



Consultation Document on Listing Eligibility and Conservation Actions

***Mixophyes fleayi* (Fleay's Barred Frog)**



Mixophyes fleayi (image: M. Mahony, University of Newcastle)

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

- 1) the eligibility of *Mixophyes fleayi* (Fleay's Barred Frog) for inclusion on the EPBC Act threatened species list in the **Endangered** category and
- 2) the necessary conservation actions for the above species.

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.

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 Agriculture, Water and the Environment
PO Box 787
Canberra ACT 2601

Responses are required to be submitted by 24 July 2020.

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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.

Mixophyes fleayi

Fleay's Barred Frog

Taxonomy

Conventionally accepted as *Mixophyes fleayi* Corben & Ingram, 1987. No subspecies are recognised.

Species/Sub-species Information

Description

Mixophyes fleayi (Fleay's Barred Frog) is a large burrowing frog endemic to mid-eastern Australia. Females are larger than males, having a snout-to-vent length (SVL) of over 90 mm and weighing over 100 g. Males reach 80 mm (SVL) and weigh up to 59 g. The skin is finely granular above and smooth below. The dorsal surface is light to dark brown, with indistinct darker marbling. Typical of barred frogs, an irregular, dark, vertebral stripe is present. The Y-shaped stripe commences between the eyes and extends to the vent, sometimes breaking up into a series of blotches along the midline. The flanks are grey-brown, fading to yellow posteriorly, and overlaid by a series of black spots. The ventral surface is typically yellow. The snout is steeply sloped and blunt, with an irregular dark band running from the nostrils, through the eye, to a point behind the large, oval tympanum. The eyes are prominent, with a dark purple patch visible beneath. The upper part of the iris may be straw-brown through light blue to silvery-white. The pupil is vertical. The upper lip is usually mottled brown with one or more purplish-brown blotches. A vocal sac is present in adult males. The thighs are grey-brown with seven or eight narrow, black cross-bands. The fingers are not webbed, whilst the feet are about one-third webbed. The tips of the fingers and toes do not have disc-like pads. The soles and palms are black. Males develop dark brown nuptial pads on the prepollex, first finger, and sometimes the second finger.

Fleay's Barred Frog is similar to other frogs in the genus *Mixophyes*, particularly *M. balbus* (Stuttering Frog), from which it can be distinguished by the presence of mottling on the flanks as well as differences in the male advertisement calls. The male Fleay's Barred Frog makes a throaty "ok-ok-ok-ok-ok" or a long, rasping "arrrrk" call from leaf litter beside streams during spring and summer. The description of the adult is drawn from Corben & Ingram (1987); Meyer et al. (2001); Hines (2012); Cogger (2014); and Anstis (2017).

Metamorphs have been measured at 20 mm (SVL). They closely resemble adults except that they are a dull bronze coloration with less distinct markings and the upper third of the iris is copper-red (Anstis 2017).

Tadpoles are large (growing to 100 mm in length), with a fusiform body and a thick, muscular tail that is twice the length of the body. The tail fins are opaque and have scattered dark spots and splotches. The limb buds and vent tube lie within a translucent 'skirt' at the base of the tail. From above, tadpoles are almost black in early stages, whilst the underside is a silver-grey colour. A fine layer of gold or rusty brown pigment gradually covers the entire body as the tadpole grows (except for a darker patch across the base of the body). The intestinal mass is fully obscured, with the heart and gills barely visible. Eyes are positioned dorsolaterally and the iris is golden. The mouth is sub-terminal with a large oral disc surrounded by papillae. The spiracle is sinistral and opens lateroventrally near the midpoint of the body. The description of the tadpole is drawn from Meyer et al. 2001; and Anstis 2017.

Distribution

Fleay's Barred Frog is patchily distributed in montane areas in far south-east Queensland and far north-east NSW. The species has been recorded from the Conondale Range, Queensland (40 km inland from the Sunshine Coast) to Yabbra National Park (NP), NSW (110 km inland from Byron Bay) (Hines et al. 1999; Doak 2005; Stratford et al. 2010; Anstis 2017), and as far

west as Tooloom NP, NSW (D Newell 2020. pers comm 15 April). Within this narrow range, it is known from 30 scattered sites (Newell et al. 2013), mostly within National Parks (Hines 2012).

Mitochondrial DNA analysis conducted by Doak (2005) identified two distinct areas of genetic endemism either side of the Brisbane River Valley, with isolation of the Conondale Range in the north from all other subpopulations to the south. This regional isolation could date back to rainforest fragmentation during the Pliocene (5.3 million to 2.14 million years ago). Doak (2005) proposed that these divergent and geographically isolated lineages are separate Evolutionarily Significant Units warranting independent conservation and management actions.

In Queensland, the species is known from Conondale NP, Lamington NP, Springbrook NP, Main Range NP, Mount Barney NP, Adjinbilly Nature Refuge and from private properties in the headwaters of Tallebudgera Creek and Condamine River. However, sometime during the 1970-1990s, Fleay's Barred Frog declined and disappeared from some previously known sites, largely as a result of disease (later identified as chytridiomycosis) (Newell et al. 2013; Newell 2018). Surveys did not record the Fleay's Barred Frog in the Mount Tamborine area, the Bunya Mountains, and downstream sites in the Conondale Range (Goldingay et al. 1999; Hines & the South-east Queensland Threatened Frogs Recovery Team 2002; Hines 2012). Whether Fleay's Barred Frog experienced declines at other sites is difficult to assess due to a lack of survey data before the early 1990s. However, the very low numbers recorded from many well surveyed sites in the late 1990 to early 2000s suggest that this may have occurred (Hines & the South-east Queensland Threatened Frogs Recovery Team 2002).

Fleay's Barred Frog is also thought to have declined in NSW, with surveys (1995–2000) finding the species restricted to a number of disjunct sites within its former distribution. The species was recorded at sites within Border Ranges NP, Tooloom NP, Yabbra NP, Wollumbin NP, and Nightcap NP. However, subsequent searches failed to find frogs at some previously populated sites within these locations, including Sheepstation creek (Border Ranges NP) and Mt Warning (Wollumbin NP) (DPIE 2000).

Following this decline, Fleay's Barred Frog was thought to have been generally recovering in Queensland during the late 1990s and early 2000s (H Hines 2020 per. comm 14 May) and a recovery at some sites in NSW had been demonstrated. Mark-recapture studies by Newell et al. (2013) showed recovery at Brindle Creek (Border Ranges NP) and Tuntable Falls (Nightcap NP) over a seven-year period (2001-2008). At Brindle Creek, numbers increased tenfold (from 6 to 60 individuals), and at Tuntable Falls, numbers increased threefold (19 to 57 individuals). Quick et al. (2015) showed a subpopulation at high elevations in the Border Ranges NP had remained relatively stable over a 10-year period, and at Terania Creek (Nightcap NP) Fleay's Barred Frog has slowly returned, following its disappearance in the early 1990s.

Relevant Biology/Ecology

Fleay's Barred Frog is a ground-dwelling amphibian, inhabiting montane rainforest and adjoining wet sclerophyll forest habitat (Doak 2005; Anstis 2017). The species mostly occurs at higher altitudes (above 400 m) but has been found at elevations ranging from 100–1000 m (Goldingay et al. 1999; Hines & the South-east Queensland Threatened Frogs Recovery Team 2002). Fleay's Barred Frog is an obligate stream breeder, relying on permanent and semi-permanent freshwater streams for breeding habitat (Hines & the South-east Queensland Threatened Frogs Recovery Team 2002). Habitat critical to the survival of the species is usually defined in terms of stream environments but terrestrial habitat may be of greater importance to species recovery, with females spending most of their time (often at a significant distance) away from breeding sites, including along ridge tops (Hines & the South-east Queensland Threatened Frogs Recovery Team 2002; Doak 2005). Newell et al. (2013) identified longevity of adults as central to buffering the population from periods of low recruitment and of greater importance than increased egg or tadpole survival in streams.

Observation of the movement patterns of Fleay's Barred Frog reveal that adult males display high levels of philopatry, staying in the leaf litter around established breeding sites, whilst females and sub-adults punctuate small localised movements with larger movements, travelling

many hundreds of metres away. These movements may allow females to disperse between neighbouring breeding sites. However, genetic analysis on mitochondrial DNA has shown subpopulations separated by as little as two km to be genetically significantly different from each other, indicating low gene flow (interbreeding) between sub-catchments (Doak 2005).

Gene flow is believed to be restricted by geographical distance, the presence of potential landscape barriers, the availability of interconnecting suitable habitat, and environmental conditions. Dry, lowland areas are thought to act as effective barriers to dispersal and, instead, females are believed to move between sub-catchments along shared mountain ridge-tops, with the extent of the shared boundary increasing the probability and magnitude of gene flow. However, females often display a preference for familiar breeding sites, returning from surrounding ridge-tops to the same site in subsequent seasons. This apparent breeding site fidelity by both males and females reduces the likelihood of Fleay's Barred Frog successfully colonising or recolonising vacant habitat in the event of subpopulation extinction (Doak 2005).

Breeding occurs under suitable conditions from July to March, with males calling at dusk and into the night from rock or debris perches in or adjoining the stream, as well as from under leaf litter near the stream (O'Reilly & Hines 2002, Hines 2012). For successful breeding, the species has specialised site requirements with favourable environmental conditions that are thought to reduce the chance of egg predation from fish and large tadpoles. Fleay's Barred Frog can form large breeding aggregations, where males physically compete for access to females. Stratford et al. (2010) observed that the number of individuals comprising a chorus was highly variable and significantly related to ambient temperature and stream height, which (with rainfall, humidity and wind intensity) accounted for most of the variation in aggregation size. Cooler conditions reduce breeding activity and Fleay's Barred Frog does not appear to breed during or immediately after heavy rain. Rather, the species breeds shortly after stream flow has slowed towards basal flow, with egg deposition only occurring where shallow stream riffles form. A non-foamy egg mass of up to 1000 eggs is deposited either into a rounded nest depression in the substrate or occasionally directly onto bedrock (Knowles et al. 2015). Tadpoles are long-lived and present year round at some sites, taking six months to two years to complete their development (Hines & the South-east Queensland Threatened Frogs Recovery Team 2002; Hines 2012).

The diet of Fleay's Barred Frog is not known, although other *Mixophyes* species feed on arthropods, arachnids, amphipods, centipedes, millipedes, gastropods, nematodes, skinks and other anuran species (Lemckert & Shoulder 2007; Martin & Murray 2011). The diet of the tadpole is also poorly known, although observations of tadpole feeding include algae, detritus and carrion (Anstis 2002, Meyer & Hines 2004).

The generational length of Fleay's Barred Frog is not known but is estimated to be four to five years. A capture-mark-recapture study by Newell et al. (2013) found individual frogs recurring throughout the six-year study, and Morrison et al. (2004) identified males ranging between two-six years and females three-eight years of age at breeding sites, with most males and females four years of age.

Threats

Table 1: Threats impacting the Fleay's Barred Frog in approximate order of severity of risk, based on available evidence

Number	Threat factor	Threat type and status	Evidence base
1.0	Habitat loss and fragmentation		
1.1	Vegetation clearance/habitat fragmentation	known current	Large-scale clearing has resulted in much of the remaining subtropical montane rainforest along the Great Dividing Range of south-east

			<p>Queensland and north-east NSW being reduced to a discontinuous arc (Hagger et al. 2013).</p> <p>Through mapping habitat quality, measuring metapopulation capacity, and predicting occupancy patterns of Fleay's Barred Frog across north-eastern NSW, Drielsma and Ferrier (2009) predicted that the species will likely be restricted to just five locations, each separated by approximately 20 km from the next nearest subpopulation. Connecting habitat was deemed to be of low value and was evaluated to have a high metapopulation extinction risk.</p> <p>Historic fragmentation has occurred in the Queensland population, with two distinct areas of genetic endemism either side of the Brisbane River Valley identified by Doak (2005), with the Conondale Range subpopulation isolated in the north from all other subpopulations to the south.</p> <p>This fragmentation and isolation of subpopulations across the distribution range, together with the low dispersal ability (and associated poor recolonisation potential) of the species (Doak 2005), reduces the likelihood of recovery from future extreme events (Drielsma & Ferrier 2009; Hagger et al. 2013; Newell et al. 2013).</p> <p>More generally, upstream clearing of habitat, and disturbances such as timber harvesting and urban development, may reduce water quality and flow regimes. Increased sedimentation in streams can result in filling of crevices in stream substrates, reducing the availability of suitable oviposition sites or refugia for tadpoles (Welsh & Ollivier 1998).</p>
2.0	Climate Change		
2.1	Increased temperature intensity/frequency and change to precipitation patterns	known current	<p>Climate change is expected to cause a pronounced increase in extinction risk for anuran species over the coming century (Hagger et al. 2013; Pearson et al. 2014). Climate projections for eastern Australia include reduced rainfall, increased average temperatures, and more frequent droughts. These conditions will increase the scale, frequency and intensity of wildfires (CSIRO 2007; CSIRO & Bureau of Meteorology 2015) and could severely impact the duration and seasonality of stream breeding sites, thereby lowering frog recruitment (Lemckert and Penman 2012).</p> <p>Climate change impacts are compounded by Fleay's Barred Frog's restricted area of</p>

			<p>occupancy, low population density at sites, prevalence at higher altitudes (above 400 m), short generation length (under 10 years), and large body size. These variables are identified as increasing the risk of local extinction (Oza et al. 2012; Hagger et al. 2013; Pearson et al. 2014) and are amongst the strongest predictors of species' vulnerability to climate change (Pearson et al. 2014).</p> <p>Tanner-McAllister et al. (2018) developed conceptual models for four World Heritage National Parks to predict the likely impact to stream-dwelling frogs from climate change. The models showed a higher probability of a decreasing population under increasing severity of climate change, even under a 'good' management scenario. An increase in wildfire events was found to be the most detrimental impact, giving a higher probability of a decreasing population under both moderate and substantial climate change models, with the most severe scenario resulting in over a 50 percent probability that there would be a population decrease.</p>
2.2	Increased intensity/frequency of wildfire	known current	<p>Localised extinction of anurans has been observed through wildfire events. Penman et al. (2006) observed that temperate Australian frog species generally have a critical thermal limit of 34–38 °C. Burrowing by Fleay's Barred Frog is restricted to the leaf litter and very upper top-soil, providing little protection from the heat generated by wildfire. At particular risk are adult female frogs, who spend most of their time (often at a significant distance) away from stream breeding sites, including along ridge tops (Hines & the South-east Queensland Threatened Frogs Recovery Team 2002; Doak 2005)</p> <p>Wildfire can adversely affect stream breeding habitat: increasing water temperature, altering water chemistry (Lyon & O'Connor 2008), and creating sediment/ash runoff 'slugs' that can form in waterways following rainfall (Lyon & O'Connor 2008; Alexandra & Finlayson 2020). These slugs can fill in crevices in stream substrates, reducing the availability of refugia for tadpoles (Welsh & Ollivier 1998), and promote toxic algal blooms (Alexandra & Finlayson 2020) that can deoxygenate the water and cause egg and tadpole death. Sediment slugs are known to impact aquatic ecosystems up to 80 km downstream of burnt areas (Lyon & O'Connor 2008), greatly increasing the impact to stream dependent species outside of the immediate</p>

			<p>burnt area. Impacts from these slugs can persist for a significant period of time. Following the 2006-07 fires in Victoria (which burnt over 32 percent of the Gippsland Lakes' catchment), rains washed an extremely high nutrient load into the lakes, which prompted a <i>Synechococcus</i> algal bloom that persisted until the winter of 2008 (Alexandra & Finlayson 2020).</p> <p>In 2019-20, following years of drought (DPI 2020), catastrophic wildfire conditions culminated in fires that covered an unusually large area of eastern and southern Australia. In many places, the fires burnt with high intensity. The full impact of the 2019-20 bushfires has yet to be determined. The bushfires will not have impacted all areas equally: some areas burnt at very high intensity whilst other areas burnt at lower intensity, potentially even leaving patches unburnt within the fire footprint. However, an initial analysis estimates that 10–30 percent of the distribution range of Fleay's Barred Frog was impacted. This sort of event is increasingly likely to reoccur as a result of climate change.</p>
3.0	Disease		
3.1	Chytridiomycosis caused by chytrid fungus	known current	<p>Chytridiomycosis is an infectious disease caused by the amphibian chytrid fungal pathogen <i>Batrachochytrium dendrobatidis</i> (<i>Bd</i>). Infected populations exhibit diverse susceptibility to <i>Bd</i>. Some species do not exhibit any apparent symptoms, whilst others are extremely vulnerable, resulting in mass die-off and extinction (DOEE 2016).</p> <p>Studies have shown that Fleay's Barred Frog is impacted by <i>Bd</i>, with the pathogen identified as the cause of death of individuals from a number of sites (Berger et al 1998, Murray et al 2010). Tadpoles are known to carry <i>Bd</i> in their mouthparts, and a study by Hines (2012) showed the prevalence in the tadpole population to be close to 100 percent in the Main Range NP. Ingram & McDonald (1993) suggested that species abundance dropped by up to 90 percent across the geographic range, largely as a result of disease (later identified as chytridiomycosis).</p> <p>Eradicating <i>Bd</i> is difficult. Some amphibian species are reasonably tolerant, acting as a natural reservoir, spreading the pathogen, which persists even at low host densities. There is no evidence that <i>Bd</i> has disappeared from any location in eastern Australia (Voyles et al. 2009; Newell et al. 2013).</p>

			<p>However, recovery of Fleay's Barred Frog at sites has been shown in the presence of <i>Bd</i> (Hines 2012; Newell et al. 2013). Mark-recapture studies found the number of individuals in two separate sites increased three-tenfold over a seven-year period (Newell et al. 2013). In addition, Quick et al. (2015) showed a subpopulation at high elevations in the Border Ranges in NSW has remained relatively stable over a 10-year period.</p> <p>Despite signs of recovery, Fleay's Barred Frog may still be vulnerable to future declines from <i>Bd</i>. Monitoring reveals Fleay's Barred Frog remains absent from some historic locations, with other subpopulations characterised by low abundance (Newell et al. 2013; Newell 2018).</p>
4.0	Invasive species		
4.1	Habitat damage by Feral Pigs (<i>Sus scrofa</i>).	known current	<p>Feral pigs are found in all states and territories of Australia, particularly in association with wetlands and river systems (DOEE 2017a). Large areas of habitat, containing known Fleay's Barred Frog subpopulations, has been damaged by feral pigs in the Conondale NP, Main Range NP and Yabbra NP.</p> <p>Although there may be direct predation by pigs, the greatest effect is likely to be the impact of increased silt on embryos and tadpoles (Hines & the South-east Queensland Threatened Frogs Recovery Team 2002). By wallowing and rooting, feral pigs modify streambanks and increase erosion (DOEE 2017a). Increased sedimentation can result in the filling of crevices in stream substrates, reducing the availability of suitable oviposition sites or refugia for tadpoles (Welsh & Ollivier 1998). This is likely to be a significant threat to Fleay's Barred Frog as their tadpoles take between six months to two years to complete development (Hines & the South-east Queensland Threatened Frogs Recovery Team 2002; Hines 2012).</p>
4.2	Habitat damage by domestic stock	known current	<p>Areas of habitat have been damaged by domestic cattle trampling in Lamington NP and Main Range NP, with effects on water quality similar to those described above for feral pigs (Hines & the South-east Queensland Threatened Frogs Recovery Team 2002). However, there has been successful fencing of streams in these two NPs, with marked improvements in water quality and habitat (Hines 2020. pers comm 14 May).</p>

4.3	Invasive weeds	potential current	<p>Mistflower (<i>Ageratina riparia</i>), Crofton Weed (<i>A. adenophora</i>), and Lantana (<i>Lantana camara</i>) are highly invasive weeds that occur along wet forest stream habitat. The effect of these weeds is not known, but they may have negative impacts by reducing the area of sites suitable for egg laying (Hines & the South-east Queensland Threatened Frogs Recovery Team 2002; Hines 2012).</p> <p>Changes to invertebrate assemblages brought about by exotic plant invasion may also impact Fleay's Barred Frog by altering the availability and composition of invertebrates, which are an important component of the diet of <i>Mixophyes</i> species (Lemckert & Shoulder 2007; Martin & Murray 2011).</p>
4.4	Predation by introduced and native species, including feral cats (<i>Felis catus</i>), <i>Cherax destructor</i> (Freshwater Yabby), and introduced fish species.	suspected current	<p>Little is known about predation on Fleay's Barred Frog but introduced predators may present a threat to both adults and tadpoles.</p> <p>The extent of predation by feral cats on adult frogs is unknown. However, in the aftermath of a fire, survivors may be isolated in an environment without shelter (leaf litter) and thereby become far easier to catch (Leahy et al. 2015; McGregor et al. 2015). In addition, the number of predators attracted to the area (Hradsky et al. 2017) and predator activity (Leahy et al. 2015) increase where habitat has been modified through frequent or intense burning.</p> <p>The presence of the Freshwater Yabby in virtually all coastal drainage systems in NSW has the potential to cause the local extirpation of fragmented subpopulations of Fleay's Barred Frog. Predation on Fleay's Barred Frog by the Freshwater Yabby has not been observed but known yabby behaviour includes stalking and hunting for frogs and tadpoles. Fleay's Barred Frog breeds in streams that are suitable for Freshwater Yabby invasion and are considered at high risk from this species. In addition, Fleay's Barred Frog lay their eggs in a single mass, making them more susceptible to being eaten by the Freshwater Yabby (Coughran & Daly 2012).</p> <p>Limited research has been carried out in Australia on the impact of introduced fish upon amphibian assemblages. However, Fleay's Barred Frog, as an obligate stream breeder, is a species identified as likely to be affected by exotic fish, such as the Plague Minnow (<i>Gambusia holbrooki</i>). Fish are known to be a major influence on amphibian assemblage structure, and the introduction of exotic fish to</p>

			aquatic systems has the potential to eliminate amphibian species through tadpole predation (Gillespie and Hero 1999).
4.5	Habitat competition from invasive Cane Toad (<i>Rhinella marina</i>)	potential current	<p>The distribution and abundance of the Cane Toad has rapidly increased in Australia. Recent surveys have found individuals in high elevation rainforests of the Border Ranges. This region contains one of the largest known Fleay's Barred Frog subpopulations in NSW. The Cane Toad was not previously known from high altitude rainforests and was considered unlikely to occupy this habitat type (Newell 2011). In addition, following the 2019-20 bushfires, juvenile toads have been observed moving through burnt rainforest in Lamington NP (H Hines 2020. pers comm 14 May).</p> <p>Impacts of the arrival of the Cane Toad on Fleay's Barred Frog are not understood but Newell (2011) proposed that it may compete for food and shelter sites. The Cane Toad may also act as a vector for introduced parasites and pathogens, including <i>Bd</i>.</p>
5.0	Human disturbance		
5.1	Visitors to National Parks	Known current	<p>With increased tourism to National Parks, there is a greater number of vehicles travelling through the distribution range of Fleay's Barred Frog, increasing the chance of frog road-kill, particularly of females that sit on or move across roads on wet nights. Female frogs are the main source of gene flow between catchments (Doak 2005) and road-kill could, therefore, have negative impacts for gene flow between catchments.</p> <p>Increased use of waterways by national parks visitors can impact on frog recruitment. Walking tracks that cross streams where frogs lay eggs are at risk of trampling, with damage to streambanks and direct mortality of eggs and tadpoles.</p>

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%
<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><i>based on any of the following</i></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:

The generation length for Fleay's Barred Frog is not known with certainty, but it is estimated to be four-five years based on studies (Morrison et al. 2004; Newell et al. 2013). This gives a timeframe of 12–15 years for this criterion.

The population size of Fleay's Barred Frog is also not known with certainty (Hines 2012; Quick et al. 2015). However, it is considered likely under 10 000 individuals, given the very low numbers recorded from many well surveyed sites (Goldingay et al. 1999; Hines & the South-east Queensland Threatened Frogs Recovery Team 2002) and species disappearance from some previously known sites (Goldingay et al. 1999; DPIE 2000; Hines & the South-east Queensland Threatened Frogs Recovery Team 2002; Hines 2012; Newell et al. 2013; Newell 2018). A total of just 1722 records of Fleay's Barred Frog are recorded in the Atlas of Living Australia (as of 20 April 2020), with the majority (1217) recorded in the decade 2000-2009 (ALA 2020).

A substantial decline in the population (estimated up to 90 percent) is believed to have occurred, predominantly in the 1970s to early 1990s (Ingram & McDonald 1993; Hines et al. 1999; Hines 2002; Newell et al. 2013; Quick et al. 2015; Berger et al. 2016), with chytridiomycosis identified as the likely cause (Laurance et al. 1996; Hero & Morrison 2004; Berger et al. 2016). This decline was not based on empirical data, due to a lack of surveys prior to the early 1990s (Hines & the South-east Queensland Threatened Frogs Recovery Team 2002), but resulted in Fleay's Barred Frog being listed as Endangered under the *EPBC Act* (DoEE 2017b).

This decline took place over 30 years ago and is outside of the three generation timeframe. In addition, Fleay's Barred Frog was thought to have been generally recovering in Queensland (H Hines 2020 per. comm 20 April) and a recovery at some sites in NSW had been demonstrated (Newell et al. 2013). However, the resulting absence of the species from some historic locations, very low abundance at others, and isolation of remaining subpopulations (Hines & the South-east Queensland Threatened Frogs Recovery Team 2002; Newell et al. 2013; Newell

2018), together with the low dispersal ability (and associated poor recolonisation potential) of the species (Doak 2005), has reduced the likelihood of species recovery from extreme events associated with climate change or disease (Drielsma & Ferrier 2009; Hagger et al. 2013; Newell et al. 2013).

Fleay's Barred Frog has been identified as having physiological and ecological traits that confer both low resistance and low resilience to climate change, and therefore is highly vulnerable to climate change. In particular, the species' specialised breeding requirements may be impacted by reduced rainfall and increased temperatures, whilst an increased frequency and intensity of bushfires pose both a direct and indirect threat to the species (Hagger et al. 2013). A conceptual model by Tanner-McAllister (2018) showed a higher probability of a decreasing population under increasing severity of climate change, even under a 'good' management scenario.

The full impact of the 2019-20 bushfires on Fleay's Barred Frog has yet to be determined but the population is likely significantly reduced, with 10–30 percent of the Fleay's Barred Frog's distribution range overlapping with the fire-affected areas. These fires covered an unusually large area and, in many places, burnt with an unusually high intensity. The full impact of the bushfires on Fleay's Barred Frog has yet to be fully examined but the extent of potential mortality as a result of fire and the unfavourable post-fire conditions (loss of shelter, increased susceptibility to predators, and loss of food-stuff), as well as a reduction in future recruitment (egg and tadpole death and stream breeding site degradation), has led the Department to identify it as one of the highest priority species for urgent management intervention (DAWE 2020b).

Early observations in Queensland are that areas of habitat with known subpopulations of Fleay's Barred Frog have burnt in Main Range NP, Lamington NP and Mount Barney NP. Significant mortality (particularly of juveniles and adult females) is likely in subcatchments where fire was widespread (e.g. Burnett Creek catchment, Mt Barney NP) or where it burnt along the stream banks or stream bed. Post-fire sediment slugs have been observed within occupied subcatchments, impacting oviposition site availability. However, significant subpopulations in Lamington NP, Border Ranges NP, and the large subpopulation in the Dalrymple Creek catchment (Main Range NP) were not affected by the fires. In addition, fire severity mapping and ground-truthing has shown some relatively large unburnt areas of wet forests within the mapped burn extents in Mount Barney NP and Main Range NP (H Hines 2020. pers comm 14 May).

Given the signs of species recovery before the 2019-20 bushfires and the early indications that the population reduction following the fires is likely under 30 percent (the upper limit of overlap between the frog's distribution range and fire affected areas), a population reduction great enough to meet the threshold under this criterion is not inferred or suspected. 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 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 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:

Fleay's Barred Frog is sparsely distributed along a small, mid-eastern section of the Great Dividing Range. Based on the mapping of point records for a 20-year time period (1997-2017) (obtained from state governments, museums and CSIRO) the Extent of Occurrence (EOO) has been estimated at 13 166 km², and the Area of Occupancy (AOO) at 112 km². 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. The EOO meets the threshold for listing as Vulnerable under sub criterion B1 and the AOO meets the threshold for listing as Endangered under sub criterion B2.

Due to large-scale clearing of lowland subtropical rainforest, much of the remaining habitat across the distribution range of Fleay's Barred Frog occurs in a discontinuous arc (Hagger et al. 2013), with Fleay's Barred Frog known from just 30 scattered sites (Newell et al. 2013), mostly within National Parks (Hines 2012). Subpopulations separated by as little as two km demonstrate significant genetic differences from each other, indicating a low level of interaction between individuals from different sites (Doak 2005). In addition, analysis conducted by Drielsma and Ferrier (2009) demonstrated that most of the NSW subpopulations are not viable. Mapping habitat quality and measuring metapopulation capacity, they predicted that occupancy of Fleay's Barred Frog would be reduced to just five sites, each separated by approximately 20 km from the next nearest subpopulation. Connecting habitat was deemed to be of low value and was evaluated to have a high extinction risk. Similar fragmentation has occurred in the Queensland population, with two distinct areas of genetic endemism either side of the Brisbane River Valley identified by Doak (2005), with the Conondale Range subpopulation historically isolated in the north from all other subpopulations to the south. The Fleay's Barred Frog population is therefore considered severely fragmented, meeting sub criterion (a), with a projected greater than 50 percent of AOO containing habitat patches that are not viable and with habitat patches separated by large distance (IUCN 2019).

Based on ongoing threats, the Fleay's Barred Frog population is projected to continue to decline in EOO, AOO, extent and quality of habitat, number of locations or subpopulations, and number of mature individuals, thereby meeting sub criterion (b) (i,ii,iii,iv,v) (Hero et al. 2006). In particular, the small population size of Fleay's Barred Frog, already high degree of isolation of subpopulations (Hines & the South-east Queensland Threatened Frogs Recovery Team 2002; Newell et al. 2013; Newell 2018), and the low dispersal ability (and associated poor recolonisation potential) of the species (Doak 2005), reduces the likelihood of recovery from extreme events, such as climate change or disease (Drielsma & Ferrier 2009; Hagger et al. 2013; Newell et al. 2013) (as identified in Criterion 1).

Disease and climate change have already greatly impacted the population, with a decline in the 1970s to 1990s, likely as a result of chytridiomycosis (Ingram & McDonald 1993; Laurance et al.

1996; Hines et al. 1999; Hines 2002; Hero & Morrison 2004; Newell et al. 2013; Quick et al. 2015; Berger et al. 2016), and the impact of the 2019-20 bushfires suspected to be significant, with 10–30 percent of the distribution range of Fleay’s Barred Frog overlapping with the fire-affected areas (DAWE 2020b). Further, Fleay’s Barred Frog has been identified as having physiological and ecological traits that confer both low resistance and low resilience to climate change, and therefore is highly vulnerable to climate change (Hagger et al. 2013; Tanner-McAllister 2018).

The data presented above appear to demonstrate that the species is **eligible for listing as Endangered (B2(a)(b)(i, ii, iii, iv & v))** 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:

The population size of Fleay’s Barred Frog is not known with certainty (Hines 2012; Quick et al. 2015), but a small population size is suspected and considered likely under 10 000 mature individuals (see Criterion 1), meeting the threshold for listing as Vulnerable.

Following the recent 2019-20 bushfires, and into the immediate future (within three generations), a substantial population reduction is projected (as identified in Criterion 1). The direct and indirect impacts of the bushfires are the primary factors in this decline, with the surviving population further fragmented and less likely to recover from extreme events, such as climate change and disease (Drielsma & Ferrier 2009; Hagger et al. 2013; Newell et al. 2013). The Committee projects the extent of the decline to be over 10 percent (the lower limit of overlap between the frog’s distribution range and fire affected areas). This level of decline meets the threshold for listing as Vulnerable under sub criterion C1.

The data presented above appear to demonstrate that the species is **eligible for listing as Vulnerable (C1)** 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 (Medium-term future) ¹
Number of mature individuals	< 50	< 250	< 1,000
D2 ¹ Only applies to the Vulnerable category Restricted area of occupancy or number of locations with a plausible future threat that could drive the species to critically endangered or Extinct in a very short time	-	-	D2. Typically: area of occupancy < 20 km ² or number of locations ≤ 5

¹ The IUCN Red List Criterion D allows for species to be listed as Vulnerable under Criterion D2. The corresponding Criterion 4 in the EPBC Regulations does not currently include the provision for listing a species under D2. As such, a species cannot currently be listed under the EPBC Act under Criterion D2 only. However, assessments that demonstrate eligibility for listing under other criteria may include information relevant to D2. This information will not be considered by the Committee in making its assessment of the species' eligibility for listing under the EPBC Act, but may assist other jurisdictions to adopt the assessment outcome under the [common assessment method](#).

Evidence:

The population size of Fleay's Barred Frog is not known with certainty (Hines 2012; Quick et al. 2015) but is considered likely greater than 1000 mature individuals (see Criterion 1). In addition, the AOO is greater than the threshold under subcriterion D2, and so Fleay's Barred Frog does not meet the requirements for listing under this criterion.

The data presented above appear to demonstrate 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 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 appears not to have been undertaken, there are insufficient data 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.

Conservation Actions

Recovery Plan

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

Primary conservation actions

2019-20 bushfire response

- As per the guidance developed by Southwell (2020), conduct rapid on-ground surveys to establish extent of population loss as a result of the 2019-20 bushfires and to provide a baseline for ongoing monitoring.
- Protect unburnt areas within or adjacent to recently burnt areas from further fire, in order to provide refuge sites, as well as protecting (from fire) unburnt areas that are not adjacent to burnt areas.
- Control of introduced species to support recovery of populations affected by fires, or populations near areas that have been affected by fire.
- Establish the impact of fire retardants, used to fight bushfires, on frog populations.
- Control introduced herbivores in burnt areas to support habitat recovery post fire.
- Weed control and habitat restoration works may support the regeneration of forest and streambank habitat at some localised sites. Note that herbicide formulations can be toxic to frogs and tadpoles, particularly if they contain glyphosate and surfactants (Mann et al. 2003).

Conservation and management priorities

Habitat loss, disturbance and modifications

- Protect unburnt areas within or adjacent to recently burnt areas from further fire, in order to provide refuge sites, as well as protecting (from fire) unburnt areas that are not adjacent to burnt areas.
- Investigate options for enhancing the resilience of the species' current habitat to climate change.
- Designate protection zones around known site locations to ensure habitat is not fragmented by roads, timber harvesting or clearing of freehold land. Activities permitted in protection zones should be dictated by further research into the effects of disturbance on Fleay's Barred Frog.
- Identify key sites and implement a program ensuring suitable habitat is maintained.
- Identify and conserve landscape characteristics that facilitate movement between subpopulations.
- Investigate options for providing new habitat that would be suitable for the species under climate change scenarios.

- Assess the effectiveness of current forestry management practices in ameliorating disturbance to the habitat of Fleay's Barred Frog, and revise management practices if necessary.
- Educate landowners and managers of the importance of maintaining riparian habitat, and the integration of habitat protection into land management regulations.

Invasive species (including threats from grazing, trampling, predation)

- In areas burnt by the 2019-20 bushfires, control of introduced predators may be required to support population recovery, and control of introduced herbivores will aid habitat recovery. Weed control and habitat restoration may be needed in localised areas to support habitat regeneration. Note that herbicide formulations can be toxic to frogs and tadpoles, particularly if they contain glyphosate and surfactants (Mann et al. 2003).
- Develop and implement longer-term strategies to control invasive and native predators (including the Freshwater Yabby) by implementing eradication programs as necessary.
- Monitor and control damage to riparian areas by feral pigs. This may require a collaborative strategy with land holders and local government authorities to control numbers and potentially fence key sites, where feasible.
- Monitor and control any invasion by the Cane Toad into stream habitat used by Fleay's Barred Frog by implementing eradication programs as necessary.
- Use fencing, or other measures where applicable, to reduce the access of domestic stock to stream banks.
- Assess the impact of exotic weeds on habitat suitability for Fleay's Barred Frog. If impact is shown to be significant, develop a strategy for control or elimination of the invasive weeds. Note that herbicide formulations can be toxic to frogs and tadpoles, particularly if they contain glyphosate and surfactants (Mann et al. 2003).

Disease

- Collect and analyse samples from all monitoring programs for the species, to test for the presence of *Bd* and improve understanding of disease spread throughout the species' range.
- Establish the susceptibility of the Fleay's Barred Frog to *Bd*, in particular, whether the species has developed an immune response, or if the strain is reduced in virulence.
- Minimise the spread of the amphibian chytrid fungus by implementing suitable hygiene protocols (Murray et al. 2011) to protect priority populations as described in the threat abatement plan for infection of amphibians with chytrid fungus resulting in chytridiomycosis (DOEE 2016).
- Provide disease identification and prevention protocols (methods of handling, diagnostic keys, etc.) to researchers and land managers for use in the field.

Stakeholder Engagement

- Provide input into the various impact assessment and planning processes on measures to protect Fleay's Barred Frog and its habitat. These include water resource plans, park management plans and environmental impact assessments.
- Provide advice to private land holders and community groups on how to protect and restore habitat.

- Interested nature conservation, land management and land holder groups could be engaged in conservation management activities, such as survey and monitoring, but should be made aware of the need to follow correct field practices and hygiene protocols to mitigate the risks of trampling and disease transmission. If necessary, use workshops to aid stakeholders in developing the skills and knowledge required to manage threats to this species while undertaking these activities.

Survey and Monitoring priorities

- Conduct rapid on-ground surveys to establish extent of population loss caused by the 2019-20 bushfires, and to provide a baseline for ongoing monitoring.
- Monitoring should be undertaken for a small number of subpopulations regularly during spring, summer and autumn. Frogs should be individually marked to provide detailed information on population dynamics and ecology.
- Broad scale regular monitoring should be undertaken over the species' known range. Sites should span the altitudinal and latitudinal range and a range of other habitat characteristics. These data will be used to assess the species' status and assess further declines or re-establishment/recovery of subpopulations.
- Survey sites within the known range of the species where the environment is considered likely to be suitable for the species to identify whether subpopulations exist that are previously unknown.

Information and research priorities

- Investigate options for linking, enhancing or establishing additional subpopulations.
- Improve understanding of the extent and impact of infection by *Bd* on Fleay's Barred Frog by building on ongoing research, including an ARC grant program on species recovery from *Bd* infection and an NSW Environmental Trust Grant on *Bd* (both yet to be published), to better inform how to apply existing or new management actions relevant to the recovery. This includes knowledge on:
 - The susceptibility of Fleay's Barred Frog to the fungus
 - the different strains of the fungus
 - levels of virulence
 - mechanisms for resistance to the disease
 - treatment options
 - husbandry methods
 - the potential of other species (e.g. Freshwater Crayfish) to act as reservoirs or vectors for transmission of the fungus (Department of the Environment and Energy 2016).
- Understand the potential influence of climate change on the long-term survival prospects of the species, due to altered temperatures, rainfall patterns, bushfires, environmental stressors and diseases.
- Investigate options for reintroductions if subpopulations continue to become fragmented and isolated, especially if recent unexplained declines continue within isolated subpopulations. Any assisted translocation programs should be done via captive reared and released animals, with the movement of adults to be radio tracked.

Collective list of questions – your views

SECTION A GENERAL

1. Is the information used to assess the nationally threatened status of the species 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 species/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 SPECIES? (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 species not in the current advice/plan?

SECTION C ARE YOU AWARE OF THE STATUS OF THE TOTAL NATIONAL POPULATION OF THE SPECIES? (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 species? 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 species (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:

1–50 51–250 251–1000 >1000 >10 000

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 SPECIES? (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 in 2008-2010 (*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:

- 1–50 51–250 251–1000 >1000 >10 000

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 species/subspecies' total population size over the last approximately 10 years? 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 SPECIES? (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 species/subspecies? If not, please provide justification for your response.
- 14. Has the survey effort for this species/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 km² 100 – 5 000 km² 5 001 – 20 000 km² >20 000 km²

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 km² 11 – 500 km² 501 – 2000 km² >2000 km²

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 SPECIES?
(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 km² 100 – 5 000 km² 5 001 – 20 000 km² >20 000 km²

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 km² 11 – 500 km² 501 – 2000 km² >2000 km²

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 SPECIES? (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 species/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 species/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 SPECIES? (If no, skip to section I)

25. What planning, management and recovery actions are currently in place supporting protection and recovery of the species/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 species/subspecies?
27. Would you recommend translocation (outside of the species' historic range) as a viable option as a conservation actions for this species/subspecies?

SECTION I DO YOU HAVE INFORMATION ON STAKEHOLDERS IN THE RECOVERY OF THE SPECIES? (If no, skip to Part 3)

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

31. How aware of this species are land managers where the species is found?
32. What level of awareness is there with individuals or organisations around the issues affecting the species/subspecies?
- Where there is awareness, what are these interests of these individuals/organisations?
 - 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 species?

References cited in the advice

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