Australian Government
Department of Agriculture, Water and the Environment

Consultation Document on Listing Eligibility and Conservation Actions

Mixophyes iteratus (Giant Barred Frog)

Mixophyes iteratus (copyright: H.B. Hines, Queensland Department of Environment and Science)

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

1) the eligibility of *Mixophyes iteratus* (Giant Barred Frog) for inclusion on the EPBC Act threatened species list in the **Vulnerable** 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.

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 iteratus

Giant Barred Frog

Taxonomy

Conventionally accepted as *Mixophyes iteratus* Straughan, 1968. No subspecies are recognised.

Species/Sub-species Information

Description

Mixophyes iteratus (Giant Barred Frog) is the largest of the barred frogs and Australia's second largest frog. Females are larger than males, having a snout-to-vent length (SVL) to 120 mm and weighing around 190 g. Males reach 88 mm (SVL) and weigh up to 80 g. The skin is finely granular above and smooth below. The dorsal surface is beige to dark brown, with darker blotches. Typical of barred frogs, an irregular, dark, vertebral stripe is present. The stripe commences between the eyes and extends to the vent, sometimes breaking up into a series of blotches along the midline. The flanks are pale yellow with irregular dark spots or mottling. The ventral surface is yellow to white in colour.

The head is large and broad with a prominent, projecting snout, giving the Giant Barred Frog a more triangular shape than other *Mixophyes* species. A black stripe commences at the snout and continues posteriorly, through the nostrils and eyes, extending over a distinct tympanum, before terminating at a point above the forelimbs. The ventral surface of the chin is typically yellow with fine brown mottling. The upper lip has irregular darker markings. The eyes are prominent with a vertical black pupil and an iris colour of pale silvery-white to pale gold above, darker in the lower portion.

The limbs have a series of dark and pale crossbars of similar width. The hind limbs are proportionately larger than in other *Mixophyes* species, with the back of the thigh ranging from black with a few large yellow spots to being marbled black and yellow. There is often a rust colouration along the outer toes and fingers. The fingers lack webbing, while the toes are fully webbed, with only the last two joints of the fourth toe free (as opposed to three joints of the toe being free of webbing in the other *Mixophyes* species). The outer metacarpal is poorly developed. The inner metatarsal tubercle is well developed but only half as long as the first toe (versus being nearly of equal length in the other *Mixophyes* species). Discs are absent on the toes and fingers. The description of the adult is drawn from Meyer et al. (2001); Hines (2012); Cogger (2014); and Anstis (2017).

Metamorphs have been measured at 30 mm (SVL). They closely resemble adults except that they are a dull gold colour (which brightens as they grow), have a golden iris and lack a visible tympanum (Anstis 2017).

Tadpoles are large (maximum length over 100 mm), deep-bodied and ovoid, with the tail twice as long as the body. From above, the colouring is gold or dull copper-gold, with dark spots/splotches, and a dark patch at the base of tail. As the tadpole grows, gold pigments may gradually become duller. The underside is transparent in early stages, gradually becoming silver-white in later stages. The snout of the tadpole is rounded, and the eyes are positioned dorsolaterally and prominent with a vertical pupil noticeable by the later stages of development (about stage 37). The iris is golden, and a bright gold ring surrounds the pupil. The nares are equidistant between snout and eyes and open laterally. The oral disc is surrounded by papillae. The spiracle is short and opens in a dorsoposterior fashion below the body axis, near the midpoint of the body. The vent tube is dextral. The tail is thick and muscular with fins that are moderately arched to near midpoint before tapering to a rounded tip. The fins are opaque with dark flecking (except the anterior half of the ventral fin). The description of the tadpole is drawn from Meyer et al. 2001; Hines 2012; and Anstis 2017.

Distribution

The Giant Barred Frog is sparsely distributed from Doongul Creek near Hervey Bay, south-east Queensland (Hines 2012) to Warrimoo in the Blue Mountains, NSW (OEH 2017). The species is found near permanent flowing drainages (from shallow, rocky rainforest streams to slow-moving rivers), in lowland open wet-forests (rainforest and wet sclerophyll forest) and (to a lesser degree) cleared land (DPIE 1999; Lewis & Rohweder 2005; Anstis 2017). Much of the currently occupied habitat of this species in Queensland falls on private land (Hines 2012) and over 75 percent of the species' NSW distribution occurs outside of National Parks and Wildlife Service estates (OEH 2017).

Covacevich & McDonald (1993) identified that the species has been found at elevations ranging from 100–1000 m. However, during surveys for rainforest stream-dwelling frogs conducted in north-eastern NSW, the Giant Barred Frog was recorded only at low elevation sites (below 300 m) (Goldingay et al. 1999), except in the Coffs Harbour-Dorrigo catchment, where frogs were recorded up to 600 m (NPWS 1994). In Queensland, known subpopulations are restricted to lower elevations. However, the species is showing some signs of population recovery at mid-altitude, with small numbers of individuals recorded more recently at sites at 500 m altitude in the Conondale Range and Lamington National Park (NP) (H Hines 2020. pers comm 13 May).

In Queensland, the Mary River catchment contains an estimated 65 percent of the total Giant Barred Frog population (Hines 2012; Ford and Hines, pers comm, cited MRCCC 2016). The species also occurs in various locations south of the Mary River, in the headwaters of the Brisbane River (e.g. Stanley River, Byron Creek) and in coastal streams (e.g. Caboolture River, Burpengary Creek), all north of Brisbane. There is then a break in distribution to a small remnant population in the eastern foothills of the McPherson Range (Canungra and Nixons Creeks, Coomera and Numinbah Rivers) close to the Queensland-NSW border (Hines 2012).

In NSW, strongholds are in north-eastern areas, particularly the Coffs Harbour-Dorrigo catchment and Washpool NP. Elsewhere in NSW, very small disjunct subpopulations occur south to Warrimoo in the Blue Mountains (OEH 2017). These include Mebbin NP, the upper Tweed River, Whian Whian NP, the Bungawalbyn area, Manning River drainage (DPIE 1999), and the Watagan area (Anstis 2017).

The Giant Barred Frog population can be broadly divided into three distribution zones separated by intervening dry areas. The northern distribution: north and west of Brisbane, Queensland (including the Sunshine Coast hinterland), within the Mary River and Stanley River catchments; the central distribution: from areas west and south-west of the Gold Coast, Queensland to the ranges north-west of Newcastle, NSW; and the southern distribution: from the Hunter Valley, through the Hawksbury River catchment, and to the Blue Mountains, NSW (DOE 2020). Despite the isolation of these broad zones from each other, examination of the nuclear genome (allozymes) of subpopulations across the entire range shows no geographical differences that would indicate sub-species or species delineation (Mahony et al. 2006).

Declines in both the size and number of subpopulations has occurred over much of the species' known historic range, mainly during the late 1970s and early 1980s. Field observations conducted throughout much of the north-east region of NSW and the central coast found marked declines (Mahony 1993), whilst surveys in Queensland failed to detect the species until the 1990s (Lewis & Rohweder 2005). 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), together with other threatening processes (Ingram & McDonald 1993; Laurance et al. 1996; Hines et Lemckert & Brassil 2000; Hero & Morrison 2004; Berger et al. 2016).

In Queensland, Hines (2012) identified the Main Range and the Bunya Mountains subpopulations as extirpated. However, the subpopulation in the Conondale Range is thought to be slowly recovering after earlier surveys had failed to find the species (Hines 2012; Newell 2018), and since 2000, the numbers at the Mary River catchment (containing the majority of the total Giant Barred Frog population) appears to have been relatively stable (MRCCC 2016).

In NSW, declines occurred most severely at the southern limit of the range, within the Blue Mountains and along the Central Coast (DPIE 1999). There have been no recent records south of the Hawkesbury River (OEH 2017), and in the Blue Mountains, previously large numbers recorded at the Grose River Valley have dramatically declined, with the species rarely seen there this century (Hoser 2016). The species disappeared from the Watagan Mountains on the central coast of NSW, where a 15-year study (1977-1992) failed to record the species after 1984 (Mahony 1993) and further north, the species disappeared from Terania Creek (Nightcap NP) in the mid-1990s, and (despite near annual visits) was not recorded again until one female frog was observed in 2017 (Newell 2018). In Bungawalbin, north-eastern NSW, Giant Barred Frogs are now found in five isolated subpopulations, with varying abundance, which are thought to have once been a single population (Lewis & Rohweder 2005). However, there is an indication of population recovery in northern NSW, where an increased number of subpopulations have been discovered, some of which have gradually been increasing in numbers (Newell 2018).

Relevant Biology/Ecology

The Giant Barred Frog is a large ground-dwelling frog (Lemckert & Brassil 2000; Anstis 2017). It is a noted habitat specialist, found in a limited range of wet forest types, staying in the riparian zone all year round (Lemckert 1999; Lemckert & Brassil 2000; Meyer et al. 2001; Hines 2012). This habitat provides deep, damp, leaf litter that is utilised for both shelter and foraging, with the permanent wet conditions negating the need for seasonal migrations (Lemckert & Brassil 2000; Owner 2016; OEH 2017). However, Giant Barred Frogs will sometimes occur in other riparian habitats, such as those in drier forest or degraded riparian remnants and even occasionally around dams (OEH 2017).

Giant Barred Frogs are generally confined to a narrow strip of vegetation either side of a stream or river and are mostly associated with pools in larger streams. Short term studies of movement patterns show that individuals move up to 100 m in a night but not more than 20 m from the stream, with the majority staying within 10 m (Lemckert & Brassil 2000; Koch & Hero 2007; OEH 2017). However, Meyer et al. (2001) identified that adults, especially females, may be found up to 150 m from water. Juvenile frogs appear to have similar movement patterns to adults (Lemckert & Brassil 2000). During rainfall, the Giant Barred Frog has been observed to move away from waterways, probably as flood avoidance behaviour (Koch & Hero 2007).

The Giant Barred Frog does not burrow into the soil like other barred frogs (Lemckert & Brassil 2000) but instead hides within the leaf litter by day, well camouflaged by dorsal pigment patterns (Anstis 2017). Behavioural surveys indicate that temperature is the most important climatic variable influencing this behaviour. During cold conditions (<18 °C), males (in particular) bury under the leaf litter, but usually remain in a position with their head clearly exposed (Lemckert & Brassil 2000; Koch & Hero 2007).

In breeding seasons (spring to autumn), males call from the ground beside streams, with peak periods in November and February (Hines 2012; Anstis 2017). The call of the male appears to precede rainfall (Goldingay et al. 1999) and has been described as a deep, guttural grunt ‘ork’ (OEH 2017). Calling does not occur on a nightly basis, being more sporadic in nature, and this allows males to move freely without the requirement of defending a site (Lemckert & Brassil 2000).

Once eggs are laid and fertilised, the female kicks them out of the water, sticking them onto overhanging or steeply sloped banks or rocks. Once hatched, the tadpoles then drop into the stream below (Knowles et al. 2015; Anstis 2017). The average clutch size is 2000 eggs (Anstis 2017).

Tadpoles can grow to over 100 mm, and it may take up to 14 months between egg laying to completion of metamorphosis (Lemckert & Brassil 2000; OEH 2017), consequently tadpoles may overwinter (Meyer et al. 2001). Tadpoles are bottom-dwellers, grazing over rocks and the

substrate in still or slowly flowing pools or at the sides of streams. They are powerful swimmers and the sectorial disk enables quite firm adherence in flowing water (Anstis 2017).

The Giant Barred Frog is believed to be a generalist feeder, likely to eat any potential prey items encountered when foraging, with large insects, snails, spiders and frogs included in its diet (Lemckert & Shoulder 2007; OEH 2017). Lemckert & Shoulder (2007) examined the stomach contents of 52 Giant Barred Frogs, which revealed 98 percent of items eaten to be invertebrates, with insects the dominant prey item (53 percent). Tadpoles feed on bottom sediment, algae, detritus, fallen fruit and probably carrion (Hines 2012).

Generation length is not known with certainty. Maas & Passioura (1999) indicate that the Giant Barred Frog reaches maturity by the end of the first year and has a potential reproductive lifespan of 10 years, with an average age of parents being five years. Mahony (2020. pers comm 16 April) observed that non-chytrid life span is 6-8 years (3-4 years in chytrid impacted populations) with species maturity reached in 2-3 years. Therefore, the estimated generation length is considered four-five years.

Threats

Table 1: Threats impacting the Giant 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 the remaining subtropical rainforest of south-east Queensland and north-east NSW being reduced to a discontinuous arc along the Great Dividing Range (Hagger et al. 2013). Within this habitat, much of the Giant Barred Frog's distribution is on private land, outside of the protection of National Parks and Wildlife Service estates, and in the lower reaches of streams that are the focus of agricultural and rural residential development (Hines 2012; OEH 2017). The Giant Barred Frog is impacted by disturbance (Hero & Morrison 2004). Lemckert (1999) observed that the Giant Barred Frog is more frequently found at sites surrounded by a high proportion of undisturbed vegetation. The Giant Barred Frog is absent in forests in early stage of regeneration, but can inhabit regenerated forests, irrespective of how extensive the original disturbance may have been. The Giant Barred Frog is predominantly found in a limited range of wet forest types (Lemckert 1999; Lemckert & Brassil 2000; Meyer et al. 2001; Hines 2012). This specialisation, together with the noted fragmentation of the population (OEH 2017; DOE 2020), the low number of

			individuals at localities (particularly within the south of the species range) (OEH 2017), its sensitivity to disturbance (Hero & Morrison 2004; Lemckert 1999), and its low dispersal ability (Lemckert & Brassil 2000; Koch & Hero 2007; OEH 2017), increases the Giant Barred Frog's susceptibility to local extinction (Lemckert 1999; Lemckert & Brassil 2000; OEH 2017).
2.0	Climate Change		
2.1	Increased temperature intensity/frequency and change to precipitation patterns	known current	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). Climate change impacts are compounded by the Giant Barred Frog's restricted area of occupancy, low population density at sites (particularly within the south of the species' range), 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). 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 decrease in population.

2.2	Increased intensity/frequency of wildfire	known current	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 ºC. As a non-burrowing species, the Giant Barred Frog faces a greater threat from fire, through both direct contact as well as a reduction in leaf-litter for foraging and shelter. Wildfires 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 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 *Synechococcus* algal bloom that persisted until the winter of 2008 (Alexandra & Finlayson 2020). 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 30–50 percent of the distribution range of the Giant Barred Frog was impacted. This sort of event is increasingly likely to reoccur as a result of climate change.
3.0	Disease		
3.1	Chytridiomycosis caused by chytrid fungus	known current	Chytridiomycosis is an infectious disease caused by the amphibian chytrid fungal pathogen *Batrachochytrium dendrobatidis* (*Bd*). Infected populations exhibit diverse susceptibility to *Bd*. Some species do not

			exhibit any apparent symptoms, whilst others are extremely vulnerable, resulting in mass die-off and extinction (DOEE 2016). The Giant Barred Frog is known to carry chronic infections of *Bd*, with Ingram & McDonald (1993) suggested that species abundance dropped by up to 90 percent across the geographic range, largely as a result disease (later identified as chytridiomycosis). However, this assessment was based on poor baseline data, and it is unclear whether the Giant Barred Frog is continuing to decline from *Bd* infection (Hunter & Gillespie 2011; OEH 2017). The increased virulence of *Bd* under cooler, moist conditions is consistent with frog populations at higher elevations in mesic environments appearing to be more susceptible to decline (Laurance et al. 1996; Hero & Morrison 2004; Skerratt et al. 2010; Hero et al. 2015). Consequently, the Giant Barred Frog's ongoing vulnerability to this pathogen may be tempered as much of the remaining population is found at lower elevations (under 300 m) (Goldingay et al. 1999). Eradicating *Bd* 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 *Bd* has disappeared from any location in eastern Australia (Voyles et al. 2009; Newell et al. 2013). Although adaptive immune responses have been proposed as a possible reason for anuran species recovery, acquired immunity towards *Bd* has not been demonstrated, and frogs have been showed to become reinfected even after multiple exposures (Murray et al. 2009; Cashins et al. 2013; Berger et al. 2016).
4.0	Invasive species		
4.1	Habitat damage by Feral Pigs (*Sus scrofa*).	known current	Feral pigs are found in all states and territories of Australia, particularly in association with wetlands and river systems (DOEE 2017a). Although there may be direct predation by pigs, the greatest effect is likely to be through habitat alteration. Rooting and wallowing behaviour can increase sedimentation and result in filling of crevices in stream substrates, reducing the availability of refugia for tadpoles (Welsh & Ollivier 1998; Hines & the South-east Queensland Threatened Frogs Recovery Team 2002; Hines 2012; OEH 2017). This is likely to be a significant threat to the Giant Barred Frog

			as their tadpoles take up to 14 months to complete development (Lemckert & Brassil 2000; OEH 2017).
4.2	Habitat damage by domestic stock	known current	Large areas of habitat have been damaged by domestic cattle with effects on water quality similar to those described above for feral pigs (Hines & the South-east Queensland Threatened Frogs Recovery Team 2002; OEH 2017). In addition, trampling around stream banks can reduce riparian vegetation and damage overhanging or near vertical stream banks, thereby reducing availability of oviposition sites (Knowles et al. 2015).
4.3	Invasive weeds	potential current	Mistflower (*Ageratina riparia*), Crofton Weed (*A. adenophora*), Lantana (*Lantana camara*), and exotic grasses are highly invasive weeds found alongside wet forest stream habitat. The effect of these weeds is not known, but they may have negative impacts on habitat by reducing the area of sites suitable for egg laying (Hines & the South-east Queensland Threatened Frogs Recovery Team 2002; Hines 2012; OEH 2017). Changes to invertebrate assemblages brought about by exotic plant invasion may also impact the Giant Barred Frog by altering the availability and composition of invertebrates, which are an important component of the diet of *Mixophyes* species (Lemckert & Shoulder 2007; Martin & Murray 2011).

4.4	Predation by introduced and native species, including feral cats (*Felis catus*), *Cherax destructor (*Freshwater Yabby), and predatory fish species.	Suspected current	Little is known about predation on the Giant Barred Frog but introduced predators may present a threat to both adults and tadpoles. 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 becoming 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. The presence of the Freshwater Yabby in virtually all coastal drainage systems in NSW has the capacity to cause the local extirpation of fragmented subpopulations of the Giant Barred Frog. Predation on the Giant Barred Frog by the Freshwater Yabby has not been observed but known yabby behaviour includes stalking and hunting for frogs and tadpoles. The Giant Barred Frog breeds in streams that are suitable for Freshwater Yabby invasion and are considered at high risk from this species (Coughran & Daly 2012). Lower order streams that contain key populations of the Giant Barred Frog (e.g. Mary, Stanley and Coomera Rivers) are rich in fish species, including large native predatory species such as *Gobiomorphus* species (Gudgeons), Mogurnda adspersa (Southern Purple-spotted Gudgeon), *Anguilla* species (Eels), *Tandanus tandanus* (Freshwater Catfish), *Macquaria novemaculeata* (Australian Bass) and *Maccullochella* species (Cod) (Knowles et al. 2015). Fish are known to be a major influence on amphibian assemblage structure and have the potential to eliminate amphibian species through predation on tadpoles (Gillespie and Hero 1999). However, these predatory fish species are native to these catchments and the Giant Barred Frog has co-existed with them over time, likely through adaptations to reduce the impact of predation.

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 followin

(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 the Giant Barred Frog is not known with certainty, but it is estimated to be four-five years. This gives a timeframe of 12–15 years for this criterion.

The population size of the Giant Barred Frog is also not known with certainty (Hines 2012) but is considered likely greater than 10 000 individuals (M Mahony 2020. pers comm 16 April; H Hines 2020. pers comm 23 April). A total of 4885 records of the Giant Barred Frog are recorded in the Atlas of Living Australia (as of November 2019), with the majority (3026) recorded in the last decade 2010-2019 (ALA 2019).

A substantial decline in the population (estimated up to 90 percent) is believed to have occurred, predominantly in the 1970s to early 1980s (Ingram & McDonald 1993; Laurance et al. 1996; DPIE 1999; Goldingay et al. 1999; Lemckert & Shoulder 2007; Hines 2012), with chytridiomycosis suspected as a primary cause (Lemckert & Brassil 2000; Hero & Morrison 2004; Berger et al. 2016). This decline was not based on empirical data, due to a lack of surveys before the early 1990s (Hines & the South-east Queensland Threatened Frogs Recovery Team 2002), but resulted in the Giant 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, unpublished studies indicate a species recovery prior to the 2019-20 bushfires (M Mahony 2020. pers comm 16 April; H Hines 2020. pers comm 23 April). However, the absence of the species from some historic locations, very low abundance at others (particularly in the southern limit of the range), and isolation of remaining subpopulations (DPIE 1999; Hines & the South-east Queensland Threatened Frogs Recovery Team 2002), together with the low dispersal ability (and associated poor recolonisation potential) of the species (Lemckert & Brassil 2000), has reduced the likelihood of recovery from future extreme events associated with land clearing, climate change or disease (Hagger et al. 2013).

Due to large-scale clearing of lowland subtropical rainforest, much of the remaining Giant Barred Frog habitat occurs in a discontinuous arc (Hagger et al. 2013). The remaining distribution of the

Giant Barred Frog occurs in the lower reaches of streams that are the focus of agricultural and rural residential development (OEH 2017). The Giant Barred Frog is noted as being negatively affected by logging and land clearing, being found to be more prevalent at sites where there is a high proportion of undisturbed vegetation (Lemckert 1999; Hero & Morrison 2004, Hero et al. 2006).

The Giant Barred Frog has physiological and life history traits, identified by Hagger et al. (2013), 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 increased frequency and intensity of wildfire events pose both a direct and indirect threat to the species. 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 the Giant Barred Frog has yet to be determined but the population is likely reduced, with 30–50 percent of the Giant 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 impact of the bushfires on the Giant 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 2020).

Early observations in Queensland are that the 2019-20 bushfires only affected some habitat of the low density subpopulation at Nixon Creek in Lamington NP. The subpopulations on Canungra Creek and Coomera River in Lamington NP had more widespread and ecologically severe fire which likely significantly impacted populations there. Subpopulations in the Brisbane and Mary River catchments (containing the majority of the Queensland Giant Barred Frog population) were largely unaffected by the fires (H Hines 2020. pers comm 14 May).

Given the lack of baseline data, signs of species recovery before the 2019-20 bushfires, and the uncertainty surrounding the extent of population reduction following the 2019-20 bushfires (extensive overlap of distribution range with fire affected areas but suspected low impact to the Queensland population), there is insufficient data available to assess the severity of any population reduction. Therefore, 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.

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 Giant Barred Frog is sparsely distributed from Doongul Creek near Hervey Bay, south-east Queensland (Hines 2012) to Warrimoo in the Blue Mountains west of Sydney, NSW (OEH 2017). Based on the mapping of point records for a 20-year time period (1999-2019) (obtained from state governments, museums and CSIRO) the Extent of Occurrence (EOO) has been estimated at 132 654 km^2 and the Area of Occupancy (AOO) at 1908 km^2, with the AOO meeting the threshold for listing as Vulnerable under sub criterion B2. 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 (DoE 2015).

The number of locations is identified as three, which is under the threshold for listing as Vulnerable under sub criterion (a). A location is defined as "a geographically or ecologically distinct area in which a single threatening event can rapidly affect all individuals of the taxon present" (IUCN 2019). The Giant Barred Frog population can be divided into three broad distribution zones separated by intervening dry areas. The northern distribution: north and west of Brisbane, Queensland (including the Sunshine Coast hinterland), within the Mary River and Stanley River catchments; the central distribution: from areas west and south-west of the Gold Coast, Queensland to the ranges north-west of Newcastle, NSW; and the southern distribution: from the Hunter Valley, through the Hawksbury River catchment, and to the Blue Mountains, NSW (DOE 2020). Given the extent of the 2019-20 bushfires, which are believed to have impacted between 30–50 percent of the distribution range of the Giant Barred Frog, these broad zones can be identified as three separate locations, each of which could be rapidly affected in a single bushfire season (which can involve multiple fire events).

Based on ongoing threats, the Giant 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 already isolated and scattered nature of subpopulations (DPIE 1999; Hines & the South-east Queensland Threatened Frogs Recovery Team 2002), together with the low dispersal ability (and associated poor recolonisation potential) of the species (Lemckert & Brassil 2000), reduces the likelihood of recovery from future extreme events associated with land-clearing, climate change or disease (Hagger 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; DPIE 1999; Goldingay et al. 1999; Lemckert & Brassil 2000; Hero & Morrison 2004; Lemckert & Shoulder 2007; Hines 2012; Berger et al. 2016), and the impact of the 2019-20 bushfires suspected to be significant, with 30–50 percent of the distribution range of Giant Barred Frog overlapping with the fire-affected areas (DAWE 2020b). Further, the Giant Barred Frog has the 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 Vulnerable (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**
	(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 the Giant Barred Frog is not known with certainty (Hines 2012) but is considered likely greater than 10 000 individuals (H Hines 2020. pers comm 23 April; M Mahony 2020 pers comm 16 April). A total of 4885 records of the Giant Barred Frog are recorded in the Atlas of Living Australia (as of November 2019), with the majority (3026) recorded in the last decade 2010-2019 (ALA 2019). Therefore, the species 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, further abundance surveys are required to get an accurate assessment of population numbers and current trends. 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 km2 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 the Giant Barred Frog is not known with certainty (Hines 2012) but is considered likely greater than 10 000 individuals (H Hines 2020. pers comm 23 April; M Mahony 2020 pers comm 16 April). A total of 4885 records of the Giant Barred Frog are recorded in the Atlas of Living Australia (as of November 2019), with the majority (3026) recorded in the last decade 2010-2019 (ALA 2019). In addition, the Giant Barred Frog does not meet the quantitative threshold for Vulnerable under subcriterion D2, with the area of occupancy estimated to be 1908 km^2. Therefore, the species does not meet the requirements for listing under D2.

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

1. 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. Note: in the winter months (June – August) adults are in torpor (inactive and buried) so monitoring would need to be conducted on the basis of tadpole occurrence.
    - 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 providing new habitat that would be suitable for the species under climate change scenarios.
- 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 the Giant Barred Frog.
- Identify key sites and implement a program ensuring suitable habitat is maintained.
- Investigate options for enhancing the resilience of the species' current habitat to climate change.
- Identify and conserve landscape characteristics that facilitate movement between subpopulations.
- Assess the effectiveness of current forestry management practices in ameliorating disturbance to the habitat of the Giant Barred Frog, and revise management practices if necessary.
- Educate landowners and managers of the importance of maintaining and protecting 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 introduced 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.
- 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 the Giant 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 Giant 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 subpopulations 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 the Giant 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. Note: in the winter months (June – August) adults are in torpor (inactive and buried) so monitoring would need to be conducted on the basis of tadpole occurrence.
- 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

- Establish whether the forestry protocols designed to protect the Giant Barred Frog from logging impacts are effective.
- Investigate options for linking, enhancing or establishing additional subpopulations.
- Improve understanding of the extent and impact of infection by the amphibian chytrid fungus on the Giant Barred Frog to better inform how to apply existing or new management actions relevant to the recovery. This includes knowledge on:
    - The susceptibility of the Giant 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 declines continue within isolated subpopulations.

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 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 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 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 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?

    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 species?

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