Australian Government
Department of the Environment and Energy

Consultation Document on Listing Eligibility and Conservation Actions

Trichosurus vulpecula arnhemensis (Northern Brushtail Possum)

You are invited to provide your views and supporting reasons related to:

1) the eligibility of *Trichosurus vulpecula arnhemensis* (Northern Brushtail Possum) for inclusion on the EPBC Act threatened species list in the Vulnerable category; and

2) the necessary conservation actions for the above subspecies.

Evidence provided by experts, stakeholders and the general public are welcome. Responses can be provided by any interested person.

Anyone may nominate a native species, ecological community or threatening process for listing under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) or for a transfer of an item already on the list to a new listing category. The Threatened Species Scientific Committee (the Committee) undertakes the assessment of species to determine eligibility for inclusion in the list of threatened species and provides its recommendation to the Australian Government Minister for the Environment and Energy.

Responses are to be provided in writing either by email to:
species.consultation@environment.gov.au

or by mail to:

The Director
Marine and Freshwater Species Conservation Section
Biodiversity Conservation Division
Department of the Environment and Energy
PO Box 787
Canberra ACT 2601

Responses are required to be submitted by 24 January 2020.

Contents of this information package	Page

General background information about listing threatened species

The Australian Government helps protect species at risk of extinction by listing them as threatened under Part 13 of the EPBC Act. Once listed under the EPBC Act, the species becomes a Matter of National Environmental Significance (MNES) and must be protected from significant impacts through the assessment and approval provisions of the EPBC Act. More information about threatened species is available on the department's website at: http://www.environment.gov.au/biodiversity/threatened/index.html.

Public nominations to list threatened species under the EPBC Act are received annually by the department. In order to determine if a species is eligible for listing as threatened under the EPBC Act, the Threatened Species Scientific Committee (the Committee) undertakes a rigorous scientific assessment of its status to determine if the species is eligible for listing against a set of criteria. These criteria are available on the Department's website at: http://www.environment.gov.au/system/files/pages/d72dfd1a-f0d8-4699-8d43-5d95bbb02428/files/tssc-guidelines-assessing-species-2018.pdf.

As part of the assessment process, the Committee consults with the public and stakeholders to obtain specific details about the species, as well as advice on what conservation actions might be appropriate. Information provided through the consultation process is considered by the Committee in its assessment. The Committee provides its advice on the assessment (together with comments received) to the Minister regarding the eligibility of the species for listing under a particular category and what conservation actions might be appropriate. The Minister decides to add, or not to add, the species to the list of threatened species under the EPBC Act. More detailed information about the listing process is at: http://www.environment.gov.au/biodiversity/threatened/nominations.html.

To promote the recovery of listed threatened species and ecological communities, conservation advices and where required, recovery plans are made or adopted in accordance with Part 13 of the EPBC Act. Conservation advices provide guidance at the time of listing on known threats and priority recovery actions that can be undertaken at a local and regional level. Recovery plans describe key threats and identify specific recovery actions that can be undertaken to enable recovery activities to occur within a planned and logical national framework. Information about recovery plans is available on the department's website at: http://www.environment.gov.au/biodiversity/threatened/recovery.html.

Privacy notice

The Department will collect, use, store and disclose the personal information you provide in a manner consistent with the Department's obligations under the Privacy Act 1988 (Cth) and the Department's Privacy Policy.

Any personal information that you provide within, or in addition to, your comments in the threatened species assessment process may be used by the Department for the purposes of its functions relating to threatened species assessments, including contacting you if we have any questions about your comments in the future.

Further, the Commonwealth, State and Territory governments have agreed to share threatened species assessment documentation (including comments) to ensure that all States and Territories have access to the same documentation when making a decision on the status of a potentially threatened species. This is also known as the 'common assessment method'. As a result, any personal information that you have provided in connection with your comments may be shared between Commonwealth, State or Territory government entities to assist with their assessment processes.

The Department's Privacy Policy contains details about how respondents may access and make corrections to personal information that the Department holds about the respondent, how

respondents may make a complaint about a breach of an Australian Privacy Principle, and how the Department will deal with that complaint. A copy of the Department's Privacy Policy is available at: http://environment.gov.au/privacy-policy .

Information about this consultation process

Responses to this consultation can be provided electronically or in hard copy to the contact addresses provided on Page 1. All responses received will be provided in full to the Committee and then to the Australian Government Minister for the Environment.

In providing comments, please provide references to published data where possible. Should the Committee use the information you provide in formulating its advice, the information will be attributed to you and referenced as a 'personal communication' unless you provide references or otherwise attribute this information (please specify if your organisation requires that this information is attributed to your organisation instead of yourself). The final advice by the Committee will be published on the department's website following the listing decision by the Minister.

Information provided through consultation may be subject to freedom of information legislation and court processes. It is also important to note that under the EPBC Act, the deliberations and recommendations of the Committee are confidential until the Minister has made a final decision on the nomination, unless otherwise determined by the Minister.

Trichosurus vulpecula arnhemensis

Northern Brushtail Possum

Note: The information contained in this Conservation Advice was primarily sourced from 'The Action Plan for Australian Mammals 2012' (Woinarski et al. 2014). Any substantive additions obtained during the consultation on the draft will be cited within the advice.

Taxonomy

Generally accepted as *Trichosurus vulpecula arnhemensis* (Collet 1897). The Northern Brushtail Possum is a subspecies of *T. vulpecula*.

There has been contention as to whether the Northern Brushtail Possum is a separate species or a subspecies. Ride (1970) elevated it to species status as *T. arnhemensis*, which was subsequently recognised by some authors. However, a recent analysis of genetic variation in *Trichosurus* concluded that *Trichosurus vulpecula arnhemensis* should be recognised as a valid subspecies (Woinarski et al. 2014). The subspecies status is accepted by the Australian Faunal Directory and elsewhere (as detailed in Jackson & Groves 2015).

The number of subspecies of *T. vulpecula* is currently unresolved. Woinarski et al. (2014) recognises three subspecies, however Jackson & Groves (2015) and the Australian Faunal Directory recognise six.

Species/Subspecies Information

Description

The Northern Brushtail Possum has a body length of approximately 35–55cm and a tail length of 25–40cm. The coat is typically grey in colour, however variations can include reddish brown, copper or chocolate brown. The fur is shorter and tail less hairy than *T. vulpecula* subspecies found in southern Australia (for example *T. v. fuliginosus;* Kerle 1991), and it has long, oval ears and a hairless underside. The subspecies is nocturnal, commonly nesting in tree hollows and forest canopy. Its diet consists mostly of leaves, flowers and fruits (Woinarski et al. 2014).

Distribution

The Northern Brushtail Possum occurs discontinuously from the Gulf of Carpentaria hinterland near Borroloola, Northern Territory (NT) (Woinarski et al. 2011b) westward to the Kimberley, Western Australia (WA) (McKenzie 1981; Kerle & How 2008; Morris et al. 2008). Most of the current population appears to be in the NT, with limited sightings recorded in WA.

The subspecies is known to occur on the following NT Islands: Bathurst (1645 km^2), Cotton (197 km^2), Croker (310 km^2), Elcho (270 km^2), Field (44 km^2), Indian (28 km^2), Melville (5730 km^2) and North (18 km^2) and South Peron (5 km^2) Islands, and Groote Eylandt (2258 km^2) (Abbott & Burbidge 1995; Woinarski et al.1999; Woinarski 2004; Firth et al. 2006). It is not known to occur on any Kimberley islands (Gibson & McKenzie 2012). It formerly occurred on at least some of the Sir Edward Pellew Islands in the NT, but appears to have disappeared from the area sometime around the mid-20th century. Mammal surveys on the five main islands over 1966 to 2010 failed to detect the subspecies, which was previously recorded from the islands in ethno-biological accounts (Woinarski et al. 2011b).

Its extent of occurrence (EOO) and area of occupancy (AOO) have decreased (and continue to decrease) due to broad-scale losses of regional subpopulations across semi-arid north-western Australia (Kitchener 1978; Baynes & Jones 1993; Abbott 2012; Stobo-Wilson et al. 2019), and more recent reductions across extensive areas of its NT range (Woinarski 2004; Woinarski et al.

2011b; Gibson & McKenzie 2012; Ziembicki et al. 2013; Stobo-Wilson et al. 2019). Within its broad range, its distribution is patchy (Kitchener et al. 1981; Kerle & Burgman 1984).

Cultural Significance

Traditional Owners of the Tiwi Islands regularly hunt the Northern Brushtail Possum. The subspecies is an important and highly regarded food source (Puruntatameri 2001; C Kerinaiua 2019. pers comm 24 July). Cooking and distributing food from possums follows traditional laws (Puruntatameri 2001).

Relevant Biology/Ecology

The Northern Brushtail Possum is a nocturnal arboreal marsupial. It occurs mainly in tall eucalypt open forests with large hollow-bearing trees, particularly where the understorey includes some shrubs that bear fleshy fruits (Kerle 1985; Friend & Taylor 1985). However, the subspecies also occurs in some mangrove communities (especially where these contain hollow-bearing trees) (Woinarski et al. 2011b), some rainforests (Menkhorst & Woinarski 1992; Firth et al. 2006) and some semi-urban areas (notably around Darwin). In the monsoonal tropics its diet mostly comprises fruits, flowers and foliage (for example mistletoe species such as *Lysiana spathulata* (Northern Mistletoe)*, Amyema miquelii* and *Amyema bifurcate*, as well as *Erythrophleum chlorostachys* (Cooktown Ironwood) (Kerle 1985). In forests of northern Australia it shelters mostly in tree hollows (and in some cases, human infrastructure).

The subspecies is found in higher abundance where shrub density is high; these areas likely provide refuge from predation by feral cats (*Felis catus*) as well as important food resources (Stobo-Wilson et al. 2019). However, its persistence in the rugged desert uplands in the arid zone of the NT indicates that it is not strictly dependent on high shrub abundance where other forms of shelter from predation exist (Stobo-Wilson et al. 2019). Its selection of rugged rocky areas, despite the presence of riparian areas where food sources are typically more abundant (McDonald et al. 2015, 2017), suggests that a shrubby understorey is more important in providing refuge from predation (Stobo-Wilson et al. 2019).

The Northern Brushtail Possum is smaller than other subspecies of *T. vulpecula* (for example *T. v. fuliginosus;* Kerle 1991; Wayne et al. 2005) and has no distinct breeding season (Kerle & Howe 1992; Short & Turner 1994). Sexual maturity is achieved at 12−15 months (Kerle & Howe 1992), and longevity (for the subspecies as a whole) is up to 10 years (Kerle & How 2008), so generation length is 5−6 years (Woinarski et al. 2014). Generation length, as calculated in Woinarski et al. (2014), is based on the sum of maximum longevity and age to reproductive maturity, divided by two.

Threats

The Northern Brushtail Possum is mainly threatened by too frequent fires, predation by feral cats and habitat modification from invasive grasses (African gamba grass (*Andropogon gayanus*) and mission grass (*Pennisetum polystachion*)). These threats do not act in isolation, as each threat may exacerbate another. For example, a positive-feedback loop may occur between invasive grasses and fire (the grass-fire cycle), whereby invasive grasses increase fuel loads, leading to an increase in fire intensity, which reduces tree cover, which facilities an increase in invasive grasses (Rossiter et al. 2003). Predation by feral cats may also increase with frequently burnt landscapes, as fire can remove shelter sites for the subspecies (Oakwood 2000). The threats to the subspecies are outlined in Table 1.

Table 1 − Threats impacting the Northern Brushtail Possum in approximate order of severity of risk, based on available evidence

Number	Threat factor	Threat type and status	Evidence base
1.0	**Fire**		
1.1	Too frequent fires	Known current	Small mammal (<2kg) numbers have declined dramatically in northern Australia in recent decades. Contemporary fire regimes characterised by frequent, extensive, late-season wildfires are implicated in this decline (Lawes et al. 2015). Altered fire regimes have been identified as a key driver of shrub loss in the mesic savannas of northern Australia (Russell-Smith et al. 2012; Vigilante & Bowman 2004), reducing food resources and habitat quality for species such as the Northern Brushtail Possum (Kerle 1985; Friend & Taylor 1985; Woinarski 2004). The frequency and intensity of bushfires are increasing with climate change, compounding the impacts of fire.
2.0	**Invasive species**		
2.1	Predation by feral cats	Suspected current	The Northern Brushtail Possum falls within the critical weight range (35g-3.5kg), meaning it is extremely susceptible to predators (Radford et al. 2018). Although arboreal, the subspecies is frequently observed on the ground, exposing it to predation by ground-based predators (Stobo-Wilson et al. 2019). Northern Brushtail Possum remains have been found in 12% of feral cat scats in Kakadu National Park (Stokeld et al. 2018). Population-level impacts of feral cats on the subspecies are uncertain (Woinarski et al. 2014; Radford et al. 2018; Stobo-Wilson et al. 2019). However, feral cats are implicated in the decline of small mammals in northern Australia. Numbers of feral cats across Northern Australia may have increased because of dingo (*Canis familiaris*) reduction (Johnson et al. 2007). Fire can amplify the impacts of predation by reducing understorey and ground cover, particularly following high-intensity burns (Oakwood 2000; Leahy et al. 2015). For example, fire in a forest in south-eastern Australia reduced understorey cover by more than 80 per cent, resulting in a five-fold increase in the occurrence of feral cats and foxes (*Vulpes vulpes*) (Hradsky et al. 2017).

2.2	Habitat degradation due to invasive grasses	Known current	Several invasive grasses − for example African Gamba Grass (*Andropogon gayanus*) and Mission Grass (*Cenchrus* spp.) − are spreading through the subspecies' preferred habitat, with high biomass fuelling higher intensity fires, and probably making ground movement more difficult (Woinarski 2004; Woinarski et al. 2014). African Gamba Grass is a serious threat to northern Australia's savannas. Invasion by Gamba Grass has resulted in fuel loads up to seven times higher than those dominated by native grasses, and supported fires about eight times more intense than those recorded in native grass savannas at the same time of year (Rossiter et al. 2003).
2.3	Disease carried by black rats (*Rattus rattus)*	Potential	Disease is a potential threat to the subspecies (Abbott 2012). There has been an observed increase in the NT of the prevalence and abundance of exotic black rats, which are known vectors for some diseases that have caused mammal extinctions elsewhere (Wyatt et al. 2008). The subspecies has substantial historical evidence of major population decline due to epizootic disease (Abbott 2012).
3.0	**Habitat loss and fragmentation**		
3.1	Land clearing	Known current	The subspecies' preferred habitat is subject to continuing clearance for agriculture, forestry and mining, particularly on the Tiwi Islands and in more settled areas of the NT mainland (Woinarski 2004; Firth et al. 2006; Stobo-Wilson et al. 2019); and this subspecies shows significant habitat fragmentation responses (Rankmore & Price 2004). The clearing of large hollow-bearing trees is of particular concern, as the Northern Brushtail Possum is dependent on these for nesting (Kerle 1985; Friend & Taylor 1985).
3.2	Grazing	Suspected current	The Northern Brushtail Possum preferentially inhabits areas with high shrub density (Stobo-Wilson et al. 2019). In northern Australia, overgrazing by livestock has been linked to a decline in shrub abundance (Legge et al. 2011).
4.0	**Climate change**		
4.1	Increased temperatures	Projected future	The temperature across northern Australia is projected to rise under future climate change scenarios, resulting in a substantial increase in the number of days of extreme temperature and associated severe wildfire risk (CSIRO & Bureau of Meteorology 2015). This is exacerbated by the spread of highly flammable exotic pasture grasses, such as Gamba grass (Rossiter et al. 2003).

Assessment of available information 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%**

A1 Population reduction observed, estimated, inferred or suspected in the past and the causes of the reduction are clearly reversible AND understood AND ceased.

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.

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*]

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.

based on any of the following:

(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:

The Northern Brushtail Possum has undergone broad-scale decline over the past few decades, and numbers continue to decrease across much of its formerly extensive range (Woinarski 2004; Stobo-Wilson et al. 2019). Using an occupancy model based on occurrence records, Stobo-Wilson et al. (2019) found that the modelled geographic range has declined by 72 percent between the two periods 1840−1993 (historical distribution) and 1993−2017 (contemporary distribution), with a contraction in range away from the arid areas to the mesic areas.

Assessment under this criterion considers population trends over the most recent three generation period (15−18 years).

Northern Territory

The most substantial evidence for decline is from extensive monitoring data at Kakadu National Park, where trapping was undertaken across 136 plots sampled in 2001–04 and again in 2007 – 09 (Woinarski 2010). Over this period, the mean abundance per site of the Northern

Brushtail Possum declined from 0.07 to 0.01, which equates to a greater than 80 per cent decline (through direct observation) over the ten year monitoring period (Woinarski 2010). Reasons for the decline are unclear, but the most plausible causes are too frequent fire and predation by feral cats (Woinarski 2010).

The large decline is concerning, given that Kakadu National Park is northern Australia's largest and best-resourced conservation reserve (Woinarski 2010). The habitat sampled was an equitable representation of the range of vegetation types found in the Park, with most plots (~60 per cent) being eucalypt forest or savanna woodland. Although the area monitored encompasses only about 20 000 km^2 of the total 228 774 km^2 EOO for the Northern Brushtail Possum, savanna woodlands occur over much of northern Australia (Trainor & Woinarski 1994), and key threats to the subspecies may be expected to be similar throughout its range (Table 1).

Ziembicki et al. (2013) used a qualitative monitoring approach to review Indigenous knowledge of the abundance and distribution of the subspecies (and other mammals) across the Top End of the NT. In this study, qualitative data collected from a series of interviews with local Indigenous people indicated that Northern Brushtail Possum populations declined substantially over the 20 years leading up to 2013, and over the period from the 1950s to the 1980s (Ziembicki et al. 2013).

Compared to other areas of northern Australia, subpopulations on the Tiwi Islands (comprised of Bathurst and Melville islands) are currently in a healthy state, with the mean density of individuals in eucalypt forest and savanna woodland recorded at 0.5 ha^{-1} (Davies et al. 2018; Davies & Murphy 2019). Monitoring of small mammal species on Melville Island recorded the Northern Brushtail Possum at 29 per cent more sites in 2015 than in 2001 to 2002, but recorded marked declines in *Conilurus penicillatus* (Brush-tailed Rabbit-rat) and *Mesembriomys gouldii* (Black-footed Tree-rat) (Davies et al. 2018). However, Davies et al (2018) speculates that the pattern of decline of small mammal species on Melville Island may mirror similar declines in Kakadu National Park from 2001 to 2009, where the Northern Brushtail Possum was one of the last species to show signs of decline. Given the widespread decline of the subspecies across mainland northern Australia, the current healthy state of the Tiwi Islands subpopulations should therefore not be taken as evidence that these populations are safe from decline (Davies et al. 2018; Davies & Murphy 2019). On Groote Eylandt and Croker Island, the subspecies now appears to be rare and restricted (Johnson 1964; Firth 2008; Firth & Panton 2006).

Western Australia

Data are limited in Western Australia. In the Kimberley, a review of all available trapping records from 1994 to 2012 (290 surveys) noted only two individuals had been trapped (I Radford pers comm. cited in Woinarski et al. 2014). These results are lower than reported in earlier sampling in the Kimberley, particularly over 1981–82 when six individuals were captured (Bradley et al. 1987); however, the comparison is constrained by differences in trapping methods and habitats sampled (Woinarski et al. 2014). In 1982, six individuals were recorded in a separate survey (conducted over a two hour period) in *Sonneratia* mangrove forests at Port Warrender in the Kimberley (Woinarski et al. 2014).

Summary

There are limited population data across the subspecies' distribution. However, substantial declines have been observed in Kakadu National Park (over 80 percent in a 10 year period), and large declines across the Top End may be inferred from Indigenous knowledge. Although the subspecies occurs on several islands it does not appear to be secure there; it has disappeared from some islands in the past and is rare on Groote Eylandt and Croker Island. It is also rare in Western Australia. Key threats facing the subspecies operate across its entire range, and it is very likely that the population is continuing to decline due to ongoing threats. Although there is no quantitative estimate of trends in total population size decline, given declines of over 80 percent in some areas, it is inferred that the total rate of decline across the

subspecies' distribution is likely to be at least 30 per cent over a 15−18 year (i.e. three generation) period.

The data presented above appear to demonstrate that the species is **eligible for listing as Vulnerable** (A2a,c,e) under this criterion. However, the purpose of this consultation document is to elicit additional information to better understand the species' status. This conclusion should therefore be considered to be tentative at this stage, as it may be changed as a result of responses to this consultation process.

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 km²**	**< 5,000 km²**	**< 20,000 km²**
B2. Area of occupancy (AOO)	**< 10 km²**	**< 500 km²**	**< 2,000 km²**
AND at least 2 of the following 3 conditions indicating distribution is precarious for survival:			
(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:

The EOO is estimated to be 571 694 km^2, and the AOO estimated to be 1392 km^2 (which meets the threshold for Vulnerable under B2). These figures are based on the mapping of point records from 1998 to 2018, obtained from state governments and museums. 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 2019 (DoEE 2019).

There has been a decline in habitat quality for the Northern Brushtail Possum, which satisfies subcriterion (b)(iii). Changing fire regimes have led to a reduction in the subspecies' habitat across much of northern Australia, with too frequent fires depleting the woody understorey that formerly provided fleshy fruit resources, and reducing the abundance of large trees and tree hollows (Woinarski et al. 2011a). African gamba grass and mission grass are also spreading through northern Australia, increasing biomass for fire fuel and probably making movement for the subspecies more difficult (Woinarski 2004). These invasive grasses provide a fuel load which is up to five times greater than native species (Dyer et al. 2001). Vegetation change in the subspecies' range has also been driven by cattle (*Bos taurus*) grazing and grazing by other introduced herbivores (for example feral buffalo (*Bubalus bubalis*)). This broad-scale decline in habitat quality is likely occurring across much of the subspecies' extent, including conservation reserves (Woinarski 2004). The number of mature individuals are also declining (see Criterion 1), which satisfies subcriterion (b)(v).

The Northern Brushtail Possum occurs on ten islands and the mainland, and therefore occurs in more than 10 locations. There is no evidence to indicate that the distribution is severely fragmented, or that the subspecies undergoes extreme fluctuations. Therefore, only one of the three conditions indicating distribution is precarious for survival have been met.

The data presented above appear to demonstrate that the species is not eligible for listing under this criterion. However, the purpose of this consultation document is to elicit additional information to better understand the species' status. This conclusion should therefore be considered to be tentative at this stage, as it may be changed as a result of responses to this consultation process.

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:

There is currently no reliable estimate of population size for the Northern Brushtail Possum. Woinarski et al. (2014) considers the number of mature individuals to be approximately 20 000. Given the broad distribution of the subspecies (EOO 228 770 km^2) and healthy subpopulations (for example Tiwi Islands), it is estimated that the number of mature individuals is therefore greater than 10 000.

The data presented above appear to be insufficient to demonstrate if the species is eligible for listing under this criterion. However, the purpose of this consultation document is to elicit additional information to better understand the species' status. This conclusion should therefore be considered to be tentative at this stage, as it may be changed as a result of responses to this consultation process.

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

Evidence:

There has been no robust estimate of the population size of this subspecies. However, given the broad distribution of the subspecies (EOO 228 770 km^2) and healthy subpopulations (for example Tiwi Islands), it is very likely that the number of mature individuals is greater than 1000.

The data presented above appear to demonstrate the subspecies is not eligible for listing under this criterion. However, the purpose of this consultation document is to elicit additional information to better understand the subspecies' status. This conclusion should therefore be considered to be tentative at this stage, as it may be changed as a result of responses to this consultation process.

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:

Population viability analysis for the Northern Brushtail Possum has not been undertaken. There are insufficient data to demonstrate if the subspecies is eligible for listing under this criterion. However, the purpose of this consultation document is to elicit additional information to better understand the subspecies' status. This conclusion should therefore be considered to be tentative at this stage, as it may be changed as a result of responses to this consultation process.

Conservation Actions

Recovery Plan

A decision about whether there should be a recovery plan for this subspecies has not yet been determined. The purpose of this consultation document is to elicit additional information to help inform this decision.

Primary Conservation Actions

1. Identify and protect important habitat for the Northern Brushtail Possum from habitat loss, degradation and fragmentation.
2. Minimise levels of feral cat predation on the subspecies by undertaking feral cat control.

3. Implement measures to reduce the frequency of large late-season fires.
4. Undertake long-term monitoring to assess changes in population status, evaluate the success of management actions, and inform adaptive management.

Conservation and Management Priorities

Fire

- Implement fine-scale, patchy landscape burning during the early dry season, to reduce biomass and decrease the likelihood of intense and extensive late-season fires.

Invasive Species

- Develop and implement broad-scale control of feral cats, and intensive local-scale control at and around important subpopulations of the Northern Brushtail Possum (particularly following fire).
- Undertake ongoing control and containment of invasive grasses; guidance on how to manage weeds such as African Gamba Grass and Mission Grass can be found on state/territory government websites.
- Develop or enhance biosecurity plans and management for all islands where the subspecies is present, with particular focus on preventing the introduction of feral cats.

Habitat loss disturbance and modifications

- Protect areas of high habitat value from land clearance (particularly on the Tiwi Islands).

Impacts of domestic species

- If livestock grazing occurs in the area, support and encourage land owners/managers to use an appropriate grazing regime and stocking density that enables the recruitment of native shrubs.

Stakeholder Engagement

- Engage and involve traditional owners in conservation actions, including the implementation of Indigenous fire management and other survey, monitoring and management actions.
- Liaise with the local community and NT and WA Government agencies to ensure that up-to-date population data for the subspecies inform the implementation of conservation actions.
- Develop conservation covenants on private lands with high value for the subspecies.

Survey and Monitoring priorities

- Undertake surveys to define fine-scale distribution patterns of the subspecies across its range, and the number of individuals (or relative abundance) in subpopulations.
- Design and implement an integrated monitoring program for the subspecies, in order to better estimate population trends across its distribution and enable an assessment of the effectiveness of management actions.
- Monitor and record the incidence of fire, and vegetation responses, at key subpopulations, including any changes in response to fire management.
- Monitor and record the abundance of feral cats at key subpopulations, including whether this varies with vegetation type/density and any changes in response to management.

Information and Research priorities

- Identify an optimal fire regime for the subspecies, by assessing population-level responses to a range of fire regimes, and modelling population viability across all fire scenarios.

- Assess the efficacy and impacts of management options to reduce the incidence, extent and intensity of fire and promote appropriate heterogeneity of fire mosaics.
- Determine the abundance of feral cats in the range of the subspecies, and the impact of predation on population viability of the Northern Brushtail Possum.
- Continue efforts to develop broad-scale, targeted feral cat control technology.
- Identify subpopulations that have greatest viability, and ensure that landscape planning and development cater appropriately for such subpopulations.
- Assess the incidence and impacts of disease in stable and declining populations, including potential impacts of disease transmitted by black rats.
- Undertake trial programs to examine the uptake, and impacts on population viability, of artificial hollows.
- Resolve taxonomic uncertainties and the validity of subspecies.

References cited in the advice

Abbott I & Burbidge A (1995) The occurrence of mammal species on the islands of Australia: a summary of existing knowledge. *CALMScience* 1, 259-324.

Abbott I (2012) Original distribution of *Trichosurus vulpecula* (Marsupialia: Phalangeridae) in Western Australia, with particular reference to occurrence outside the southwest. *Journal of the Royal Society of Western Australia* 95, 83-9-3.

Baynes A & Jones B (1993) The mammals of Cape Range peninsula, north-western Australia. *Records of the Western Australian Museum* 45, 207-225.

Bradley A, Kemper C, Kitchener D, Humphreys W & How R (1987) Small mammals of the Mitchell Plateau region, Kimberley, Western Australia. *Australian Wildlife Research* 14, 397-413.

CSIRO & Bureau of Meteorology (2015) *Climate change in Australia: technical report 2015*. CSIRO, Australia. Available at: http://www.climatechangeinaustralia.gov.au/

Davies H, McCarthy M, Firth R, Woinarski J, Gillespie G, Andersen A, Rioli W, Puruntatameri J, Roberts W, Kerinaiua C, Kerinauia V, Womatakimi K & Murphy B (2018) Declining populations in one of the last refuges for threatened mammal species in northern Australia. *Australi Ecology* 43, 606-212.

Davies H & Murphy B (2019) Status of the northern brushtail possum (*Trichosurus vulpecula arnhemensis*) on the Tiwi Islands. Unpublished report, Charles Darwin University.

DoEE (2019) Area of Occupancy and Extent of Occurrence for *Trichosurus vulpecula arnhemensis*. Unpublished report. Australian Government Department of the Environment and Energy, Canberra.

Dyer R, Jacklyn P, Partridge I, Russell-Smith J & Williams D (2001) Savanna Burning: Understanding and Using Fire in Northern Australia. *Tropical Savannas CRC*, Darwin.

Firth R (2008) Surveys for the threatened northern hopping-mouse, northern quoll & brush-tailed rabbit-rat on GEMCO Eastern Exploration Leases (Groote Eylandt). EWL Sciences Pty Ltd, Darwin.

Firth R, Woinarski J, Brennan K & Hempel C (2006) Environmental relationships of the brush-tailed rabbit-rat *Conilurus penicillatus* and other small mammals on the Tiwi Islands, northern Australia. *Journal of Biogeography* 33, 1820-1837.

Friend G & Taylor J (1985) Habitat preferences of small mammals in tropical open-forest of the Northern Territory. *Australian Journal of Ecology* 10, 173-185.

Gibson L & McKenzie N (2012) Occurrence of non-volant mammals on islands along the Kimberley coast of Western Australia. *Records of the Western Australian Museum* supplement 81, 15-39.

Hradsky B, Mildwaters C, Ritchie E, Christie F & Di Stefano J (2017) Responses of invasive predators and native prey to a prescribed forest fire. *Journal of Mammalogy* 98, 835-847.

IUCN Standards and Petitions Subcommittee (2019) Guidelines for Using the IUCN Red List Categories and Criteria. Version 14. Available on the Internet at: http://nc.iucnredlist.org/redlist/content/attachment_files/RedListGuidelines.pdf

Jackson S & Groves C (2015). *Taxonomy of Australian Mammals*. CSIRO Publishing, Clayton. 536 pp.

Johnson D (1964) Mammals of the Arnhem Land expedition. In R Specht (ed). *Records of the American-Australian scientific expedition to Arnhem Land. Volume 4. Zoology*. Melbourne University Press. Melbourne. pp. 427-515.

Johnson CN, Isaac JL & Fisher DO (2007) Rarity of a top predator triggers continent-wide collapse of mammal prey: dingoes and marsupials in Australia. *Proceedings of the Royal Society B* 274, 341-346.

Kerle J (1985) Habitat preference and diet of the northern brushtail possum *Trichosurus arnhemensis* in the Alligator Rivers Region, N.T. *Proceedings of the Ecological Society of Australia* 13, 161-176.

Kerle J & Burgman M (1984) Some aspects of the ecology of the mammal fauna in the Jabiluka area, Northern Territory. *Australian Wildlife Research* 11, 207-222.

Kerle J & How R (2008) Common Brushtail Possum, *Trichosurus vulpecula*, In S Van Dyck & R Strahan (eds). *The Mammals of Australia*, Third edition, Reed New Holland, Sydney. pp. 274-276.

Kerle J & Howe C (1992) The breeding biology of a tropical possum, *Trichosurus vulpecula arnhemensis* (Phalangeridae: Marsupialia). *Australian Journal of Zoology* 40, 653-665.

Kerle J, Mckay G & Sharman G (1991) A Systematic Analysis of the Brushtail Possum, Trichosurus-Vulpecula (Kerr, 1792) (Marsupialia, Phalangeridae). *Australian Journal of Zoology* 39, 313-331

Kitchener D (1978) Mammals of the Ord River area, Kimberley, Western Australia. *Records of the Western Australian Museum* 6, 189-217.

Kitchener D, Keller L, Chapman A, McKenzie N, Start A & Kenneally K (1981) Observations on mammals on the Mitchell Plateau area, Kimberley, Western Australia. In *Biological survey of Mitchell Plateau and Admiralty Gulf, Kimberley, Western Australia*. Western Australian Museum. Perth, Western Australia. pp. 123-169.

Lawes M, Murphy B, Fisher A, Woinarski J, Edwards A & Russell-Smith J (2015) Small mammals decline with increasing fire extent in northern Australia: evidence from long-term monitoring in Kakadu National Park. *International Journal of Wildland Fire* 24, 712-722.

Leahy L, Legge S, Tuft K, McGregor H, Barmuta L, Jones M & Johnson C (2015) Amplified predation after fire suppresses rodent populations in Australia's tropical savannas. *Wildlife Research* 42, 705-716.

Legge S, Kennedy MS, Lloyd R, Murphy SA & Fisher A (2011) Rapid recovery of mammal fauna in the central Kimberley, Northern Australia, following the removal of introduced herbivores. *Austral Ecology* 36,791-799.

McDonald PJ, Luck GW, Dickman CR, Ward SJ & Crowther MS (2015) Using multiple-source occurrence data to identify patterns and drivers of decline in arid-dwelling Australian marsupials. *Ecography* 38, 1090-1100.

McDonald PJ, Nano CEM, Ward SJ, Stewart A, Pavey CR, Luck GW & Dickman CR (2017) Habitat as a mediator of mesopredator-driven mammal extinction. *Conservation Biology* 31, 1183-1191.

McKenzie N (1981) Mammals of the Phanerozoic south-west Kimberley, Western Australia: biogeography and recent changes. *Journal of Biogeography* 8, 263-280.

Menkhorst K & Woinarski J (1992) Distribution of mammals in monsoon rainforests of the Northern Territory. *Wildlife Research* 19, 295-316.

Morris K, Woinarski J, Friend T, Foulkes J, Kerle A & Ellis M (2008) *Trichosurus vulpecula*. In 'IUCN red list of threatened species.' Version 2012.1. <www.iucnredlist.org>. Accessed 15 September 2012.

Oakwood M (2000) Reproduction and demography of the northern quoll, *Dasyurus hallucatus*, in the lowland savanna of northern Australia. *Australian Journal of Zoology* 48, 519-539.

Puruntatameri J, Puruntatameri R, Pangiraminni A, Burak L, Tipuamantymirri C, Tipakalippa M, Puruntatameri J, Puruntatameri P, Pupangamirri JB, Kerinaiua R & Tipiloura D (2001). Tiwi plants and animals: Aboriginal flora and fauna knowledge from Bathurst and Melville Islands, northern Australia. *Darwin, Parks and Wildlife Commission of the Northern Territory and Tiwi Land Council.*

Radford J, Woinarski J, Legge S, Baseler M, Bentley J, Burbidge A & Ringma J (2018). Degrees of population-level susceptibility of Australian terrestrial non-volant mammal species to predation by the introduced red fox (*Vulpes vulpes*) and feral cat (*Felis catus*). *Wildlife Research* 45, 645-657.

Rankmore B & Price O (2004) Effects of habitat fragmentation on the vertebrate fauna of tropical woodlands, Northern Territory, in D Lunney (ed). *Conservation of Australia's forest fauna*. *Second edition*. Royal Zoological Society of New South Wales. Mosman. pp. 452-473.

Ride W (1970) A guide to the native mammals of Australia. Oxford University Press. Melbourne.

Rossiter NA, Setterfield SA, Douglas MM & Hutley LB (2003) Testing the grass-fire cycle: alien grass invasion in the tropical savannas of northern Australia. *Diversity and Distributions* 9, 169–176.

Russell-Smith J, Edwards AC & Price OF (2012) Simplifying the savanna: the trajectory of fire-sensitive vegetation mosaics in Northern Australia. *Journal of Biogeography* 39,1303-1317.

Short J & Turner B (1994) A test of the vegetation mosaic hypothesis: a hypothesis to explain the decline and extinction of Australian mammals. *Conservation Biology* 8, 439-449.

Start A, Burbidge A, McKenzie L & Palmer C (2007) The status of mammals in the North Kimberley, Western Australia. *Australian Mammalogy* 29, 1-16.

Start A, Burbidge A, McDowell M & McKenzie N (2012) The status of non-volant mammals along a rainfall gradient in the south-west Kimberley, Western Australia. *Australian Mammalogy* 34, 36-48.

Stobo-Wilson A, Murphy B, & Cremona T (2019) Contrasting patterns of decline in two arboreal marsupials from Northern Australia. *Biodiversity Conservation* 28, 2951.

Stokeld D, Fisher A, Gentles T, Hill B, Triggs B, Woinarski JCZ & Gillespie GR (2018) What do predator diets tell us about mammal declines in Kakadu National Park? *Wildlife Research* 45, 92-101.

Trainor C & Woinarski J (1994) Responses of lizards to three experiments fires in the savanna forests of Kakadu National Park. *Wildlife Research* 21, 131-147

Vigilante T & Bowman DMJS (2004) Effects of fire history on the structure and floristic composition of woody vegetation around Kalumburu, North Kimberley, Australia: a landscape-scale natural experiment. *Australian Journal of Botany* 52, 381-404.

Wayne A, Ward C, Rooney J, Vellios C & Lindenmayer D (2005) The life history of *Trichosurus vulpecula hypoleucus* (Phalangeridae) in the jarrah forest of south-western Australia. *Australian Journal of Zoology* 53, 265-278.

Woinarski J (2004) In a land with few possums, even the common are rare: ecology, conservation and management of possums in the Northern Territory. In R Goldingay & S Jackson (eds). *The biology of Australian possums and gliding possums*, Surrey Beatty and Sons, Sydney. pp. 51-62.

Woinarski J, Armstrong M, Brennan K, Fisher A, Griffiths A, Hill B, Milne D, Palmer C, Ward S, Watson M, Winderlich S & Young S (2010) Monitoring indicates rapid and severe decline of native small mammals in Kakadu National Park, northern Australia. *Wildlife Research* 37, 116-126.

Woinarski J, Legge S, Fitzsimons J, Traill B, Burbidge A, Fisher A, Firth R, Gordon I, Griffiths A, Johnson C & McKenzie N (2011a) The disappearing mammal fauna of northern Australia: context, cause, and response. *Conservation Letters* 4, 192-201.

Woinarski J, Ward S, Mahney T, Bradley J, Brennan K, Ziembicki M & Fisher A (2011b) The mammal fauna of the Sir Edward Pellew Islands, Northern Territory: refuge and death-trap. *Wildlife Research* 38, 307-322.

Woinarski J, Burbidge A & Harrison P (2014) *The Action Plan for Australian Mammals 2012*. CSIRO Publishing.

Wyatt K, Campos P, Gilbert M, Kolokotronis S, Hynes W, DeSalle R, Daszak P, MacPhee R & Greenwood A (2008) Historical mammal extinction on Christmas Island (Indian Ocean) correlates with introduced infectious disease. *PloS one* 3, 3602.

Ziembicki M, Woinarski J & Mackey B (2013) Evaluating the status of species using Indigenous knowledge: novel evidence for major native mammal declines in northern Australia. *Biological Conservation* 157, 78-92.

Other sources cited in the advice

Kerinaiua, C (2019) Personal communication at National Environmental Science Programme Threatened Species Hub Research Showcase, 24 July 2019. Tiwi Land Rangers.

Collective list of questions – your views

SECTION A GENERAL

1. Is the information used to assess the nationally threatened status of the subspecies robust? Have all the underlying assumptions been made explicit? Please provide justification for your response.

2. Can you provide additional data or information relevant to this assessment?

3. Have you been involved in previous state, territory or national assessments of this subspecies? If so, in what capacity?

PART 1 – INFORMATION TO ASSIST LISTING ASSESSMENT

SECTION B DO YOU HAVE ADDITIONAL INFORMATION ON THE ECOLOGY OR BIOLOGY OF THE SUBSPECIES? (If no, skip to section C)

Biological information

4. Can you provide any additional or alternative references, information or estimates on longevity, average life span and generation length?

5. Do you have any additional information in the ecology or biology of the subspecies not in the current advice/plan?

SECTION C ARE YOU AWARE OF THE STATUS OF THE TOTAL NATIONAL POPULATION OF THE SUBSPECIES? (If no, skip to section D)

Population size

6. Has the survey effort for this taxon been adequate to determine its national adult population size? If not, please provide justification for your response.

7. Do you consider the way the population size has been derived to be appropriate? Are there any assumptions and unquantified biases in the estimates? Did the estimates measure relative or absolute abundance? Do you accept the estimate of the total population size of the subspecies? If not, please provide justification for your response.

8. If not, can you provide a further estimate of the current population size of mature adults of the subspecies (national extent)? Please provide supporting justification or other information.

   If, because of uncertainty, you are unable to provide a single number, you may wish to provide an estimated range. If so, please choose one of the ranges suggested in the table below of possible subspecies numbers, and also choose the level of confidence you have in this estimate:

   Number of mature individuals is estimated to be in the range of:

   ☐ >1000 ☐ >10 000 ☐ >15 000 ☐ >20 000

   Level of your confidence in this estimate:

☐ 0–30% - low level of certainty/ a bit of a guess/ not much information to go on

☐ 31–50% - more than a guess, some level of supporting evidence

☐ 51–95% - reasonably certain, information suggests this range

☐ 95–100% - high level of certainty, information indicates quantity within this range

☐ 99–100% - very high level of certainty, data are accurate within this range

SECTION D ARE YOU AWARE OF TRENDS IN THE OVERALL POPULATION OF THE SUBSPECIES? (If no, skip to section E)

9. Does the current and predicted rate of decline used in the assessment seem reasonable? Do you consider that the way this estimate has been derived is appropriate? If not, please provide justification of your response.

Evidence of total population size change

10. Are you able to provide an estimate of the total population size during the early 2000s *(at or soon after the start of the most recent three generation period)*? Please provide justification for your response.

    If, because of uncertainty, you are unable to provide a single number, you may wish to provide an estimated range. If so, please choose one of the ranges suggested in the table below of possible subspecies numbers, and also choose the level of confidence you have in this estimate.

    Number of mature individuals is estimated to be in the range of:

    ☐ >1000 ☐ >10 000 ☐ >15 000 ☐ >20 000

    Level of your confidence in this estimate:

    ☐ 0–30% - low level of certainty/ a bit of a guess/ not much information to go on

    ☐ 31–50% - more than a guess, some level of supporting evidence

    ☐ 51–95% - reasonably certain, information suggests this range

    ☐ 95–100% - high level of certainty, information indicates quantity within this range

    ☐ 99–100% - very high level of certainty, data are accurate within this range

11. Are you able to comment on the extent of decline in the subspecies' total population size over the last approximately 15 years (i.e. three generations)? Please provide justification for your response.

    If, because of uncertainty, you are unable to provide an estimate of decline, you may wish to provide an estimated range. If so, please choose one of the ranges suggested in the table below of ranges of decline, and also choose the level of confidence you have in this estimated range.

    Decline estimated to be in the range of:

☐ 1–30% ☐31–50% ☐51–80% ☐81–100% ☐90–100%

Level of your confidence in this estimated decline:

☐ 0–30% - low level of certainty/ a bit of a guess/ not much information to go on

☐ 31–50% - more than a guess, some level of supporting evidence

☐ 51–95% - reasonably certain, suggests this range of decline

☐ 95–100% - high level of certainty, information indicates a decline within this range

☐ 99–100% - very high level of certainty, data are accurate within this range

12. Please provide (if known) any additional evidence which shows the population is stable, increasing or declining.

SECTION E ARE YOU AWARE OF INFORMATION ON THE TOTAL RANGE OF THE SUBSPECIES? (If no, skip to section F)

Current Distribution/range/extent of occurrence, area of occupancy

13. Does the assessment consider the entire geographic extent and national extent of the subspecies? If not, please provide justification for your response.

14. Has the survey effort for this subspecies been adequate to determine its national distribution? If not, please provide justification for your response.

15. Is the distribution described in the assessment accurate? If not, please provide justification for your response and provide alternate information.

16. Do you agree that the way the current extent of occurrence and/or area of occupancy have been estimated is appropriate? Please provide justification for your response.

17. Can you provide estimates (or if you disagree with the estimates provided, alternative estimates) of the extent of occurrence and/or area of occupancy.

    If, because of uncertainty, you are unable to provide an estimate of extent of occurrence, you may wish to provide an estimated range. If so, please choose one of the ranges suggested in the table below of ranges of extent of occurrence, and also choose the level of confidence you have in this estimated range.

    Current extent of occurrence is estimated to be in the range of:

    ☐ <100 km^2 ☐ 100 – 5 000 km^2 ☐ 5 001 – 20 000 km^2 ☐ >20 000 km^2

    Level of your confidence in this estimated extent of occurrence

    ☐ 0–30% - low level of certainty/ a bit of a guess/ not much data to go on

    ☐ 31–50% - more than a guess, some level of supporting evidence

    ☐ 51–95% - reasonably certain, data suggests this range of decline

    ☐ 95–100% - high level of certainty, data indicates a decline within this range

☐ 99–100% - very high level of certainty, data is accurate within this range

If, because of uncertainty, you are unable to provide an estimate of area of occupancy, you may wish to provide an estimated range. If so, please choose one of the ranges suggested in the table below of ranges of area of occupancy, and also choose the level of confidence you have in this estimated range.

Current area of occupancy is estimated to be in the range of:

☐ <10 km^2 ☐ 11 – 500 km^2 ☐ 501 – 2000 km^2 ☐ >2000 km^2

Level of your confidence in this estimated extent of occurrence:

☐ 0–30% - low level of certainty/ a bit of a guess/ not much data to go on

☐ 31–50% - more than a guess, some level of supporting evidence

☐ 51–95% - reasonably certain, data suggests this range of decline

☐ 95–100% - high level of certainty, data indicates a decline within this range

☐ 99–100% - very high level of certainty, data is accurate within this range

SECTION F ARE YOU AWARE OF TRENDS IN THE TOTAL RANGE OF THE SUBSPECIES? (If no, skip to section G)

Past Distribution/range/extent of occurrence, area of occupancy

18. Do you consider that the way the historic distribution has been estimated is appropriate? Please provide justification for your response.

19. Can you provide estimates (or if you disagree with the estimates provided, alternative estimates) of the former extent of occurrence and/or area of occupancy.

    If, because of uncertainty, you are unable to provide an estimate of past extent of occurrence, you may wish to provide an estimated range. If so, please choose one of the ranges suggested in the table below of ranges of past extent of occurrence, and also choose the level of confidence you have in this estimated range.

    Past extent of occurrence is estimated to be in the range of:

    ☐ <100 km^2 ☐ 100 – 5 000 km^2 ☐ 5 001 – 20 000 km^2 ☐ >20 000 km^2

    Level of your confidence in this estimated extent of occurrence

    ☐ 0–30% - low level of certainty/ a bit of a guess/ not much data to go on

    ☐ 31–50% - more than a guess, some level of supporting evidence

    ☐ 51–95% - reasonably certain, data suggests this range of decline

    ☐ 95–100% - high level of certainty, data indicates a decline within this range

    ☐ 99–100% - very high level of certainty, data is accurate within this range

If, because of uncertainty, you are unable to provide an estimate of past area of occupancy, you may wish to provide an estimated range. If so, please choose one of the ranges suggested in the table below of ranges of past area of occupancy, and also choose the level of confidence you have in this estimated range:

Past area of occupancy is estimated to be in the range of:

☐ <10 km^2 ☐ 11 – 500 km^2 ☐ 501 – 2000 km^2 ☐ >2000 km^2

Level of your confidence in this estimated extent of occurrence:

☐ 0–30% - low level of certainty/ a bit of a guess/ not much data to go on

☐ 31–50% - more than a guess, some level of supporting evidence

☐ 51–95% - reasonably certain, data suggests this range of decline

☐ 95–100% -high level of certainty, data indicates a decline within this range

☐ 99–100% - very high level of certainty, data is accurate within this range

PART 2 – INFORMATION FOR CONSERVATION ADVICE ON THREATS AND CONSERVATION ACTIONS

SECTION G DO YOU HAVE INFORMATION ON THREATS TO THE SURVIVAL OF THE SUBSPECIES? (If no, skip to section H)

20. Do you consider that all major threats have been identified and described adequately?

21. To what degree are the identified threats likely to impact on the subspecies in the future?

22. Are the threats impacting on different populations equally, or do the threats vary across different populations?

23. Can you provide additional or alternative information on past, current or potential threats that may adversely affect the subspecies at any stage of its life cycle?

24. Can you provide supporting data/justification or other information for your responses to these questions about threats?

SECTION H DO YOU HAVE INFORMATION ON CURRENT OR FUTURE MANAGEMENT FOR THE RECOVERY OF THE SUBSPECIES? (If no, skip to section I)

25. What planning, management and recovery actions are currently in place supporting protection and recovery of the subspecies? To what extent have they been effective?

26. Can you recommend any additional or alternative specific threat abatement or conservation actions that would aid the protection and recovery of the subspecies?

27. Would you recommend translocation (outside of the subspecies' historic range) as a viable option as a conservation actions for this subspecies?

SECTION I DO YOU HAVE INFORMATION ON STAKEHOLDERS IN THE RECOVERY OF THE SUBSPECIES?

28. Are you aware of other knowledge (e.g. traditional ecological knowledge) or individuals/groups with knowledge that may help better understand population trends/fluctuations, or critical areas of habitat?

29. Are you aware of any cultural or social importance or use that the subspecies has?

30. What individuals or organisations are currently, or potentially could be, involved in management and recovery of the subspecies?

31. How aware of this subspecies are land managers where the species is found?

32. What level of awareness is there with individuals or organisations around the issues affecting the subspecies?

    a. Where there is awareness, what are these interests of these individuals/organisations?

    b. Are there populations or areas of habitat that are particularly important to the community?

PART 3 – ANY OTHER INFORMATION

33. Do you have comments on any other matters relevant to the assessment of this subspecies?