

THREATENED SPECIES SCIENTIFIC COMMITTEE

Established under the *Environment Protection and Biodiversity Conservation Act 1999*

The Minister approved this Conservation Advice and included this species in the Vulnerable category, effective from 15/08/2017

Conservation Advice

Phascogale tapoatafa kimberleyensis

Kimberley brush-tailed phascogale

Note: The information contained in this conservation advice was primarily sourced from 'The Action Plan for Australian Mammals 2012' (Woinarski et al., 2014) and the Western Australian Department of Parks and Wildlife. Any substantive additions obtained during the consultation on the draft have been cited within the advice. Readers may note that conservation advices resulting from the Action Plan for Australian Mammals show minor differences in formatting relative to other conservation advices. These are reflective of the desire to achieve efficiency over preparation of a large number of advices by adopting the approach of the Action Plan for Australian Mammals in presentation of information and do not reflect any difference in the evidence used to develop the recommendation.

Taxonomy

Conventionally accepted as *Phascogale tapoatafa kimberleyensis* (Aplin & Rhind 2015). Two other geographically disjunct subspecies are recognised: *P. t. tapoatafa* (eastern brush-tailed phascogale) and *P. t. wambenger* (south-western brush-tailed phascogale).

The brush-tailed phascogale (*P. tapoatafa*) is closely related to the northern brush-tailed phascogale (*P. pirata*), which occurs in the top end of the Northern Territory.

Summary of assessment

Conservation status

Vulnerable: Criterion 2 B2 (a),(b)(i-v)

Species can be listed as threatened under state and territory legislation. For information on the listing status of this species under relevant state or territory legislation, see <http://www.environment.gov.au/cgi-bin/sprat/public/sprat.pl>

Reason for conservation assessment by the Threatened Species Scientific Committee

This advice follows assessment of new information provided to the Committee to list *Phascogale tapoatafa kimberleyensis*.

Public consultation

Notice of the proposed amendment and a consultation document was made available for public comment for 40 business days between 30 September 2015 and 25 November 2015. Any comments received that were relevant to the survival of the species were considered by the Committee as part of the assessment process.

Species/subspecies information

Description

The brush-tailed phascogale is uniformly grizzled grey above, and cream to white below. Its ears are large and bare. It has a conspicuous black 'bottle-brush' on the distal two-thirds of the tail, on which the hairs grow to 55 millimetres long (Soderquist & Rhind 2008).

The Kimberley subspecies (*P. t. kimberleyensis*) differs from the eastern subspecies (*P. t. tapoatafa*) externally with shorter, crisper and generally paler fur above, more extensive cream fur below, a relatively shorter tail, a more boldly patterned face with contrasting cream muzzle and cheek, and probable lower number of teats. The south-western subspecies (*P. t. wambenger*) also differs from the Kimberley subspecies externally, with lusher fur and generally darker colouration above, grey-based fur below, a much narrower zone of contrasting pale fur on the inside of the fore- and hind-limbs, a preauricular patch rarely developed, a relatively longer tail with more extensive furring of the base and longer 'brush,' much larger ears, and an inner metatarsal pad smoothly united with first interdigital pad (Aplin et al., 2015).

Distribution

The Kimberley brush-tailed phascogale originally occurred in coastal and near coastal areas in the tropical north from Kalumburu to Broome. Its current status in the Kimberley is unclear as there have been very few recent records despite numerous surveys: it has been recorded at only three localities since 1910 (Yampi Peninsula, Mitchell Plateau, Mt Hart in the King Leopold Ranges), all of which were recorded in the past 25 years. It has not been located on Kimberley islands (Gibson & McKenzie 2012). This small number of records is despite very considerable mammal survey effort in the Kimberley over the past decade. Although these surveys have not been designed to target this subspecies, the surveys (and associated research programs) have included substantial deployments of camera traps, which are a more appropriate trapping technique for phascogales than traditional box traps.

Relevant biology/ecology

There is little information on the ecology of the brush-tailed phascogale in the Kimberley. However, based on vegetation mapping and habitat requirements of other phascogale species, the Kimberley brush-tailed phascogale is likely to require woodlands dominated by *Eucalyptus* and *Corymbia* species with old and dead trees that have suitable nesting hollows (DPaW 2016). The records are located on a variety of bunch grasslands with a savanna woodland structure dominated by *E. tetradonta* (Darwin stringybark), *C. dichromophloia* (small-fruited bloodwood), *E. tectifera* (Darwin box), *C. ferruginea* (rusty bloodwood), *E. brevifolia* (northern white gum), *E. phoenicea* (scarlet gum); and in tropical forest woodlands dominated by Darwin stringybark and woollybutt (*E. miniata*) (DPaW 2016). Surveys on Yampi Peninsula that detected the species were always associated with woollybutt woodland (T. Willing pers. comm., cited in DPaW 2016). On the Mitchell Plateau the subspecies was observed in an area consisting of relatively tall *E. miniata*/*Corymbia nesophila* forest with high canopy cover (32–46% projected canopy cover) and a high number of old growth trees with multiple tree hollows (estimated 54 hollows per hectare) (I. Radford pers. comm., 2016).

Studies of the brush-tailed phascogale in southern Australia show that this is the most arboreal species of the dasyurid marsupials, seldom feeding on the ground. Its diet predominantly consists of invertebrates found on or under bark, but nectar is also taken and appears to be a particularly prized but rare and patchy food source (Scarff et al., 1998). An agile hunter, it can leap up to 2 m between tree branches or trunks. It is nocturnal and shelters in tree hollows during the day. Home ranges in females can typically be 20–40 ha, while male home ranges may be greater than 100 ha. However, home ranges can be much smaller in high quality forest (van der Ree et al., 2001).

Rhind (2002) reported that, in south-western Australia, habitat quality was correlated with body size suggesting food is a normally limiting resource for this species in this environment. The largest phascogales were routinely found in swamp and gully systems. Growth and survival of dependent young seemed poor during a drought (food-poor) year. In that year maternal mortality appeared high during late lactation as orphaned, unweaned young were encountered in nest boxes. Subsequently, adult males grew to be 25% less in mass than usual; females 15% less. Population decline followed with capture rates one-third of that typically found for the time of year. Recovery was not apparent until two years after drought. In this food-limited environment phascogale populations appear particularly vulnerable to decline due to annual fluctuations in rainfall.

Both sexes breed at one year of age and generation length is assumed to be one year (Woinarski et al., 2014). In south-eastern Australia, breeding occurs from May and July and females give birth to 3 – 8 young (Cuttle 1982, Soderquist & Serena 1994). The species exhibits male semelparity and all males die after their first breeding season (Rhind 1992; Cuttle 1982; Soderquist & Ealey 1994; Rhind 2002; Menkhorst et al., 2008). In captivity males may survive for up to three years, but are sexually senescent after the first year. In the wild females can breed for two years but reproductive success varies, with significant female deaths while lactating in some areas (Soderquist 1993a, b).

Threats

The Kimberley brush-tailed phascogale is mainly threatened by inappropriate fire regimes and feral cats (*Felis catus*), and its distribution in isolated subpopulations may make it more vulnerable to local extirpation from these threats. Sparse densities, fluctuating reproductive success and annual male die off means an isolated subpopulation that fails to reproduce in one year will fail (Soderquist & Rhind 2008). The south-western subspecies competes for suitable nesting hollows with feral honeybees and other arboreal species (possums), bats, carpet pythons and hollow-nesting birds (DPaW 2016); feral honeybees may be an issue for the Kimberley subspecies.

Threats to the Kimberley brush-tailed phascogale are outlined in the table below (Woinarski et al., 2014).

Threat factor	Consequence rating	Extent over which threat may operate	Evidence base
Extensive and high intensity fires	severe	entire	Extensive and high intensity fires, which became increasingly common in the Kimberley from the 1990s, reduce both hollow and food availability, in particular nectar (Vigilante & Bowman 2004). Fires may also increase predation by feral cats and indigenous predators, by reducing cover. However, fire regimes have been improving within the subspecies' range over the past few years due to a number of landscape-scale fire projects.
Predation by feral cats	moderate-severe	entire	Feral cats are a major cause of failure in two of three releases of brush-tailed phascogales in Gippsland (Soderquist 1994). 30 out of 165 sightings (of living and dead animals) of the south-western subspecies were made because cats had killed the phascogale. It is possible that cats prey on individuals more keenly when the phascogales are weakened by breeding or food shortages (DPaW 2016).
Poisoning by cane toads (<i>Rhinella marina</i>)	unknown (possibly severe)	minor currently, but entire by c. 2020	There is no direct evidence for this subspecies, but there is some circumstantial evidence for impacts on the similar northern brush-tailed phascogale (<i>P. pirata</i>) in the Northern Territory.

How judged by the Committee in relation to the EPBC Act criteria and regulations

Criterion 1. Population size reduction (reduction in total numbers)			
Population reduction (measured over the longer of 10 years or 3 generations) based on any of A1 to A4			
	Critically Endangered Very severe reduction	Endangered Severe reduction	Vulnerable Substantial reduction
A1	≥ 90%	≥ 70%	≥ 50%
A2, A3, A4	≥ 80%	≥ 50%	≥ 30%
<p>A1 Population reduction observed, estimated, inferred or suspected in the past and the causes of the reduction are clearly reversible AND understood AND ceased.</p> <p>A2 Population reduction observed, estimated, inferred or suspected in the past where the causes of the reduction may not have ceased OR may not be understood OR may not be reversible.</p> <p>A3 Population reduction, projected or suspected to be met in the future (up to a maximum of 100 years) [(a) cannot be used for A3]</p> <p>A4 An observed, estimated, inferred, projected or suspected population reduction where the time period must include both the past and the future (up to a max. of 100 years in future), and where the causes of reduction may not have ceased OR may not be understood OR may not be reversible.</p>	<p>based on any of the following:</p> <ul style="list-style-type: none"> (a) direct observation [except A3] (b) an index of abundance appropriate to the taxon (c) a decline in area of occupancy, extent of occurrence and/or quality of habitat (d) actual or potential levels of exploitation (e) the effects of introduced taxa, hybridization, pathogens, pollutants, competitors or parasites 		

Evidence:

Insufficient data to determine eligibility

There are very few records of the Kimberley brush-tailed phascogale, despite considerable survey effort (using several types of traps) for mammals in the north-western Kimberley over the past 30 years. Camera trapping has been undertaken in the King Leopold Ranges, the Artesian Range, the Mitchell Plateau, and near the historical records at Drysdale River and Prince Regent River, by the WA State government, Indigenous ranger groups, private landholders and Non-Government Organisations (NGOs). Capture rates for the subspecies have been extremely low; it is possible that targeted surveys are required to detect this species. Alternatively, the paucity of records may indicate very low abundance in the region. The subspecies may have always been rare, at least in parts of the former range; in the 1890s only a single specimen was collected from Roebuck Bay, Broome, over a collecting period of five months, when other (now rare or regionally extinct taxa) were reported as common (Dahl 1926).

There are no robust estimates of population size or trends. However, surveys indicate a decline in occurrences, and distribution, over the past 30 years (DPaW 2016):

Dampier Peninsula

- Single specimen collected in 1896 (Dahl 1926); no reports of the subspecies on the Dampier Peninsula since then.

King Leopold Ranges to Kimbolton (Yampi):

- In 2008, an individual was trapped on the Yampi Peninsula during wildlife surveys conducted by the Department of Defence (T. Sonneman pers. comm., March 2016, cited in DPaW 2016). Over the summer of 2016–2017 seven individuals were recorded at Yampi during Australian Wildlife Conservancy (AWC) surveys: four on camera traps, and three during spotlighting at Kimbolton homestead.

- There has been a recent sight record from Mt Hart in the King Leopold Ranges (S. Craswell pers. comm., cited in Woinsarski et al., 2014).
- The subspecies has not been found despite extensive survey and research effort at AWC sanctuaries within the presumed EOO (Morrington, Charnley River) (A. James pers. comm., cited in DPaW 2016).

North Kimberley:

- Surveys during the 1970s and 1980s in the north and south-west Kimberley recorded the subspecies in some isolated areas (McKenzie 1981; Start et. al., 2007; Bradley et. al., 1987).
- A 2003–2004 study did not trap any individuals in areas of the north Kimberley where it had previously been recorded (Start et. al., 2007).
- In recent years, no phascogales were detected by DPaW on camera traps at a site at Mitchell Falls where they were previously recorded, and no phascogales nor evidence of phascogales were observed elsewhere during ground-based surveys (using multiple trapping methods) at the Mitchell Plateau (24 sites), Mount Trafalgar and Cascade Creek, Prince Regent National Park (16 sites), Bachsten Creek (8 sites), Mount Elizabeth (8 sites), King Leopold Range National Park at Silent Grove/ Inglis Gap (6 sites) or Mount Hart (6 sites) (I. Radford pers. comm., 2016).
- In 2016 an individual was seen during a spotlighting survey on the Mitchell Plateau, and a subsequent targeted camera trap survey resulted in images of phascogales on 3 of the 8 cameras over a four week period (I. Radford pers. comm., 2016).

Nest boxes were added to the monitoring program in 2014 with a focus on the Mitchell Plateau, with the aim of collecting information on the distribution and abundance of the subspecies along with other arboreal species; the boxes are yet to be checked (I. Radford pers. comm., cited in DPaW 2016).

The northern brush-tailed phascogale has had a marked reduction in population size and distribution on the Northern Territory mainland, and is estimated to be declining at a rate of more than 30 percent over 10 years. It is assumed that the reasons for its decline (feral cat predation, changes in fire regimes, habitat degradation and cane toad poisoning) may also apply to the Kimberley brush-tailed phascogale (DPaW 2016). However, while the subspecies is likely to have undergone a population decline, there are insufficient data to demonstrate the rate of decline.

The Committee considers that there is insufficient information to determine the eligibility of the subspecies for listing in any category under this criterion.

Criterion 2. Geographic distribution as indicators for either extent of occurrence AND/OR area of occupancy			
	Critically Endangered Very restricted	Endangered Restricted	Vulnerable Limited
B1. Extent of occurrence (EOO)	< 100 km ²	< 5,000 km ²	< 20,000 km ²
B2. Area of occupancy (AOO)	< 10 km ²	< 500 km ²	< 2,000 km ²
AND at least 2 of the following 3 conditions:			
(a) Severely fragmented OR Number of locations	= 1	≤ 5	≤ 10
(b) Continuing decline observed, estimated, inferred or projected in any of: (i) extent of occurrence; (ii) area of occupancy; (iii) area, extent and/or quality of habitat; (iv) number of locations or subpopulations; (v) number of mature individuals			
(c) Extreme fluctuations in any of: (i) extent of occurrence; (ii) area of occupancy; (iii) number of locations or subpopulations; (iv) number of mature individuals			

Evidence:

Eligible under Criterion 2 B2 (a),(b)(i-v) for listing as Vulnerable

The Kimberley brush-tailed phascogale is known from only three locations post-1985. Prior to 1985 it was recorded at four additional locations; the subspecies has apparently disappeared from at least some of these locations (e.g. Dampier Peninsula, Prince Regent National Park and Drysdale River; see Criterion 1). However, there are areas of suitable habitat between these locations that have not been surveyed (DPaW 2016).

EOO and AOO

DPaW (2016) calculated the original extent of occurrence 61 583 km², based on a polygon derived from the QGIS-based Delaunay triangulation tool (following IUCN standards); other calculation methods were not appropriate due to the number and location of points. Using only post-1985 records, the EOO is calculated to be 29 190 km². Suitable habitat within the vicinity of the records was included in the calculations (DPaW 2016).

DPaW (2016) calculated the area of occupancy to be 60 km² using all records, and 40 km² using only post-1985 records (based on IUCN standards of 2x2 km² grids). They considered that the AOO is likely to be a significant underestimate due to the few records across the subspecies' potential range.

DotEE (2017) calculated the EOO to be 21 580 km² and the AOO to be 44 km², based on the mapping of point records from 1977 to 2017 obtained from state governments, museums and CSIRO. The EOO was calculated using a minimum convex hull, and the AOO calculated using a 2x2 km grid cell method, based on the IUCN Red List Guidelines 2014.

Although the calculated AOOs are probably underestimates, identifying an upper limit for the AOO is difficult due to the paucity of records. Given the patterns of decline in other small to medium-sized mammals in the region, the large scale of high-intensity fires, and the ubiquitousness of feral cats in the region, the phascogale is likely to persist in suitable habitat only within the most rugged parts of the Kimberley. It is therefore possible that the AOO is much less than the EOO; it is very possible that it is less than 2000 km², and even possible that it is less than 500 km². The subspecies is therefore likely to meet the threshold for Vulnerable, and possibly Endangered, under sub-criterion B2.

Conditions (a),(b),(c)

Based on recent records, the subspecies occurs at a minimum of three locations. The phascogale could persist at additional locations that have not been surveyed, but given the evidence of decline, and the range contractions of other mammal species in northern Australia, the number of additional locations is likely to be very small. The subspecies is therefore likely to meet the threshold for Vulnerable, and possibly Endangered, under condition (a).

The subspecies is known from highly isolated areas, suggesting that the distribution could be severely fragmented; given that phascogales are semelparous, if breeding were to fail in one year a subpopulation could become locally extinct (DPaW 2016). However, the available vegetation mapping indicates that suitable habitat is widespread across the Kimberley coast, and it is possible that the distribution is not heavily fragmented (DPaW 2016).

The evidence presented in Criterion 1 indicates that the EOO, AOO and number of locations have declined over the past 130 years. The rate of this decline is not clear because of few historical and contemporary data. Increased survey efforts across the Kimberley in the past decade have not led to an increase in records of this subspecies (however, this may be partly attributed to its low detectability). As well as a decline in AOO and EOO, a decline in the quality of habitat is inferred, as the shift to a more extreme fire regime (of extensive high intensity fires) since the 1970s is known to affect woodland structure, hollow and food availability, including nectar availability (Williams et al., 1999; Vigilante & Bowman 2004). There is an inferred decline in the number of mature individuals, given the decline in AOO and EOO.

The Committee considers that the subspecies' area of occupancy is at least limited, and possibly restricted. The geographic distribution is precarious for the survival of the subspecies because it occurs in fewer than ten (possibly fewer than five) locations, and a decline in AOO, EOO, habitat quality, number of locations and number of individuals may be inferred. Therefore, the subspecies has met the relevant elements of Criterion 2 to make it eligible for listing as Vulnerable. It may be eligible for listing as Endangered, if further surveys are undertaken in suitable habitat and these result in confirmation that the subspecies is absent from large areas within its EOO.

Criterion 3. Population size and decline			
	Critically Endangered Very low	Endangered Low	Vulnerable Limited
Estimated number of mature individuals	< 250	< 2,500	< 10,000
AND either (C1) or (C2) is true			
C1 An observed, estimated or projected continuing decline of at least (up to a max. of 100 years in future)	Very high rate 25% in 3 years or 1 generation (whichever is longer)	High rate 20% in 5 years or 2 generation (whichever is longer)	Substantial rate 10% in 10 years or 3 generations (whichever is longer)
C2 An observed, estimated, projected or inferred continuing decline AND its geographic distribution is precarious for its survival based on at least 1 of the following 3 conditions:			
(a) (i) Number of mature individuals in each subpopulation	≤ 50	≤ 250	≤ 1,000
(a) (ii) % of mature individuals in one subpopulation =	90 – 100%	95 – 100%	100%
(b) Extreme fluctuations in the number of mature individuals			

Evidence:

Insufficient data to determine eligibility

The Kimberley brush-tailed phascogale has suffered a historical decline in range and its population size is likely to be small. Woinarski et al. (2014) infer the number of mature individuals to be fewer than 10 000; however, there are few data to support this estimate. There is an inferred continuing decline in population. The number of subpopulations is unknown.

There are no estimates of abundance. Brush-tailed phascogales do not readily enter the trap types commonly used for zoological surveys, and lack of records in the Kimberley may partially be due to detection issues (Start et al., 2007), declines or both. Dahl (1926) collected this subspecies near Broome in 1896, but there are no records from the south-western Kimberley since. Despite many thousands of trap nights targeting mammals in the north-western Kimberley over the past 30 years, there have been very few records (Bradley et al., 1987; Start et al., 2007; Radford et al., 2011; I. Radford pers. comm., cited in Woinarski et al., 2014; Hohnen et al., 2015, 2016; Smith et al., 2016). One phascogale was recorded during an intensive survey in 1981 and 1982 by Bradley et al. (1987). In trapping surveys in the Kimberley region from 1994 to 2011 (91 695 trap nights) there were six records of phascogales at three sites on Yampi Peninsula (I. Radford pers. comm., cited in Woinarski et al., 2014). In the Mitchell Falls area there have been three sightings (with one confirmed by photo) of phascogales from 2007 to 2012, suggesting they are present but probably not abundant in the region. There has been a recent sight record from Mt Hart in the King Leopold Ranges (S. Craswell pers. comm., cited in Woinarski et al., 2014). In 2016 an individual was seen during a spotlighting survey on the Mitchell Plateau, and images of the subspecies were recorded in a subsequent targeted camera trap survey (I. Radford pers. comm., 2016).

The Committee considers that there is insufficient information to determine the eligibility of the subspecies for listing in any category under this criterion.

Criterion 4. Number of mature individuals			
	Critically Endangered Extremely low	Endangered Very Low	Vulnerable Low
Number of mature individuals	< 50	< 250	< 1,000

Evidence:

Insufficient data to determine eligibility

There is no robust estimate of population size (see Criterion 3).

The Committee considers that there is insufficient information to determine the eligibility of the subspecies for listing in any category under this criterion.

Criterion 5. Quantitative Analysis			
	Critically Endangered Immediate future	Endangered Near future	Vulnerable Medium-term future
Indicating the probability of extinction in the wild to be:	≥ 50% in 10 years or 3 generations, whichever is longer (100 years max.)	≥ 20% in 20 years or 5 generations, whichever is longer (100 years max.)	≥ 10% in 100 years

Evidence:

Insufficient data to determine eligibility

Population viability analysis has not been undertaken.

Conservation actions

Recovery plan

The Committee recommends that there should not be a recovery plan for *Phascogale tapoatafa kimberleyensis* (Kimberley brush-tailed phascogale). An approved Conservation Advice provides sufficient direction to implement priority actions, mitigate key threats and enable recovery. A recovery plan would not add significant benefit.

Primary conservation actions

1. Develop and implement better survey techniques to increase detectability
2. Maintain the viability of the subspecies, and increase abundance and geographic range, by managing threats from fire and feral cats
3. Translocate individuals to at least one Kimberley Island to establish an insurance population.

Further habitat destruction from extensive or high intensity fires is likely to have a significant impact on the subspecies, particularly if it results in extirpation of an isolated subpopulation.

Predation by feral cats is also likely to have a significant impact on the subspecies.

Conservation and management priorities

There is no taxon-specific management for this subspecies. Recommended management actions are outlined in the table below (Woinarski et al., 2014).

Theme	Specific actions	Priority
Active mitigation of threats	Implement fire management that is favourable to this subspecies	High
	Where possible, seek to control feral cats at broad-scale, and/or intensively at and around significant subpopulations	High
	Control the number of cane toads if research determines them to be a threat	Medium
Captive breeding	Establish an 'insurance' captive population	Low
Translocation	Translocate to a Kimberley island, if a risk assessment shows that removal of individuals from the wild will not compromise populations	High
Community engagement	Support Aboriginal communities, who manage much of the land within the subspecies' EOO, in survey, monitoring and management	Medium

Survey and monitoring priorities

Theme	Specific actions	Priority
Establish or enhance monitoring program	Develop and trial more efficient survey technologies (e.g. nest boxes and camera traps)	High
	Develop cost-effective monitoring protocols	High
Survey to better define distribution and estimate population size and trends	Implement long-term, targeted monitoring at known (historical and recent) and potential sites, using a variety of detection techniques, to define distribution and estimate population size and trends	High

Information and research priorities

Theme	Specific actions	Priority
Assess impacts of threats on subspecies	Assess the population-level impact of feral cats	High
	Assess responses to a range of fire regimes, and identify an optimal regime	High
	Assess responses to cane toads and determine appropriate management if required	Medium-high
Assess effectiveness of threat mitigation options	Assess responses to better fire management	High
Assess habitat requirements	Delineate habitat requirements, including the extent to which tree hollow occurrence and quality is a limiting factor on phascogale subpopulations	High
	Undertake vegetation surveys to identify suitable habitat	
Assess diet, life history	Document diet and life history	High
Undertake research to develop new or enhance existing management mechanisms	Develop broad-scale, targeted feral cat eradication technology	High

Recommendations

- (i) The Committee recommends that the list referred to in section 178 of the EPBC Act be amended by **including** in the list in the Vulnerable category:
Phascogale tapoatafa kimberleyensis
- (ii) The Committee recommends that there not be a recovery plan for this subspecies.

Threatened Species Scientific Committee

24 March 2017

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