td>7 (100)</td>
</tr>
<tr>
<td>NZG</td>
<td>8</td>
<td>2 (11.11)</td>
<td>5 (26.32)</td>
<td>1 (100)</td>
<td>0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>43</td>
<td>18</td>
<td>19</td>
<td>1</td>
<td>7</td>
</tr>
</tbody>
</table>

Table 5: Different outcomes of the rehabilitated birds. Values in brackets are percentages.

<table>
<thead>
<tr>
<th>Organisation</th>
<th>n</th>
<th>Released</th>
<th>Kept in captivity</th>
<th>Traded</th>
<th>Euthanasia</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Gyps coprotheres (CGV)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DeWildt</td>
<td>85</td>
<td>40 (63.49)</td>
<td>38 (55.88)</td>
<td>6 (35.29)</td>
<td>1 (7.14)</td>
</tr>
<tr>
<td>Rhino and Lion</td>
<td>45</td>
<td>21 (33.33)</td>
<td>10 (14.71)</td>
<td>2 (11.76)</td>
<td>12 (85.71)</td>
</tr>
<tr>
<td>NZG</td>
<td>32</td>
<td>2 (3.17)</td>
<td>20 (29.41)</td>
<td>9 (52.94)</td>
<td>1 (7.14)</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>162</td>
<td>63</td>
<td>68</td>
<td>17</td>
<td>14</td>
</tr>
</tbody>
</table>

| **Gyps africanus (AWBV)** |
| DeWildt                 | 17   | 3 (30.00) | 14 (56.00)        | 0       | 0          |
| Rhino and Lion          | 10   | 7 (70.00) | 2 (8.00)          | 1 (33.33)| 0          |
| NZG                     | 11   | 0         | 9 (36.00)         | 2 (66.67)| 0          |
| **Total**               | 38   | 10        | 25                | 3       | 0          |

R&L: Rhino & Lion Wildlife Conservation Non-Profit Organisation; NZG: National Zoological Gardens of South Africa.
impact, as the percentage of released birds remains relatively low (47.1 % for CGV and 17.6 % for AWBV). Nonetheless, the true value of rehabilitation efforts is their ability to protect the species, as even a single bird that is saved represents continued maintenance of genetic diversity within the threatened population.

ACKNOWLEDGEMENTS

Our sincere gratitude to our sponsors namely: Rand Merchant Bank, Computer Facilities, Tony & Lisette Lewis Foundation, Lomas Wildlife Protection Trust, Eskom, Aberdare Cables and Natural Encounters Inc., as well as veterinarians and volunteers who have participated in the vulture rehabilitation efforts. We would also like to acknowledge the relevant provincial agencies for their support towards this effort.

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