Contents

National Risk Assessment: MODERATE

RISK ASSESSMENT FOR AUSTRALIA: **Binturong (*Arctictis binturong*)**

Class - Mammalia**, Order -** Carnivora**, Family -** Viverridae**, Genus -** *Arctictis***.**

SPECIES: *Arctictis binturong* (Raffles, 1821) **Synonyms:** *Viverra binturong* (Raffles, 1821) **Subspecies:** *Arctictis binturong albifrons* (Curvier, 1822) *Arctictis binturong binturong* (Raffles, 1821) *Arctictis binturong kerkhoveni* (Sody, 1936) *Arctictis binturong menglaensis* (Wang and Li, 1987) *Arctictis binturong penicillatus* (Temminck, 1835) *Arctictis binturong whitei* (Allen, 1910) **Common Names:** Binturong Bearcat Asian Bearcat	**Species description:** Binturongs, the largest civet species (Wemmer and Murtaugh, 1981) and have long, heavy bodies, and short, stocky legs. Binturongs have short, pointed snouts that contain more teeth than most carnivores. It has a long, thick, shaggy coat and stiff white whiskers. The general colour is black (sometimes brown) with the tips of the guard hairs being white (giving a grizzled appearance in some individuals) or rust coloured. The head is black, greyish, or almost white; the greyish colour of the head can also extend behind the shoulder. The ears are black and rounded, with a white rim and long tufts of hairs on the dorsal surface and at the tip (GBIF). Their most notable traits (prehensile tail, crushing cheekteeth, and hindfeet with syndactylous third and fourth toes) are adaptive to their arboreal habit and frugivorous diet (Wemmer and Murtaugh, 1981). **General information:** Binturongs are found in India, Nepal, Bhutan, Bangladesh, China, Cambodia, Laos, Malaysia (Sarawak, Sabah, Peninsular Malaysia), Thailand, Vietnam, Myanmar, Philippines, and Indonesia (Kalimantan, Jawa, Sumatera) (Smithsonian, IUCN). It potentially occurred historically in Singapore although there are no known records from the country (Chua et al. 2012). There are no confirmed records from Brunei, but this is likely to be because of poor survey effort and not because of any ecological factors (Semiadi et al., in prep.). Binturongs live in the canopies of tall, dense, tropical forests. They require thick vegetation, both in the trees and on the ground. It occurs from sea level up to 3,000 metres above sea level, although it is thought to live at higher densities in lowland forest habitats (i.e. below 1,000 metres) (IUCN). Binturongs look like carnivores with sharp teeth and claws, but they mostly eat fruits and berries. When they do hunt, they prefer small animals, including fish, rodents, birds, worms and insects. They will also eat carrion (meat that another animal killed), eggs, and leaves. Some tropical forest seeds, like those of the strangling fig, have evolved to germinate better after having passed through a binturong's digestive tract (Smithsonian).

	The binturong is arboreal but will descend to the ground to move between trees. Binturongs can climb trees with ease, but progress slowly and deliberately, using their long prehensile tails for balance and to hold branches for support. On the ground, they are plantigrade and walk along on the soles of their feet with a waddling gait (GBIF). Binturongs can swim fairly well and have good vision day or night and so can be active at any hour they choose (San Diego). Usually, binturongs are solitary in the wild coming together only to mate. They sometimes live in small family groups consisting of a female and her immature offspring. Both males and females become sexually mature at approximately 30 months (2.5 years) of age. After a pregnancy of approximately 3 months, the female gives birth, usually to 1 – 3 offspring, although as many as 6 have been recorded. Mothers will stay with their offspring until the young are big enough to fend for themselves, usually around 6 to 8 weeks old. However, mothers may also stay with their young until they are ready to breed at around 2.5 years old. Binturongs are born with eyes sealed and remain hidden in the mother's thick fur for their first few days. At six to eight weeks, they are the size of a domestic cat, have grown a coat of coarse hair, and begin to explore and eat solid food (San Diego). Binturongs are reported by several websites to be “one of the few mammals that reproduce by delayed implantation”. However, the paper cited by these websites (e.g. ADW; Animalia; San Diego; Smithsonian etc) as the source of this claim (Wemmer and Murtaugh, 1981), does not appear to have formed this conclusion. It seems possible that the term “interbirth interval” was misinterpreted by one website and the incorrect information has then been copied by others. No evidence was found of binturongs being a pest or invasive species in any region. However, as a frugivore it is known to be a “seed disperser”, transporting the seeds of many plants (Rai, 2018). **Longevity:** 18 years in the wild (ADW), 27 years in captivity (AnAge, ADW). **Conservation status:** **IUCN:** Vulnerable **CITES:** Appendix III
DATE OF ASSESSMENT: July 2022 (Jodi Buchecker)	**The risk assessment model:** Models for assessing the risk that exotic vertebrates could establish in Australia have been developed for mammals, birds (Bomford 2003, 2006, 2008), reptiles and amphibians (Bomford et al 2005, Bomford 2008). Developed by Dr Mary Bomford for the Bureau of Rural Sciences (BRS), the model uses criteria that have been demonstrated

EIC ENDORSEMENT: 16/06/23 **Risk assessment model used for the assessment:** Bomford 2008, Mammals and Birds	to have significant correlation between a risk factor and the establishment of populations of exotic species and the pest potential of those species that do establish. For example, a risk factor for establishment is similarity in climate (temperature and rainfall) within the species' distribution overseas and Australia. For pest potential, the species' overseas pest status is a risk factor. The model is published as 'Risk assessment models for the establishment of exotic vertebrates in Australia and New Zealand' (Bomford 2008) and is available online on the PestSmart website https://pestsmart.org.au/wp-content/uploads/sites/3/2020/06/Risk_Assess_Models_2008_FINAL.pdf **CLIMATE**: In 2021 a new version of the Climatch program used to assess similarity in climate was released by the Australian Bureau of Agricultural Resource Economics and Sciences (ABARES): CLIMATCH v2.0. The increase in resolution in this new version (from 50 km to 20 km) required recalibration of Climate Match Scores. See Table 1. Sixteen climate parameters (variables) of temperature and rainfall are used to estimate the extent of similarity between data from meteorological stations located within the species' world distribution and stations in Australia. Worldwide, data from approximately 19000 locations are available for analysis. The number of locations used in an analysis will vary according to the size of the species' distribution and the number of meteorological stations located within that distribution. To represent the climate match visually, the map of Australia is divided into 19236 grid squares, each measured in 0.2 degrees in both longitude and latitude. CLIMATCH v2.0 calculates a match for each Australian grid by comparing data from all meteorological stations within the species' distribution (excluding any populations in Australia) and allocating a score ranging from ten for the highest level match to zero for the poorest match. Levels of climate match are used in the risk assessment for questions B1 (scores are summed to give a cumulative score), C6, and C8. Climatch v2.0 can be accessed on the ABARES website, agriculture.gov.au/abares. The direct URL is https://climatch.cp1.agriculture.gov.au/.

Bird and Mammal Model:

FACTOR	**SCORE**	**DETAIL**
STAGE A: RISKS POSED BY CAPTIVE OR RELEASED ANIMALS		
A1. Risk to people from individual escapees (0–2) *Assess the risk that individuals of the species could harm people. (NB, this question only relates to aggressive behaviour shown by escaped or released individual animals. Question C11 addresses the risk of harm from aggressive behaviour if the species establishes a wild population).* *Aggressive behaviour, size, plus the possession of organs capable of inflicting harm, such as sharp teeth, claws, spines, a sharp bill,*	1	*Animal that is unlikely to make an unprovoked attack but which can cause serious injury (requiring hospitalisation) or fatality if cornered or handled.* Normally quite shy (will not attack unprovoked) but aggressive when harassed, cornered or handled and have sharp teeth. Binturongs prefer to flee (usually up a nearby tree) but as a defence mechanism the binturong may sometimes balance on its tail and flash its claws to appear threatening to potential predators.

or toxin-delivering apparatus may enable individual animals to harm people. Any known history of the species attacking, injuring or killing people should also be taken into account. Assume the individual is not protecting nest or young.		Binturongs are reported to initially urinate or defecate on a threat and then, if teeth-baring and snarling does not deter the threat, it uses its powerful jaws and teeth in self-defence. Wild caught animals in captivity are reported as not actively aggressive unless cornered, "although if a person has angered one, [the binturong] may slyly attempt to urinate or defecate on that person from above. Aggressive adult behaviour is not especially common toward humans and is seen more often toward mates." (Stinner) Females are potentially aggressive to people when in season or with young. "Most aggression towards humans occurs when a pair has babies, when a female is preparing to give birth, and if an animal is sick or hurt" (Stinner). For noting only (as only one reference found): "[Binturongs are] capable of "skunking" when very frightened. This is a fine spray of liquid which has an acrid smell, and which actually almost burns when inhaled. While many people have a strong allergic reaction to bints in general, I know of at least one person who had an anaphylactic reaction to an infant skunking, and she ended up in the emergency room" (Stinner).
A2. Risk to public safety from individual captive animals (0–2) *Assess the risk that irresponsible use of products obtained from captive individuals of the species (such as toxins) pose a public safety risk (excluding the safety of anyone entering the animals' cage/enclosure or otherwise coming within reach of the captive animals)*	0	*Nil or low risk (highly unlikely or not possible).*
STAGE A PUBLIC SAFETY RISK SCORE **SUM A1 - A2 (0-4)**	1	**Moderately dangerous**
STAGE B: PROBABILITY ESCAPED OR RELEASED INDIVIDUALS WILL ESTABLISH FREE-LIVING POPULATIONS		
Model 1: FOUR-FACTOR MODEL FOR BIRDS AND MAMMALS (BOMFORD 2008)		
B1. Degree of climate match between species overseas range and Australia (1–6)	2	*Low climate match to Australia* Value X = 1,428

Map the selected mammal or bird species' overseas range, including its entire native and exotic (excluding Australia) ranges over the past 1000 years. *Use CLIMATCH v2.0, Value X = sum of classes 6 – 10, see Table 1.*		Climate Match Score = 2
B2. Exotic population established overseas (0–4) *An established exotic population means the introduced species must have bred outside of captivity and must currently maintain a viable free-living population where the animals are not being intentionally fed or sheltered, even though they may be living in a highly disturbed environment with access to non-natural food supplies or shelter.*	0	*No exotic population ever established.*
B3. Overseas range size score (0–2) < 1 = 0; 1– 70 = 1; >70 = 2 *Estimate the species overseas range size* including currently and the past 1000 years; natural and introduced range in millions of square kilometres*	1	*Overseas range between 1 to 70 million square kilometres.* Approximately 4 million km^2
B4. Taxonomic Class (0–1) *Bird = 0; mammal = 1*	1	*Mammal*
B. ESTABLISHMENT RISK SCORE **SUM OF B1- B4 (1–13)**	4	**Low establishment risk**
Model 2: Seven-Factor Model For Birds And Mammals (Bomford 2008)		
B5. Diet score (0–1) *Specialist = 0; generalist = 1*	1	*Generalist with a broad diet of many food types.* Omnivore: consuming fruits, insects, small mammals, birds, eggs and sometimes earthworms and fish.
B6. Habitat score (0–1) *Undisturbed or disturbed habitat*	1	*Can survive and breed in human-disturbed habitats (including grazing and agricultural lands, forests that are intensively managed or planted for timber harvesting and/or urban–suburban environments) without access to undisturbed (natural) habitats.*

		Can live in disturbed habitats. It has been observed in mosaic open forest landscapes, interspersed with agriculture and non-native forest plantations (IUCN).
B7. Migratory score (0–1) *Always migratory = 0; non-migratory = 1*	1	*Non-migratory* (IUCN).
B. ESTABLISHMENT RISK SCORE SUM OF B1- B7 (1–16)	7	**Moderate establishment risk**
STAGE C: PROBABILITY AN ESTABLISHED SPECIES WILL BECOME A PEST		
C1. Taxonomic group (0–4)	2	*Mammal in one of the orders that have been demonstrated to have detrimental effects on prey abundance and/or habitat degradation (Carnivora).*
C2. Overseas range size including current and past 1000 years, natural and introduced range (0–2) *Estimate the species overseas range size (including current and past 1000 years, natural and introduced range) in millions of square kilometres*	0	*Overseas geographic range less than 10 million square kilometres.* Approximately 4 million km^2
C3. Diet and feeding (0–3)	1	*Mammal that is a non-strict carnivore (mixed animal-plant matter in diet).* Generalist omnivore. Its main diet contains of insects, supplemented with small snakes, bird eggs, snails, amphibians and worms (Deef, 2019).
C4. Competition with native fauna for tree hollows (0–2)	0	*Does not use tree hollows.*
C5. Overseas environmental pest status (0–3) *Has the species been reported to cause declines in abundance of any native species of plant or animal or cause degradation to any natural communities in any country or region of the world?*	0	*Never reported as an environmental pest in any country or region.*
C6. Climate match to areas with susceptible native species or communities (0–5) *Identify any native Australian animal or plant species or communities that could be susceptible to harm by the exotic species if it were to establish a wild population here.*	4	*The species has 208-691 grid squares within the highest four climate match classes that overlap the distribution of any susceptible native species or ecological communities = 4*

		Examples of susceptible native species or ecological communities include (DAWE Protected Matters Search Tool): *Acriopsis emarginata* (Pale Chandelier Orchid) – Vulnerable *Malurus coronatus coronatus* (Purple-crowned Fairy-wren) – Endangered
C7. Overseas primary production pest status (0–3) *Has the species been reported to damage crops or other primary production in any country or region of the world?*	0	*No reports of damage to crops or other primary production in any country or region.*
C8. Climate match to susceptible primary production (0–5) *Assess Potential Commodity Impact Scores for each primary production commodity listed in Table 9, based on species' attributes (diet, behaviour, ecology), excluding risk of spreading disease which is addressed in Question C9.* *0 = 0; 1-19 = 1; 20-49 = 2; 50-99 = 3; 100-149 = 4; ≥150 = 5*	1	Total Commodity Damage Score = 19 (see Table 2)
C9. Spread disease (1–2) *Assess the risk that the species could play a role in the spread of disease or parasites to other animals*	2	*All mammals (likely or unknown effect on native species and on livestock and other domestic animals).*
C10. Harm to property (0–3) *Assess the risk that the species could inflict damage on buildings, vehicles, fences, roads, equipment or ornamental gardens by chewing or burrowing or polluting with droppings or nesting material.*	0	*$0.* Nil harm to property.
C11. Harm to people (0–5) *Assess the risk that, if a wild population established, the species could cause harm to or annoy people. Aggressive behaviour, plus the possession of organs capable of inflicting harm, such as sharp teeth, tusks, claws, spines, a sharp bill, horns, antlers or toxin delivering organs may enable animals to harm people. Any known*	2	*Low risk. Harm or annoyance likely to be minor and few people exposed.* Does have sharp teeth and can be mildly aggressive when protecting young.

history of the species attacking, injuring or killing people should also be taken into account (see Stage A, Score A1).		
C. PEST RISK SCORE **SUM C 1 TO C 11 (1–37)**	12	**Moderate pest risk**
STAGE A. PUBLIC SAFETY RISK RANK – RISK TO PUBLIC SAFETY POSED BY CAPTIVE OR RELEASED INDIVIDUALS *0 = Not dangerous; 1 = Moderately dangerous; ≥ 2 = Highly dangerous*	1	Moderately dangerous
STAGE B. ESTABLISHMENT RISK RANK – RISK OF ESTABLISHING A WILD POPULATION **MODEL 1: FOUR-FACTOR MODEL FOR BIRDS AND MAMMALS (BOMFORD 2008)** *≤ 5 = low establishment risk; 6-8 = moderate establishment risk; 9-10 = serious establishment risk; ≥ 11-13 = extreme establishment risk*	4	Low establishment risk
STAGE B. ESTABLISHMENT RISK RANK – RISK OF ESTABLISHING A WILD POPULATION **MODEL 2: SEVEN-FACTOR MODEL FOR BIRDS AND MAMMALS (BOMFORD 2008)** *≤ 6 = low establishment risk; 7-11 = moderate establishment risk; 12-13 = serious establishment risk; ≥14 = extreme establishment risk*	7	Moderate establishment risk
STAGE C. PEST RISK RANK - RISK OF BECOMING A PEST FOLLOWING ESTABLISHMENT *< 9 = low pest risk; 9-14 = moderate pest risk; 15-19 = serious pest risk; > 19 = extreme pest risk*	12	Moderate pest risk

ENVIRONMENT AND INVASIVES COMMITTEE THREAT CATEGORY	**MODERATE**

World distribution map (IUCN Red List) and Climatch world distribution map indicating where meteorological data was sourced for the climate analysis (see B1):

Figure 1 - World Distribution Map - IUCN Red List

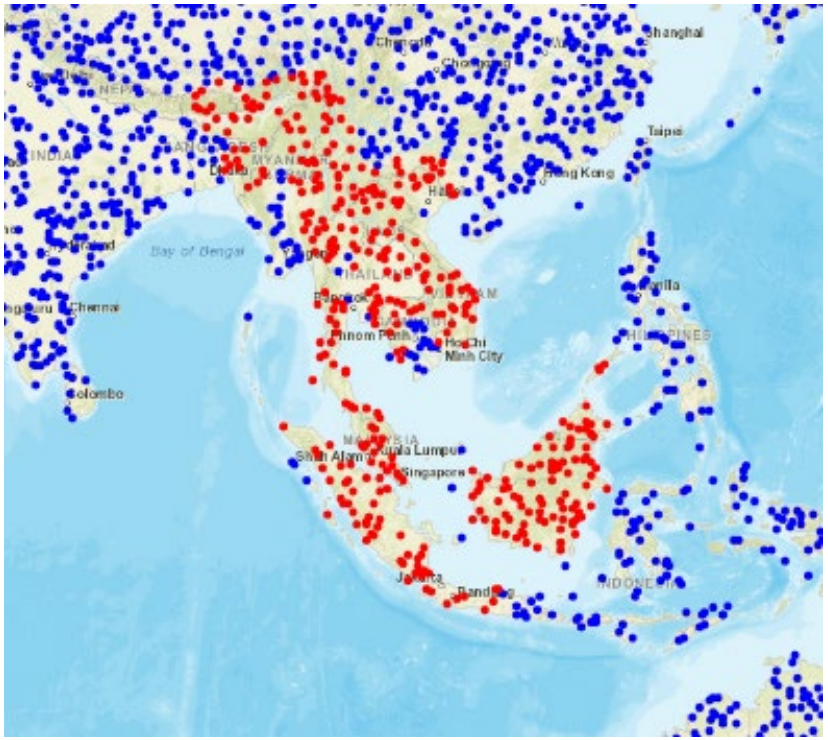
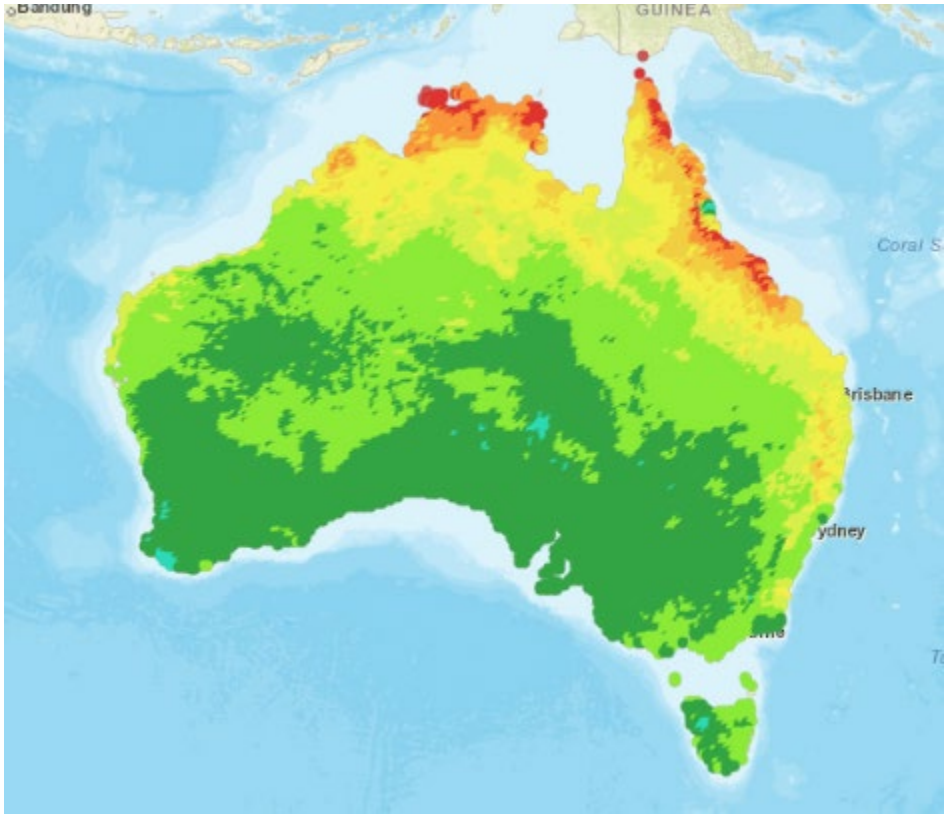


Figure 2 - World Distribution Map - Climatch

Climate match between world distribution of species and Australia:

Areas of Australia where the climate appears suitable for *Arctictis binturong*

Value X = 1,428



Score	Color	Count
0		0
1		66
2		7292
3		6464
4		1891
5		2095
6		753
7		503
8		161
9		11
10		0

Species: Arctictis binturong (Binturong)
Algorithm: Closest Standard Score
402 source features selected
19236 target features selected
Approximate selected area: 4,094,262 km^2

Table 1: ABARES recalibration thresholds

Climate Match Score (CMS)	Climatch (50 km) Closest Standard Match Sum Level 6 (Value X)	2021 Recalibrated Climatch v2.0 (20 km) Closest Standard Match Sum Level 6 (Value X)
1 (Very low)	< 100	< 691
2 (Low)	100-599	691-4137
3 (Moderate)	600-899	4138-6209
4 (High)	900-1699	6210-11735
5 (Very high)	1700-2699	11736-18642
6 (Extreme)	≥ 2700	≥ 18643

Table 2: Susceptible Australian Primary Production – Calculating Total Commodity Damage Score

The commodity value index scores in this table are derived from Australian Bureau of Statistics 1999 – 2000 data. The values will require updating if significant change has occurred in the value of the commodity (Bomford 2008).

Industry	**Commodity Value Index 1 (CVI based on best available date)**	**Potential Commodity Impact Score (PCIS 0-3)**	**Climate Match to Commodity Score (CMCS 0–5)**	**Commodity Damage Score (CDS columns 2 X 3 X 4)**
Sheep (includes wool and sheep meat)	10			
Cattle (includes dairy and beef)	10			
Timber (includes native and plantation forests)	10	1	0	0
Cereal grain (includes wheat, barley sorghum etc)	10			
Pigs	2			
Poultry and eggs	2	1	0	0
Aquaculture (includes coastal mariculture)	2			
Cotton	2			
Oilseeds (includes canola, sunflower etc)	2	1	0	0
Grain legumes (includes soybeans)	2			
Sugarcane	2			
Grapes	2	2	2	8
Other Fruit	2	2	2	8
Vegetables	2	2	1	2
Nuts	1			
Other livestock (includes goats, deer, camels, rabbits)	1			
Honey and beeswax	1			
Other horticulture (includes flowers etc)	1	1	1	1
Total Commodity Damage Score (TCDS)				19

Assess Potential Commodity Impact Scores for each primary production commodity listed in Table 9, based on species' attributes (diet, behaviour, ecology), excluding risk of spreading disease, which is addressed in Question C9, and pest status worldwide as:

0. *Nil (species does not have attributes to make it capable of damaging this commodity)*
1. *Low (species has attributes making it capable of damaging this or similar commodities and has had the opportunity but no reports or other evidence that it has caused damage in any country or region*
2. *Moderate–serious (reports of damage to this or similar commodities exist but damage levels have never been high in any country or region and no major control programs against the species have ever been conducted OR the species has attributes making it capable of damaging this or similar commodities but has not had the opportunity)*
3. *Extreme (damage occurs at high levels to this or similar commodities and/or major control programs have been conducted against the species in any country or region and the listed commodity would be vulnerable to the type of harm this species can cause).*

Climate Match to Commodity Score (0–5)

- *None of the commodity is produced in areas where the species has a climate match within the highest eight climate match classes (ie classes 10, 9, 8, 7, 6, 5, 4 and 3) = 0*
- *Less than 10% of the commodity is produced in areas where the species has a climate match within the highest eight climate match classes = 1*
- *Less than 10% of the commodity is produced in areas where the species has a climate match within the highest six climate match classes (ie classes 10, 9, 8, 7, 6 and 5) = 2*
- *Less than 50% of the commodity is produced in areas where the species has a climate match within the highest six climate match classes AND less than 10% of the commodity is produced in areas where the species has a climate match within the highest three climate match classes (ie classes 10, 9 and 8) = 3*
- *Less than 50% of the commodity is produced in areas where the species has a climate match within the highest six climate match classes BUT more than 10% of the commodity is produced in areas where the species has a climate match within the highest three climate match classes = 4*
- *OR More than 50% of the commodity is produced in areas where the species has a climate match within the highest six climate match classes BUT less than 20% of the commodity is produced in areas where the species has a climate match within the highest three climate match classes = 4*
- *More than 20% of the commodity is produced in areas where the species has a climate match within the highest three climate match classes OR overseas range unknown and climate match to Australia unknown = 5.]*

Table 2: Assigning species to EIC Threat Categories (shaded cells relate to assignment of reptiles and amphibians to EIC Threat Categories based on an assessed establishment risk and an allocated pest risk of extreme) – adapted from Bomford 2008

Establishment Risk	Pest Risk	Public Safety Risk	EIC Threat Category	Implication for any proposed import into Australia	Implication for keeping and movement in Australia
Extreme	Extreme	Highly, Moderately or Not Dangerous	**EXTREME**	Prohibited, unless sufficient risk management measures exist to reduce the potential risks to an acceptable level	Limited to those collections approved for keeping particular EXTREME Threat species
Extreme	Serious	Highly, Moderately or Not Dangerous	**EXTREME**		
Extreme	Moderate	Highly, Moderately or Not Dangerous	**EXTREME**		
Extreme	Low	Highly, Moderately or Not Dangerous	**EXTREME**		
Serious	Extreme	Highly, Moderately or Not Dangerous	**EXTREME**		
Serious	Serious	Highly, Moderately or Not Dangerous	**EXTREME**		
Moderate	Extreme	Highly, Moderately or Not Dangerous	**EXTREME**		
Serious	Moderate	Highly, Moderately or Not Dangerous	**SERIOUS**	Import restricted to those collections approved for keeping SERIOUS Threat species	Limited to those collections approved for keeping particular SERIOUS Threat species
Serious	Low	Highly, Moderately or Not Dangerous	**SERIOUS**		
Moderate	Serious	Highly, Moderately or Not Dangerous	**SERIOUS**		
Moderate	Moderate	Highly Dangerous	**SERIOUS**		
Moderate	Low	Highly Dangerous	**SERIOUS**		
Low	Extreme	Highly, Moderately or Not Dangerous	**SERIOUS**		
Low	Serious	Highly, Moderately or Not Dangerous	**SERIOUS**		
Low	Moderate	Highly Dangerous	**SERIOUS**		
Low	Low	Highly Dangerous	**SERIOUS**		
Moderate	Moderate	Moderately or Not Dangerous	**MODERATE**	Import restricted to those collections approved for keeping MODERATE Threat species	Limited to those collections approved for keeping particular MODERATE Threat species
Moderate	Low	Moderately or Not Dangerous	**MODERATE**		
Low	Moderate	Moderately or Not Dangerous	**MODERATE**		
Low	Low	Moderately Dangerous	**MODERATE**		
Low	Low	Not Dangerous	**LOW**	Import permitted	May be limited to those collections approved for keeping particular LOW Threat species
Any Value	Any Value	Unknown	**EXTREME until proven otherwise**	Prohibited, unless sufficient risk management measures exist to reduce the potential risks to an acceptable level	Limited to those collections approved for keeping particular EXTREME Threat species
Unknown	Any Value	Any Value	**EXTREME until proven otherwise**		
Any Value	Unknown	Any Value	**EXTREME until proven otherwise**		
Unassessed	Unassessed	Unassessed	**EXTREME until proven otherwise**		

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National Risk Assessment: EXTREME

RISK ASSESSMENT FOR AUSTRALIA: Panther Chameleon (*Furcifer pardalis*)

Class - Reptilia**, Order -** Squamata**, Family -** Chamaeleonidae**, Genus –** *Furcifer.*

SPECIES: *Furcifer pardalis* (Cuvier, 1829) **Synonyms:** *Chamaeleo pardalis* (Cuvier, 1829) *Chamaeleo guentheri* (Boulenger, 1888) **Subspecies:** Monotypic **Common Names:** Panther Chameleon Malagasy	**Species description:** Panther chameleons are one of the largest types of chameleons (up to 50 centimetres long (ADW; Animalia)) and are vibrantly coloured. They are sexually dimorphic; females typically being smaller and drabber in colour than males (McGeough, 2016). Weight ranges from 60 to 180 grams (males 140 – 180 grams; females 60 – 100 grams) (Andreone, 2005). Males can be recognised not only by their larger size, but by their swollen tail-base (indicating the presence of a hemipenis). Colouration and patterning vary significantly depending on origin in Madagascar. Males from the areas of Nosy Be, Ankify, and Ambanja are typically a vibrant blue, and those from Ambilobe, Antsiranana, and Sambava are red, green, or orange. Numerous other colour phases and patterns occur between and within regions. Females generally remain tan and brown with hints of pink, peach, or bright orange no matter where they are found. However, there are slight differences in patterns and colours among the different colour phases. Females can become a deep black with orange stripes when they are gravid. Panther chameleons have wide, splayed toes, bulging independently moving eyes, and a curled tail. They have very long tongues (sometimes longer than their own body length) which they can rapidly extend to capture prey. **General information:** Panther chameleons are diurnal, insectivorous, arboreal lizard's native to the coastal forests in the northern region of Madagascar. They prefer to inhabit trees, very rarely coming down to the ground (Reptile Files). From IUCN: "This species is abundant in lowland degraded scrub and forest habitats, where it uses trees of up to 10 metres in height (Raxworthy, 1988). Although it may also use the canopy in relatively intact forest (Raxworthy, 1988), this is thought to be a relatively rare occurrence (Andreone et al., 2005). D'Cruze et al. (2007) found panther chameleons in sites associated with forest or in areas that have been highly disturbed by people. On the island of Nosy Be the highest abundance was found along well-vegetation roadsides (Andreone et al. 2005), and in ylang-ylang and coffee plantations (Andreone et al., 2005). Surveys in closed forest at sites in eastern and northern Madagascar revealed a notably low abundance of chameleons compared to roadsides in Nosy Be (Andreone et al., 2005). In the Loky-Manambato complex near Daraina the lizard was found in all 12 survey sites, including dry forest, littoral forest and transitional forest. In a lowland forest in eastern Madagascar the [panther] chameleon was not encountered inside the main vegetation

	block but was found breeding in areas of abandoned agriculture adjacent to the forest (Rabearivony et al., 2008). Panther chameleons may be associated with open areas in forests that are found alongside rivers (Andreone et al., 2005). A preference for open areas might be related to the opportunities for basking or visual communication using colour (Andreone et al., 2005)." Panther chameleons are carnivores (insectivores). Their diet consists of insects, small birds, and other reptiles. Sexual maturity is reached at around 6 months in both sexes. Depending on the location, females will produce several egg clutches of 10 to 46 eggs a year. Females excavate a burrow with their front feet. When finished laying, they bury the eggs, fill in the tunnel, and stomp the soil down to conceal the location of the nest. Some females drag leaves and twigs of the nest site. When young hatch (incubation: 6 months to 1 year) they are independent and precocial (Ferguson, 2004). Only approximately 5% of each clutch of hatchlings will ever make it to full adulthood (McGeough, 2016). In captivity panther chameleons are not generally aggressive and will only be aggressive if approached or picked up (Animal Brite). Temperament is very variable between individual animals (males generally more aggressive than females) (Chameleon forum). **Longevity:** Longevity is estimated to be 1 to 3 years in the wild and 5 years in captivity (ADW). Females on average have a shorter lifespan in the wild and in captivity than males due to the stresses of reproduction and oviposition (Ferguson, 2004). The maximum recorded longevity in captivity is 5.2 years (AnAge). Ranges from 2-7 years although older specimens have been observed in captivity (McGeough, 2016) **Conservation status:** **IUCN:** Least Concern **CITES:** Appendix II
DATE OF ASSESSMENT: Aug 2022 (Jodi Buchecker) **EIC ENDORSEMENT:** 16/06/23 **Risk assessment model used for the assessment:** Bomford 2006, Reptiles	**The risk assessment model:** Models for assessing the risk that exotic vertebrates could establish in Australia have been developed for mammals, birds (Bomford 2003, 2006, 2008), reptiles and amphibians (Bomford et al 2005, Bomford 2008). Developed by Dr Mary Bomford for the Bureau of Rural Sciences (BRS), the model uses criteria that have been demonstrated to have significant correlation between a risk factor and the establishment of populations of exotic species and the pest potential of those species that do establish. For example, a risk factor for establishment is similarity in climate (temperature and rainfall) within the species' distribution overseas and Australia. For pest potential, the species' overseas pest status is a risk factor. The model is published as 'Risk assessment models for the establishment of exotic vertebrates in Australia and New Zealand' (Bomford 2008) and is available online on the PestSmart website https://pestsmart.org.au/wp-content/uploads/sites/3/2020/06/Risk_Assess_Models_2008_FINAL.pdf

Bomford 2008, Birds and Mammals	**CLIMATE**: In 2021 a new version of the Climatch program used to assess similarity in climate was released by the Australian Bureau of Agricultural Resource Economics and Sciences (ABARES): CLIMATCH v2.0. The increase in resolution in this new version (from 50 km to 20 km) required recalibration of Climate Match Scores. See Table 1. Sixteen climate parameters (variables) of temperature and rainfall are used to estimate the extent of similarity between data from meteorological stations located within the species' world distribution and stations in Australia. Worldwide, data from approximately 19000 locations are available for analysis. The number of locations used in an analysis will vary according to the size of the species' distribution and the number of meteorological stations located within that distribution. To represent the climate match visually, the map of Australia is divided into 19236 grid squares, each measured in 0.2 degrees in both longitude and latitude. CLIMATCH v2.0 calculates a match for each Australian grid by comparing data from all meteorological stations within the species' distribution (excluding any populations in Australia) and allocating a score ranging from ten for the highest level match to zero for the poorest match. Levels of climate match are used in the risk assessment for questions B1 (scores are summed to give a cumulative score), C6, and C8. Climatch v2.0 can be accessed on the ABARES website, agriculture.gov.au/abares. The direct URL is https://climatch.cp1.agriculture.gov.au/.

Reptile Model:

FACTOR	**SCORE**	**DETAIL**
STAGE A: RISKS POSED BY CAPTIVE OR RELEASED ANIMALS		
A. Climate match risk score *Map the selected reptile or amphibian species' overseas range, including its entire native and exotic (excluding Australia) ranges over the past 1000 years. Use CLIMATCH v2.0 to determine the climate match between this overseas range and Australia, selecting Euclidian Match and using all 16 climate variables for the analysis.* *CMS = sum of classes 7 – 10* *CMRS = 100 x (CMS/19236).*	10.40	CMRS = 100 x (77/19,236) + 10 = 10.40029112081514 Input area has less than 12 meteorological stations so + 10 CMRS = 10.40
B. Exotic Elsewhere Risk score (0, 15 or 30) *Score B = A species' Exotic Elsewhere Risk Score, calculated as follows:* • *Species has established breeding self-sustaining exotic population in another country = 30* • *Species has been introduced into another country and records exist of it in the wild, but it is uncertain if a breeding self-sustaining population has established = 15*	30	*Species has established breeding self-sustaining exotic population in another country.* Has been introduced to Réunion and Mauritius Islands (Jenkins, 2011). GBIF record the species as having been introduced to the United States of America, Belgium, and South Africa.

• *Species has not established an exotic population (including species not known to have been introduced anywhere) = 0*		Introduced to Florida (likely pathway: pet trade) in 2008 (Krysko, 2016). Adults and juveniles of both sexes were found within 300 metres of each other in Broward County in 2013 (Rochford, 2013; Dalaba, 2019; Engeman, 2016). A subsequent survey of Broward County, by The University of Florida, suggested that the population in Broward County had been eradicated. Recent anecdotal evidence (several You Tube videos) supports a high probability that a free-living population still exists in Florida. For noting: NSW DPI (Nathan Cutter, pers. comm.) report that the species has been collected from the open environment in Australia (NSW) in 2019. Presumption is that the male animal was either intentionally released or had escaped from an illegal collection.
C. Taxonomic Family Risk Score	30	*Chamaeleonidae*
ESTABLISHMENT RISK RANK *A species' Establishment Risk Score = Score A + Score B + Score C.* *Establishment Risk Rank — Establishment Risk Score* *Low — ≤ 22* *Moderate — 23-60* *Serious — 61-115* *Extreme — ≥ 116*	70.40	**SERIOUS**

Bird and Mammal Model for Reptiles and Amphibians:

B1. Degree of climate match between species overseas range and Australia (1–6) *Map the selected mammal or bird species' overseas range, including its entire native and exotic (excluding Australia) ranges over the past 1000 years.* *Use CLIMATCH v2.0, Value X = sum of classes 6 – 10, see Table 1.*	2	*Very Low climate match to Australia* Value X = 158 Climate Match Score = 1 + 1 (less than 12 meteorological stations) = 2

B2. Exotic population established overseas (0–4) *An established exotic population means the introduced species must have bred outside of captivity and must currently maintain a viable free-living population where the animals are not being intentionally fed or sheltered, even though they may be living in a highly disturbed environment with access to non-natural food supplies or shelter.*	4	*Exotic population established on a larger island (> 50,000 km^2) or anywhere on a continent.* The panther chameleon has been introduced to Réunion and Mauritius Islands (Jenkins, 2011). GBIF record the species as having been introduced to the United States of America, Belgium, and South Africa. Introduced to Florida (likely pathway: pet trade) in 2008 (Krysko, 2016). Adults and juveniles of both sexes were found within 300 metres of each other in Broward County in 2013 (Rochford, 2013; Dalaba, 2019; Engeman, 2016). A subsequent survey of Broward County, by The University of Florida, suggested that the population in Broward County had been eradicated. Recent anecdotal evidence (several You Tube videos) supports a high probability that a free-living population still exists in Florida. For noting: NSW DPI (Nathan Cutter, pers. comm.) report that the species has been collected from the open environment in Australia (NSW) in 2019. Presumption is that the male animal was either intentionally released or had escaped from an illegal collection.
B3. Overseas range size score (0–2) < 1 = 0; 1– 70 = 1; >70 = 2 *Estimate the species overseas range size* including currently and the past 1000 years; natural and introduced range in millions of square kilometres*	0	*Overseas range less than 1 million square kilometres.* Approximately ~160K km^2
ESTABLISHMENT RISK RANK *A species' Establishment Risk Score = Score A + Score B + Score C.* *Establishment Risk Rank Establishment Risk Score* *Low ≤ 4*	6	**MODERATE**

Moderate *Serious* *Extreme*	*5-7* *8-9* *10-12*		

ENVIRONMENT AND INVASIVES COMMITTEE THREAT CATEGORY	**EXTREME**

World distribution map (IUCN Red List) and Climatch world distribution map indicating where meteorological data was sourced for the climate analysis (see B1):

Figure 1 - World Distribution Map - IUCN Red List

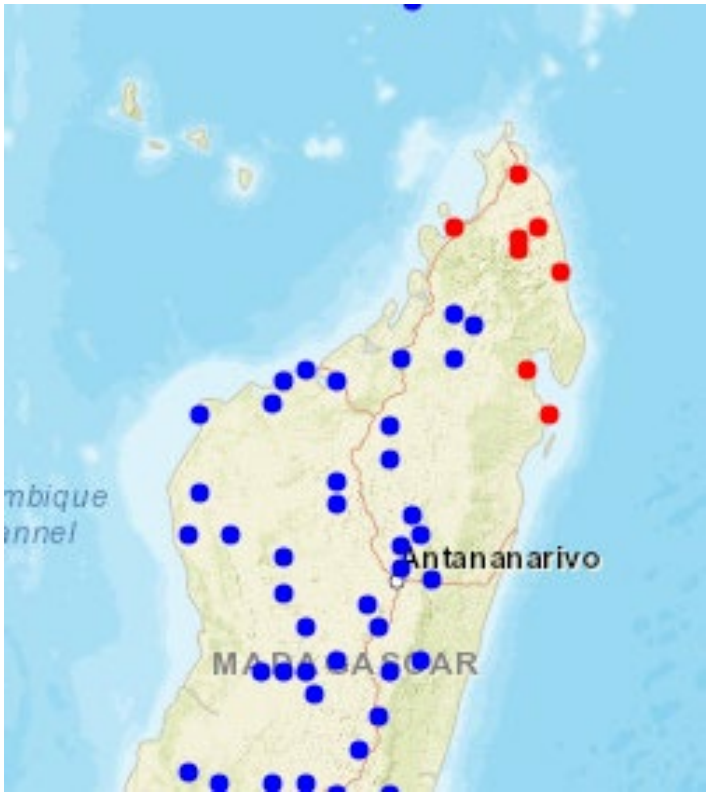


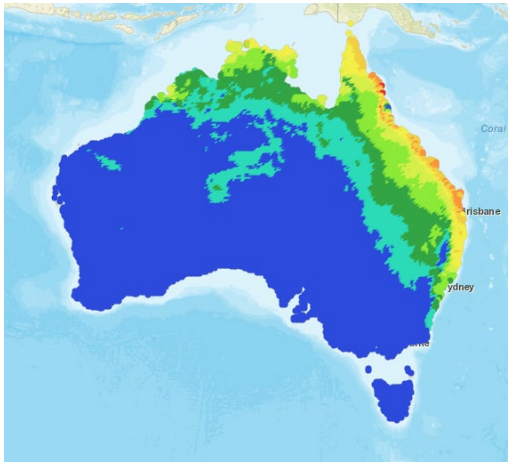
Figure 2 – World Distribution map – Climatch Madagascar

Figure 3 - Figure 2 – World Distribution map – Climatch Florida, United States of America

Reptile model: Climate match between world distribution of species and Australia:

Areas of Australia where the climate appears suitable for *Furcifer pardalis*

CMS = 77



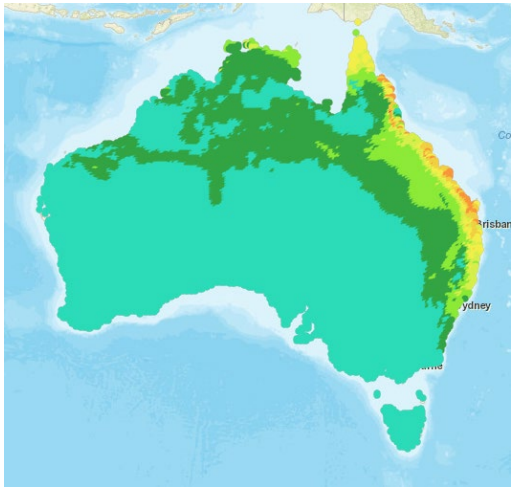
Score	Color	Count
0	●	12145
1	●	2720
2	●	2007
3	●	1188
4	●	575
5	●	342
6	●	182
7	●	74
8	●	3
9	●	0
10	●	0

Species: Furcifer pardalis (Panther Chameleon)
Algorithm: Euclidean
11 source features selected
19236 target features selected
Approximate selected area: 156,575 km^2

Bird and Mammal model: Climate match between world distribution of species and Australia:

Areas of Australia where the climate appears suitable for *Furcifer pardalis*

Value X = 158



Score	Color	Count
0	●	0
1	●	12719
2	●	4835
3	●	1046
4	●	249
5	●	229
6	●	100
7	●	57
8	●	1
9	●	0
10	●	0

Species: Furcifer pardalis (Panther Chameleon)
Algorithm: Closest Standard Score
11 source features selected
19236 target features selected
Approximate selected area: 156,575 km^2

Table 1: ABARES recalibration thresholds

Climate Match Score (CMS)	Climatch (50 km) Closest Standard Match Sum Level 6 (Value X)	2021 Recalibrated Climatch v2.0 (20 km) Closest Standard Match Sum Level 6 (Value X)
1 (Very low)	< 100	< 691
2 (Low)	100-599	691-4137
3 (Moderate)	600-899	4138-6209
4 (High)	900-1699	6210-11735
5 (Very high)	1700-2699	11736-18642
6 (Extreme)	≥ 2700	≥ 18643

Table 2: Assigning species to EIC Threat Categories (shaded cells relate to assignment of reptiles and amphibians to EIC Threat Categories based on an assessed establishment risk and an allocated pest risk of extreme) – adapted from Bomford 2008

Establishment Risk	Pest Risk	Public Safety Risk	EIC Threat Category	Implication for any proposed import into Australia	Implication for keeping and movement in Australia
Extreme	Extreme	Highly, Moderately or Not Dangerous	**EXTREME**	Prohibited, unless sufficient risk management measures exist to reduce the potential risks to an acceptable level	Limited to those collections approved for keeping particular EXTREME Threat species
Extreme	Serious	Highly, Moderately or Not Dangerous	**EXTREME**		
Extreme	Moderate	Highly, Moderately or Not Dangerous	**EXTREME**		
Extreme	Low	Highly, Moderately or Not Dangerous	**EXTREME**		
Serious	Extreme	Highly, Moderately or Not Dangerous	**EXTREME**		
Serious	Serious	Highly, Moderately or Not Dangerous	**EXTREME**		
Moderate	Extreme	Highly, Moderately or Not Dangerous	**EXTREME**		
Serious	Moderate	Highly, Moderately or Not Dangerous	**SERIOUS**	Import restricted to those collections approved for keeping SERIOUS Threat species	Limited to those collections approved for keeping particular SERIOUS Threat species
Serious	Low	Highly, Moderately or Not Dangerous	**SERIOUS**		
Moderate	Serious	Highly, Moderately or Not Dangerous	**SERIOUS**		
Moderate	Moderate	Highly Dangerous	**SERIOUS**		
Moderate	Low	Highly Dangerous	**SERIOUS**		
Low	Extreme	Highly, Moderately or Not Dangerous	**SERIOUS**		
Low	Serious	Highly, Moderately or Not Dangerous	**SERIOUS**		
Low	Moderate	Highly Dangerous	**SERIOUS**		
Low	Low	Highly Dangerous	**SERIOUS**		
Moderate	Moderate	Moderately or Not Dangerous	**MODERATE**	Import restricted to those collections approved for keeping MODERATE Threat species	Limited to those collections approved for keeping particular MODERATE Threat species
Moderate	Low	Moderately or Not Dangerous	**MODERATE**		
Low	Moderate	Moderately or Not Dangerous	**MODERATE**		
Low	Low	Moderately Dangerous	**MODERATE**		
Low	Low	Not Dangerous	**LOW**	Import permitted	May be limited to those collections approved for keeping particular LOW Threat species
Any Value	Any Value	Unknown	**EXTREME until proven otherwise**	Prohibited, unless sufficient risk management measures exist to reduce the potential risks to an acceptable level	Limited to those collections approved for keeping particular EXTREME Threat species
Unknown	Any Value	Any Value	**EXTREME until proven otherwise**		
Any Value	Unknown	Any Value	**EXTREME until proven otherwise**		
Unassessed	Unassessed	Unassessed	**EXTREME until proven otherwise**		

Risk Assessor's details:

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Date:	Aug 2022
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National Risk Assessment: SERIOUS

RISK ASSESSMENT FOR AUSTRALIA: California Quail (*Callipepla californica*)

Class - Aves**, Order -** Galliformes**, Family -** Odontophoridae**, Genus -** *Callipepla*.

SPECIES: *Callipepla californica* (Shaw, 1798) **Synonyms:** *Tetrao californicus* (Shaw, 1798) *Lophortyx californica* (Stotz, 1996) **Subspecies:** Eight subspecies recognised. Subspecies and Distribution: • *C. c. californica* (Shaw, 1798) • *C. c. orecta* (Oberholser, 1932) • *C. c. brunnescens* (Ridgway, 1884) • *C. c. catalinensis* (Grinnell, 1906) • *C. c. canfieldae* (van Rossem, 1939) • *C. c. plumbea* (Grinnell, 1926) • *C. c. decolorata* (van Rossem, 1946) • *C. c. achrustera* (J. L. Peters, 1923) (del Hoyo, Elliott *et al.,* 1994; ITIS Global, 2015)	**Species description:** The length and weight of the California quail ranges between 23-27 centimetres and 140-230 grams respectively. A stout bird, mostly grey with brownish speckled looking back and wings. The crown is chestnut with sides streaked white. The male has a black throat edged with white and white eyebrows that meet on forehead. Both sexes have a tear shaped black crest that is darker and larger in the male. Legs are grey and the bill black and short (del Hoyo, Elliot *et al.* 1999; Leary 2013). **General information:** The California quail is endemic to North and Central America. There are 8 subspecies that have been identified: • *C. c. californica* – Northwest Untied States of America (USA) (from North Oregon and Western Nevada) South to extreme Northwest Mexico (Los Coronados Islands, off Northwest Baja California); also (probably introduced) from Southwest Canada (South British Columbia) Southeast to Westcoast USA (Colorado). • *C. c. orecta* – Southeast Oregon and extreme Northeast California. • *C. c. brunnescens* (Ridgway, 1884) – coastal South Oregon to Southcentral California. Also (probably introduced) Vancouver Island, in Southwest Canada. • *C. c. catalinensis* (Grinnell, 1906) – Santa Catalina Island, off Southwest California (Southwest USA); also (probably introduced) nearby Channel Island (Santa Rosa and Santa Cruz). • *C. c. canfieldae* (van Rossem, 1939) – Eastern central California (Owens Valley). • *C. c. plumbea* (Grinnell, 1926) – South California South to extreme Northwest Mexico (North Baja California). • *C. c. decolorata* (van Rossem, 1946) – Central and South Baja California, in Northwest Mexico. • *C. c. achrustera* (J. L. Peters, 1923) – extreme South Baja California, in Western Mexico. (del Hoyo, Elliott *et al.,* 1994; ITIS Global, 2015).

Common Names: California Quail Warner Valley Quail (*C. c. orecta*) Santa Catalina Quail (*C. c. catalinensis*) San Lucas Quail (*C. c. achrustera*) (del Hoyo, Elliott *et al.* 1994) **Hybrids:** Sometimes considered conspecific with *C. gambelii*, the two hybridising in areas of range overlap. Subspecies *C. c. plumbea* and *C. c. orecta* sometimes merged in nominate, and *decolorata* perhaps undiagnosable.	Introduced populations have been established in Chile, Western Argentina, Hawaii, New Zealand (*C. c. brunnescens*), and Corsica (Calkins *et al*., 2014; del Hoyo, Elliot *et al.* 1999; Groves, 1991; Pyle and Pyle, 2017; Schwartz and Schwartz, 1950). Call of male is a distinctive 3-note 'qua-quergo'; other calls include sharp tut-tut warnings and softer tup-tup; chicks make a high whistle (Leary, 2013). The quail live in coveys or flocks (27-73 individuals in a covey), but in breeding season individuals form breeding pairs and move off together. They prefer to run but will fly to avoid predators; the flight is short in duration. The nest is a flattened area of ground well concealed among vegetation, often located against a log or rock (Leary, 2013). The California quail is an omnivore eating a variety of seeds (such as Lupinus, Erodium, Trifolium, Medicago), fruits, leaves, plant foliage, berries, grains, insects and vegetables (del Hoyo, Elliot *et al.,* 1999; Long, 1981). The California quail is also reported to consume wheat (Crispens 1960). California quails can survive in cool weather without drinking if insects and succulent plants are available and are tolerate of high temperatures but the requirement for water increases with ambient temperature (Calkins *et al*., 2014). **Longevity:** In the wild, the California quail can live up to 9.6 years (Tacutu, 2013). **Conservation status:** **IUCN:** Least Concern **CITES:** Not listed
DATE OF ORIGINAL ASSESSMENT: 28/06/2017 **DATE OF CURRENT ASSESSMENT:** Sep 2022 (Jodi Buchecker) **EIC ENDORSEMENT:** 16/06/23 **Risk assessment model used for the assessment:** Bomford 2008, Bird and Mammal	**The risk assessment model:** Models for assessing the risk that exotic vertebrates could establish in Australia have been developed for mammals, birds (Bomford 2003, 2006, 2008), reptiles and amphibians (Bomford et al 2005, Bomford 2008). Developed by Dr Mary Bomford for the Bureau of Rural Sciences (BRS), the model uses criteria that have been demonstrated to have significant correlation between a risk factor and the establishment of populations of exotic species and the pest potential of those species that do establish. For example, a risk factor for establishment is similarity in climate (temperature and rainfall) within the species' distribution overseas and Australia. For pest potential, the species' overseas pest status is a risk factor. The model is published as 'Risk assessment models for the establishment of exotic vertebrates in Australia and New Zealand' (Bomford 2008) and is available online on the PestSmart website https://pestsmart.org.au/wp-content/uploads/sites/3/2020/06/Risk_Assess_Models_2008_FINAL.pdf **CLIMATE**: In 2021 a new version of the Climatch program used to assess similarity in climate was released by the Australian Bureau of Agricultural Resource Economics and Sciences (ABARES): CLIMATCH v2.0. The increase in resolution in this new version (from 50 km to 20 km) required recalibration of Climate Match Scores. See Table 1. Sixteen climate parameters (variables) of temperature and

	rainfall are used to estimate the extent of similarity between data from meteorological stations located within the species' world distribution and stations in Australia. Worldwide, data from approximately 19000 locations are available for analysis. The number of locations used in an analysis will vary according to the size of the species' distribution and the number of meteorological stations located within that distribution. To represent the climate match visually, the map of Australia is divided into 19236 grid squares, each measured in 0.2 degrees in both longitude and latitude. CLIMATCH v2.0 calculates a match for each Australian grid by comparing data from all meteorological stations within the species' distribution (excluding any populations in Australia) and allocating a score ranging from ten for the highest level match to zero for the poorest match. Levels of climate match are used in the risk assessment for questions B1 (scores are summed to give a cumulative score), C6, and C8. Climatch v2.0 can be accessed on the ABARES website, agriculture.gov.au/abares. The direct URL is https://climatch.cp1.agriculture.gov.au/.

Bird and Mammal Model:		
FACTOR	**SCORE**	**DETAIL**
STAGE A: RISKS POSED BY CAPTIVE OR RELEASED ANIMALS		
A1. Risk to people from individual escapees (0–2) *Assess the risk that individuals of the species could harm people. (NB, this question only relates to aggressive behaviour shown by escaped or released individual animals. Question C11 addresses the risk of harm from aggressive behaviour if the species establishes a wild population).* *Aggressive behaviour, size, plus the possession of organs capable of inflicting harm, such as sharp teeth, claws, spines, a sharp bill, or toxin-delivering apparatus may enable individual animals to harm people. Any known history of the species attacking, injuring or killing people should also be taken into account. Assume the individual is not protecting nest or young.*	0	*Animal posing a low risk of harm to people (will not make unprovoked attacks causing injury requiring medical attention, and which, even if cornered or handled, are unlikely to cause injury requiring hospitalisation).* Small gamebird.
A2. Risk to public safety from individual captive animals (0–2) *Assess the risk that irresponsible use of products obtained from captive individuals of the species (such as toxins) pose a public safety risk (excluding the safety of anyone entering*	0	*Nil or no risk (highly unlikely or not possible)* Small gamebird.

the animals' cage/enclosure or otherwise coming within reach of the captive animals)		
STAGE A PUBLIC SAFETY RISK SCORE **SUM A1 - A2 (0-4)**	0	**Not dangerous**
STAGE B: PROBABILITY ESCAPED OR RELEASED INDIVIDUALS WILL ESTABLISH FREE-LIVING POPULATIONS		
Model 1: FOUR-FACTOR MODEL FOR BIRDS AND MAMMALS (BOMFORD 2008)		
B1. Degree of climate match between species overseas range and Australia (1–6) *Map the selected mammal or bird species' overseas range, including its entire native and exotic (excluding Australia) ranges over the past 1000 years.* *Use CLIMATCH v2.0, Value X = sum of classes 6 – 10, see Table 1.*	4	*High climate match to Australia* Value X = 11,415 Climate Match Score = 4
B2. Exotic population established overseas (0–4) *An established exotic population means the introduced species must have bred outside of captivity and must currently maintain a viable free-living population where the animals are not being intentionally fed or sheltered, even though they may be living in a highly disturbed environment with access to non-natural food supplies or shelter.*	4	*Exotic population established on an island larger than 50,000 square kilometres or anywhere on a continent.* Introduced to Chile, Western Argentina, Hawaii, New Zealand (*C. c. brunnescens*), and Corsica (Calkins *et al*., 2014; del Hoyo, Elliot *et al.* 1999; Groves, 1991; Pyle and Pyle, 2017; Schwartz and Schwartz, 1950). Australian introduced populations occur in New South Wales, Victoria, King Island and Norfolk Island ("Atlas of Living Australia", 2016; BirdLife Australia, 2015). California quails were introduced to New Zealand by various acclimatisation societies and by some individuals, from 1862-1917 (Long, 1981). During 1878 to 1880, the California quail were in sufficiently high numbers to be processed as food into cans and exported frozen to England and Europe (Long ,1981). The California quail has a distribution from Northland to the Waikato, inland Bay of Plenty, coastal Wairarapa, Nelson, Marlborough, North

		Canterbury and Banks Peninsula. They are uncommon or absent in Southland, the Southern Alps, the West Coast and the Chatham Islands (Leary, 2013). Recorded as introduced in 12 countries or islands (United States (Hawaii), Belgium, France, United Kingdom, Australia, Denmark, Czechia, New Zealand, Argentina, Chile, Ecuador, and United Arab Emirates) (GBIF). [Distribution could not be defined in many of these countries as only single occurrences were recorded in GBIF. These areas therefore have not been included in the climate analysis. However, a cluster in and around Belgium allowed this area to be used in the climate analysis with reasonable confidence (Figure 4)]. Potentially introduced to Germany (DAISIE, 2009). However, the distribution of the California quail in Germany could not be defined and has therefore not been included in the climate analysis.
B3. Overseas range size score (0–2) < 1 = 0; 1– 70 = 1; >70 = 2 *Estimate the species overseas range size* including currently and the past 1000 years; natural and introduced range in millions of square kilometres*	1	*Overseas range between 1 to 70 million square kilometres.* Overseas range estimated at 2.3 million km^2 including current and past 1,000 years, natural and introduced range. The California quail is endemic to North and Central America and can be found in California, Baja California and north-western USA (McIlvaine, 2000). See B2 for introduced populations.
B4. Taxonomic Class (0–1) *Bird = 0; mammal = 1*	0	*Bird*
B. Establishment Risk Score **Sum of B1- B4 (1–13)**	9	**Serious establishment risk**
Model 2: Seven-Factor Model For Birds And Mammals (Bomford 2008)		
B5. Diet score (0–1) *Specialist = 0; generalist = 1*	1	*Generalist with a broad diet of many food types.* The California quail is an omnivore eating a variety of seeds (such as Lupinus, Erodium, Trifolium, Medicago), fruits, leaves, plant foliage, berries, grains, insects and vegetables (del Hoyo, Elliot *et al.,* 1999; Long, 1981). The California quail is also reported to consume wheat

		(Crispens 1960). Foods eaten by free living California quail in Western Oregon - 70% forbes, 21% trees and shrubs, 8% grasses and 1% invertebrates (Crawford 1993).
B6. Habitat score (0–1) *Undisturbed or disturbed habitat*	1	*Can survive and breed in human-disturbed habitats (including grazing and agricultural lands, forests that are intensively managed or planted for timber harvesting and/or urban–suburban environments) without access to undisturbed (natural) habitats.* The California quail occurs in a wide range of habitats, generally in open woodlands or bushlands, including suburban locations and farmland (del Hoyo, Elliot *et al.,* 1999), irrigated lands (Stinnett and Klebenow, 1986), chaparral, valley grasslands, woodlands, residential gardens, parks, golf courses, farmland, pine forests (Calkins *et al*. 2014). Introduced populations in New Zealand occur in uncultivated open shrubland, and frequent scrubby edges of rivers, inlets, forests, roads and rural gardens (Leary, 2013). In Western Oregon (USA), roads systems were frequently used by the quail to move from habitat types and areas of bare ground received the greatest use by quail (Crawford, 1993). In Western Oregon, habit use by female quail was composed of 68% shrub and grasslands, 18% agriculture fields, 8% woodland, 1% roadsides, 6% other cover types (Crawford, 1993). Individuals generally roost off the ground in groups. Nesting sites include oaks, laurel, juniper, cacti, orange trees, saltbush, blackberry bushes, grape vines and eucalyptus. The California quail rests (loafs) during midday under short shrubby species (such as saltbush and sage) and taller species (such as live oaks). The best habitat areas provide dry dust and grit. The foliage also provides shade and prevents attacks by raptors. To escape from humans and other mammals, individuals run or fly into brushy cover or fly to the closest tree and walk down to brushier areas. Escape cover includes shrubby chaparral and scrub species, dense grasses, and rock outcrops (Calkins *et al*., 2014).
B7. Migratory score (0–1) *Always migratory = 0; non-migratory = 1*	1	*Non-migratory or facultative migrant in its native range* The Californian quail is sedentary (Calkins *et al*. 2014; Long 1981). Daily movements vary from a range of 0.8–1.2 kilometres per day in semiarid rangeland to > 1.6 kilometres per day in areas of ample water (Macgregor, 1953).

B. ESTABLISHMENT RISK SCORE **SUM OF B1- B7 (1–16)**	12	**Serious establishment risk**
STAGE C: PROBABILITY AN ESTABLISHED SPECIES WILL BECOME A PEST		
C1. Taxonomic group (0–4)	0	*Other taxonomic group* Order – Galliformes (ITIS Global, 2015).
C2. Overseas range size including current and past 1000 years, natural and introduced range (0–2) *Estimate the species overseas range size (including current and past 1000 years, natural and introduced range) in millions of square kilometres*	0	*Overseas geographic range less than 10 million square kilometres.* Overseas range estimated at 2.3 million $km^{2.}$ Overseas distribution includes Western North America, New Zealand, Argentina, Chile (del Hoyo, Elliot *et al*., 1999) (see B3 for details).
C3. Diet and feeding (0–3)	0	*Not a mammal.*
C4. Competition with native fauna for tree hollows (0–2)	0	*Does not use tree hollows.* Nest is a flattened area of ground well concealed among vegetation, often located against a log or rock (Leary, 2013).
C5. Overseas environmental pest status (0–3) *Has the species been reported to cause declines in abundance of any native species of plant or animal or cause degradation to any natural communities in any country or region of the world?*	1	*Minor environmental pest in any country or region.* In Chile, the introduced California quail was considered to compete for preferred habitat and food with the Chilean Tinamou (*Nothoprocta perdicaria*) but there was no supporting evidence (Jaksic, 1998). In Idaho (USA), it may have displaced Mountain Quail (*Oreortyx pictus*), although this has been disputed (Calkins *et al*., 2014; Leopold, 1977).
C6. Climate match to areas with susceptible native species or communities (0–5) *Identify any native Australian animal or plant species or communities that could be susceptible to harm by the exotic species if it were to establish a wild population here.*	5	*The species has more than 692 grid squares within the highest four climate match classes that overlap the distribution of any susceptible native species or ecological communities = 5* Painted Buttonquail (*Turnix maculosa*) – Least Concern Little Buttonquail (*Turnix velox*) – Least Concern Red-chested Buttonquail (*Turnix pyrrhothorax*) – Least Concern

		Buff-breasted Buttonquail (*Turnix olivii*) – Critically Endangered Black-breasted Buttonquail (*Turnix melanogaster*) – Vulnerable (Barrett, Silcocks *et al.,* 2003; del Hoyo, Elliott *et al.* 1994; Department of the Environment, 2016) Communities: No listed vulnerable or endangered ecological communities likely to be at risk.
C7. Overseas primary production pest status (0–3) *Has the species been reported to damage crops or other primary production in any country or region of the world?*	1	*Minor pest of primary production in any country or region.* California quails can damage crops when in high numbers. Introduced populations in New Zealand are reported as pests of agriculture by consuming germinating clover seed, and damaging grape and strawberry crops. Early records show the quail was considered a pest of grain crops and grapes in California, where it is still considered a pest by eating grapes (Long, 1981).
C8. Climate match to susceptible primary production (0–5) *Assess Potential Commodity Impact Scores for each primary production commodity listed in Table 9, based on species' attributes (diet, behaviour, ecology), excluding risk of spreading disease which is addressed in Question C9.* *0 = 0; 1-19 = 1; 20-49 = 2; 50-99 = 3; 100-149 = 4; ≥150 = 5*	5	Total Commodity Damage Score = 216 (see Table 2)
C9. Spread disease (1–2) *Assess the risk that the species could play a role in the spread of disease or parasites to other animals*	2	*All birds (likely or unknown effect on native species and on livestock and other domestic animals).*
C10. Harm to property (0–3) *Assess the risk that the species could inflict damage on buildings, vehicles, fences, roads, equipment or ornamental gardens by chewing or burrowing or polluting with droppings or nesting material.*	0	*$0.* No reports of damage to property.

C11. Harm to people (0–5) *Assess the risk that, if a wild population established, the species could cause harm to or annoy people. Aggressive behaviour, plus the possession of organs capable of inflicting harm, such as sharp teeth, tusks, claws, spines, a sharp bill, horns, antlers or toxin delivering organs may enable animals to harm people. Any known history of the species attacking, injuring or killing people should also be taken into account (see Stage A, Score A1).*	0	*Nil risk.* Small gamebird
C. PEST RISK SCORE **SUM C 1 TO C 11 (1–37)**	14	**Moderate pest risk**
STAGE A. PUBLIC SAFETY RISK RANK – RISK TO PUBLIC SAFETY POSED BY CAPTIVE OR RELEASED INDIVIDUALS *0 = Not dangerous; 1 = Moderately dangerous; ≥ 2 = Highly dangerous*	0	Not dangerous
STAGE B. ESTABLISHMENT RISK RANK – RISK OF ESTABLISHING A WILD POPULATION **MODEL 1: FOUR-FACTOR MODEL FOR BIRDS AND MAMMALS (BOMFORD 2008)** *≤ 5 = low establishment risk; 6-8 = moderate establishment risk; 9-10 = serious establishment risk; ≥ 11-13 = extreme establishment risk*	9	Serious establishment risk
STAGE B. ESTABLISHMENT RISK RANK – RISK OF ESTABLISHING A WILD POPULATION **MODEL 2: SEVEN-FACTOR MODEL FOR BIRDS AND MAMMALS (BOMFORD 2008)** *≤ 6 = low establishment risk; 7-11 = moderate establishment risk; 12-13 = serious establishment risk; ≥14 = extreme establishment risk*	12	Serious establishment risk
STAGE C. PEST RISK RANK - RISK OF BECOMING A PEST FOLLOWING ESTABLISHMENT	14	Moderate pest risk

< 9 = low pest risk; 9-14 = moderate pest risk; 15-19 = serious pest risk; > 19 = extreme pest risk		

ENVIRONMENT AND INVASIVES COMMITTEE THREAT CATEGORY	**SERIOUS**

World distribution map (GBIF and IUCN Red List) and Climatch world distribution map indicating where meteorological data was sourced for the climate analysis (see B1) (includes current and past 100 years):

Figure 1 - World Distribution Map - IUCN Red List

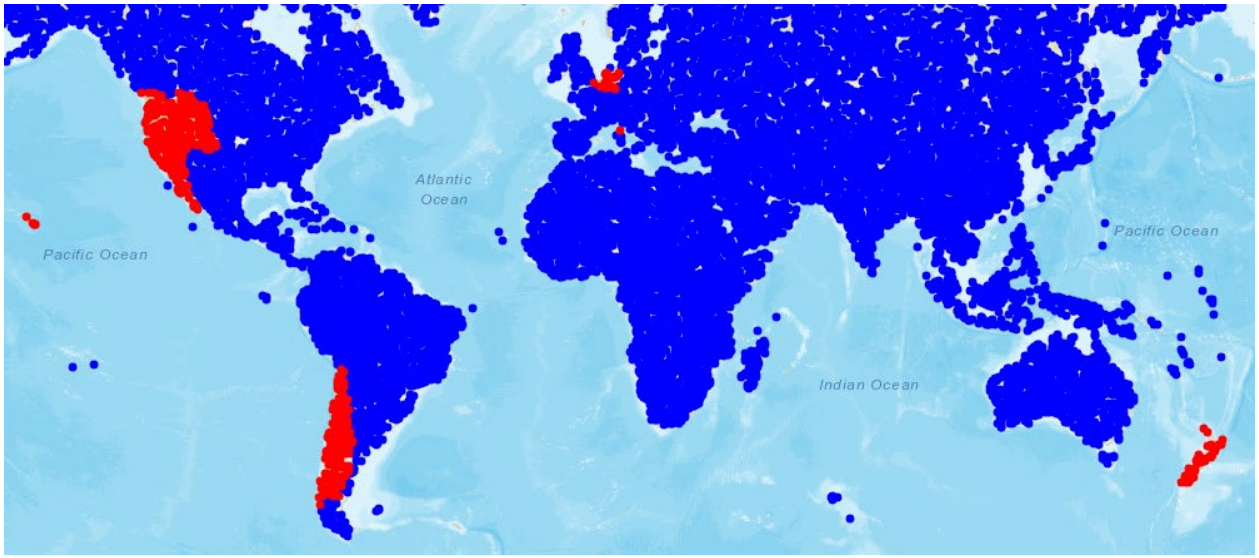


Figure 2 - World Distribution Map - Climatch

Figure 3 - World Georeferenced records (GBIF) – All referenced locations

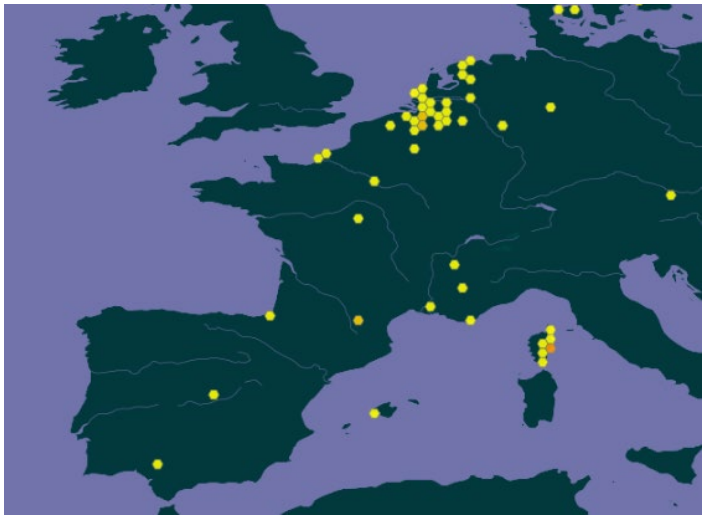
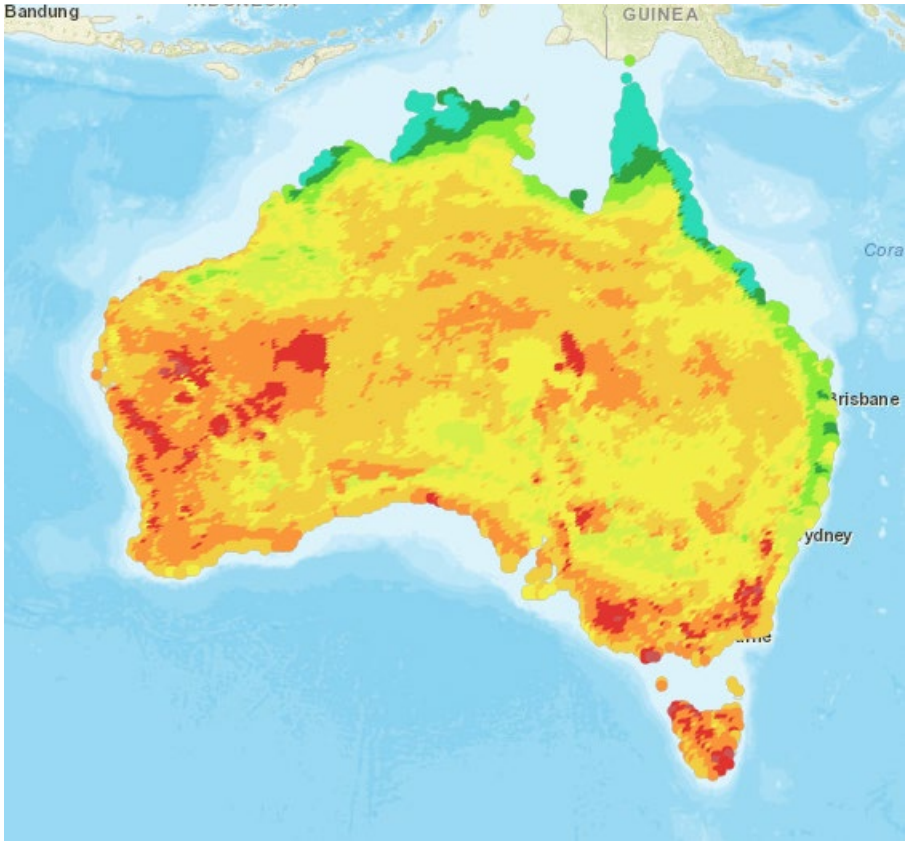


Figure 4 - World Georeferenced records (GBIF) – Europe

Climate match between world distribution of species and Australia:

Areas of Australia where the climate appears suitable for *Callipepla californica*

Value X = 11,415



Score	Color	Count
0		0
1		474
2		344
3		646
4		1424
5		4933
6		7346
7		3351
8		666
9		52
10		0

Species: California Quail (Callipepla californica)
Algorithm: Closest Standard Score
547 source features selected
19236 target features selected
Approximate selected area: 4,581,863 km^2

Table 1: ABARES recalibration thresholds

Climate Match Score (CMS)	Climatch (50 km) Closest Standard Match Sum Level 6 (Value X)	2021 Recalibrated Climatch v2.0 (20 km) Closest Standard Match Sum Level 6 (Value X)
1 (Very low)	< 100	< 691
2 (Low)	100-599	691-4137
3 (Moderate)	600-899	4138-6209
4 (High)	900-1699	6210-11735
5 (Very high)	1700-2699	11736-18642
6 (Extreme)	≥ 2700	≥ 18643

Table 2: Susceptible Australian Primary Production – Calculating Total Commodity Damage Score

The commodity value index scores in this table are derived from Australian Bureau of Statistics 1999 – 2000 data. The values will require updating if significant change has occurred in the value of the commodity (Bomford 2008).

Industry	**Commodity Value Index 1 (CVI based on best available date)**	**Potential Commodity Impact Score (PCIS 0-3)**	**Climate Match to Commodity Score (CMCS 0–5)**	**Commodity Damage Score (CDS columns 2 X 3 X 4)**
Sheep (includes wool and sheep meat)	10			
Cattle (includes dairy and beef)	10			
Timber (includes native and plantation forests)	10			
Cereal grain (includes wheat, barley sorghum etc)	10	3	4	120
Pigs	2			
Poultry and eggs	2			
Aquaculture (includes coastal mariculture)	2			
Cotton	2			
Oilseeds (includes canola, sunflower etc)	2			
Grain legumes (includes soybeans)	2			
Sugarcane	2			
Grapes	2	3	4	24
Other Fruit	2	3	4	24
Vegetables	2	3	4	24
Nuts	1			
Other livestock (includes goats, deer, camels, rabbits)	1			
Honey and beeswax	1			
Other horticulture (includes flowers etc)	1	3	4	24
Total Commodity Damage Score (TCDS)				216

Assess Potential Commodity Impact Scores for each primary production commodity listed in Table 9, based on species' attributes (diet, behaviour, ecology), excluding risk of spreading disease which is addressed in Question C9, and pest status worldwide as:

0. *Nil (species does not have attributes to make it capable of damaging this commodity)*
1. *Low (species has attributes making it capable of damaging this or similar commodities and has had the opportunity but no reports or other evidence that it has caused damage in any country or region*
2. *Moderate–serious (reports of damage to this or similar commodities exist but damage levels have never been high in any country or region and no major control programs against the species have ever been conducted OR the species has attributes making it capable of damaging this or similar commodities but has not had the opportunity)*
3. *Extreme (damage occurs at high levels to this or similar commodities and/or major control programs have been conducted against the species in any country or region and the listed commodity would be vulnerable to the type of harm this species can cause).*

Climate Match to Commodity Score (0–5)

- *None of the commodity is produced in areas where the species has a climate match within the highest eight climate match classes (ie classes 10, 9, 8, 7, 6, 5, 4 and 3) = 0*
- *Less than 10% of the commodity is produced in areas where the species has a climate match within the highest eight climate match classes = 1*
- *Less than 10% of the commodity is produced in areas where the species has a climate match within the highest six climate match classes (ie classes 10, 9, 8, 7, 6 and 5) = 2*
- *Less than 50% of the commodity is produced in areas where the species has a climate match within the highest six climate match classes AND less than 10% of the commodity is produced in areas where the species has a climate match within the highest three climate match classes (ie classes 10, 9 and 8) = 3*
- *Less than 50% of the commodity is produced in areas where the species has a climate match within the highest six climate match classes BUT more than 10% of the commodity is produced in areas where the species has a climate match within the highest three climate match classes = 4*
- *OR More than 50% of the commodity is produced in areas where the species has a climate match within the highest six climate match classes BUT less than 20% of the commodity is produced in areas where the species has a climate match within the highest three climate match classes = 4*
- *More than 20% of the commodity is produced in areas where the species has a climate match within the highest three climate match classes OR overseas range unknown and climate match to Australia unknown = 5.]*

Table 3: Assigning species to EIC Threat Categories (shaded cells relate to assignment of reptiles and amphibians to EIC Threat Categories based on an assessed establishment risk and an allocated pest risk of extreme) – adapted from Bomford 2008

Establishment Risk	Pest Risk	Public Safety Risk	EIC Threat Category	Implication for any proposed import into Australia	Implication for keeping and movement in Australia
Extreme	Extreme	Highly, Moderately or Not Dangerous	**EXTREME**	Prohibited, unless sufficient risk management measures exist to reduce the potential risks to an acceptable level	Limited to those collections approved for keeping particular EXTREME Threat species
Extreme	Serious	Highly, Moderately or Not Dangerous	**EXTREME**		
Extreme	Moderate	Highly, Moderately or Not Dangerous	**EXTREME**		
Extreme	Low	Highly, Moderately or Not Dangerous	**EXTREME**		
Serious	Extreme	Highly, Moderately or Not Dangerous	**EXTREME**		
Serious	Serious	Highly, Moderately or Not Dangerous	**EXTREME**		
Moderate	Extreme	Highly, Moderately or Not Dangerous	**EXTREME**		
Serious	Moderate	Highly, Moderately or Not Dangerous	**SERIOUS**	Import restricted to those collections approved for keeping SERIOUS Threat species	Limited to those collections approved for keeping particular SERIOUS Threat species
Serious	Low	Highly, Moderately or Not Dangerous	**SERIOUS**		
Moderate	Serious	Highly, Moderately or Not Dangerous	**SERIOUS**		
Moderate	Moderate	Highly Dangerous	**SERIOUS**		
Moderate	Low	Highly Dangerous	**SERIOUS**		
Low	Extreme	Highly, Moderately or Not Dangerous	**SERIOUS**		
Low	Serious	Highly, Moderately or Not Dangerous	**SERIOUS**		
Low	Moderate	Highly Dangerous	**SERIOUS**		
Low	Low	Highly Dangerous	**SERIOUS**		
Moderate	Moderate	Moderately or Not Dangerous	**MODERATE**	Import restricted to those collections approved for keeping MODERATE Threat species	Limited to those collections approved for keeping particular MODERATE Threat species
Moderate	Low	Moderately or Not Dangerous	**MODERATE**		
Low	Moderate	Moderately or Not Dangerous	**MODERATE**		
Low	Low	Moderately Dangerous	**MODERATE**		
Low	Low	Not Dangerous	**LOW**	Import permitted	May be limited to those collections approved for keeping particular LOW Threat species
Any Value	Any Value	Unknown	**EXTREME until proven otherwise**	Prohibited, unless sufficient risk management measures exist to reduce the potential risks to an acceptable level	Limited to those collections approved for keeping particular EXTREME Threat species
Unknown	Any Value	Any Value	**EXTREME until proven otherwise**		
Any Value	Unknown	Any Value	**EXTREME until proven otherwise**		
Unassessed	Unassessed	Unassessed	**EXTREME until proven otherwise**		

Adapted from:	California Quail (*Callipepla californica*) risk assessment for Australia. Win Kirkpatrick, Invasive Species, Dept of Agriculture and Food, Western Australia (2017)	**By:** Jodi Buchecker	**Date:** Sep 2022

Risk Assessor's details:

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Date:	Sep 2022
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National Risk Assessment: MODERATE

RISK ASSESSMENT FOR AUSTRALIA: Orange-breasted Fig Parrot (*Cyclopsitta gulielmitertii*)

Class - Aves**, Order -** Psittaciformes**, Family -** Psittacidae**, Genus -** *Cyclopsitta*.

SPECIES: *Cyclopsitta gulielmitertii* (Schlegel, 1866) **Synonyms:** *Opopsitta gulielmitertii* (Schlegel, 1866) *C. g. ramuensis* (Neumann, 1915) **Subspecies:** Subspecies according to (Collar, 2020): *C. g. fuscifrons* (Salvadori, 1876) *C. g. melanogenia* (Rosenberg, HKB, 1866) *C. g. sauvissima* (Salvadori, 1876) Subspecies according to (Zoonomen 2020): *C. g. amabilis* (Reichenow, 1891) *C. g. fuscifrons* (Salvadori, 1876) *C. g. melanogenia* (Rosenberg, HKB, 1866) *C. g. nigrifrons* (Reichenow, 1891) *C. g. sauvissima* (Salvadori, 1876) **Common Names:** Orange-breasted Fig Parrot Orange-breasted Fig-parrot Blue-fronted Fig-parrot	**Species description:** The orange-breasted fig parrot is a small parrot measuring 11-13 centimetres and weighing between 27-34 grams. Appearance varies between conspecifics; blue-fronted, black-fronted, creamy-breasted, dusky-cheeked. Generally, the orange-breasted fig parrot is dark green above, has a dark blackish blue forehead and behind eye and pale yellow lores, throat and sides of head. The breast and upper belly is orange and the bill is black. The female has orange eye-coverts (Collar, 2020). **General information:** This assessment treats *Cyclopsitta gulielmitertii* as including all subspecies listed under subspecies heading. Fig parrots are distributed throughout various regions of New Guinea and Australia, where they can be found primarily in fruit-bearing trees, especially fig trees. They are found in rainforest, swamp forest, Melaleuca woodland, dense savanna and partly cleared areas. Although mostly found at elevations below 500 metres, fig parrots can be found up to elevations of 1,100 metres above sea level. The diet of the orange-breasted fig parrot includes seeds of figs and other fruit, as well as whole small fruits, nectar from flowers and occasionally insects (New Guinea Birds). Reproduction is between September to June with 2 eggs laid. Orange-breasted fig parrots are found in small active groups of 6-10 individuals, either flying above the forest calling or grouping together to forage for figs or other fruits in the canopy (New Guinea Birds). They feed quietly and are often difficult to detect as they clamber around (World Parrot Trust). **Longevity:** No data (Tacutu, 2017). **Conservation status:** **IUCN:** Least Concern **CITES:** Appendix II

William's Fig Parrot King of Holland's Fig Parrot	
DATE OF ORIGINAL ASSESSMENT: 17/05/2022 **DATE OF CURRENT ASSESSMENT:** Nov 2022 (Jodi Buchecker) **EIC ENDORSEMENT:** 16/06/23 **Risk assessment model used for the assessment:** Bomford 2008, Bird and Mammal	**The risk assessment model:** Models for assessing the risk that exotic vertebrates could establish in Australia have been developed for mammals, birds (Bomford 2003, 2006, 2008), reptiles and amphibians (Bomford et al 2005, Bomford 2008). Developed by Dr Mary Bomford for the Bureau of Rural Sciences (BRS), the model uses criteria that have been demonstrated to have significant correlation between a risk factor and the establishment of populations of exotic species and the pest potential of those species that do establish. For example, a risk factor for establishment is similarity in climate (temperature and rainfall) within the species' distribution overseas and Australia. For pest potential, the species' overseas pest status is a risk factor. The model is published as 'Risk assessment models for the establishment of exotic vertebrates in Australia and New Zealand' (Bomford 2008) and is available online on the PestSmart website https://pestsmart.org.au/wp-content/uploads/sites/3/2020/06/Risk_Assess_Models_2008_FINAL.pdf **CLIMATE**: In 2021 a new version of the Climatch program used to assess similarity in climate was released by the Australian Bureau of Agricultural Resource Economics and Sciences (ABARES): CLIMATCH v2.0. The increase in resolution in this new version (from 50 km to 20 km) required recalibration of Climate Match Scores. See Table 1. Sixteen climate parameters (variables) of temperature and rainfall are used to estimate the extent of similarity between data from meteorological stations located within the species' world distribution and stations in Australia. Worldwide, data from approximately 19000 locations are available for analysis. The number of locations used in an analysis will vary according to the size of the species' distribution and the number of meteorological stations located within that distribution. To represent the climate match visually, the map of Australia is divided into 19236 grid squares, each measured in 0.2 degrees in both longitude and latitude. CLIMATCH v2.0 calculates a match for each Australian grid by comparing data from all meteorological stations within the species' distribution (excluding any populations in Australia) and allocating a score ranging from ten for the highest level match to zero for the poorest match. Levels of climate match are used in the risk assessment for questions B1 (scores are summed to give a cumulative score), C6, and C8. Climatch v2.0 can be accessed on the ABARES website, agriculture.gov.au/abares. The direct URL is https://climatch.cp1.agriculture.gov.au/.

Bird and Mammal Model:		
FACTOR	**SCORE**	**DETAIL**
STAGE A: RISKS POSED BY CAPTIVE OR RELEASED ANIMALS		
A1. Risk to people from individual escapees (0–2) *Assess the risk that individuals of the species could harm people. (NB, this question only relates to aggressive behaviour shown by*	0	*All other animals posing a lower risk of harm to people (ie animals that will not make unprovoked attacks causing injury requiring medical attention, and which, even if cornered or handled, are unlikely to cause injury requiring hospitalisation).*

escaped or released individual animals. Question C11 addresses the risk of harm from aggressive behaviour if the species establishes a wild population). *Aggressive behaviour, size, plus the possession of organs capable of inflicting harm, such as sharp teeth, claws, spines, a sharp bill, or toxin-delivering apparatus may enable individual animals to harm people. Any known history of the species attacking, injuring or killing people should also be taken into account. Assume the individual is not protecting nest or young.*		Poses a low risk of harm to people. Even if cornered or handled, as a small parrot they are unlikely to cause injury requiring hospitalisation.
A2. Risk to public safety from individual captive animals (0–2) *Assess the risk that irresponsible use of products obtained from captive individuals of the species (such as toxins) pose a public safety risk (excluding the safety of anyone entering the animals' cage/enclosure or otherwise coming within reach of the captive animals)*	0	*Nil or no risk (highly unlikely or not possible).*
STAGE A PUBLIC SAFETY RISK SCORE **SUM A1 - A2 (0-4)**	0	**Not dangerous**
STAGE B: PROBABILITY ESCAPED OR RELEASED INDIVIDUALS WILL ESTABLISH FREE-LIVING POPULATIONS		
Model 1: FOUR-FACTOR MODEL FOR BIRDS AND MAMMALS (BOMFORD 2008)		
B1. Degree of climate match between species overseas range and Australia (1–6) *Map the selected mammal or bird species' overseas range, including its entire native and exotic (excluding Australia) ranges over the past 1000 years.* *Use CLIMATCH v2.0, Value X = sum of classes 6 – 10, see Table 1.*	1	*Very Low climate match to Australia* Value X = 9 Climate Match Score = 1
B2. Exotic population established overseas (0–4) *An established exotic population means the introduced species must have bred outside of captivity and must currently maintain a viable free-living population where the animals are not being*	0	*No exotic population ever established.*

intentionally fed or sheltered, even though they may be living in a highly disturbed environment with access to non-natural food supplies or shelter.		
B3. Overseas range size score (0–2) < 1 = 0; 1– 70 = 1; >70 = 2 *Estimate the species overseas range size* including currently and the past 1000 years; natural and introduced range in millions of square kilometres*	0	*Overseas range <1 million km^2.* The overseas population is estimated to be 0.8 km^2 (BirdLife International, 2022) including current and past 1,000 years, natural and introduced range. Distribution: Indonesia, Papua New Guinea. The blue-fronted fig parrot is found in Northwest New Guinea, in Salawati and the lowlands of Vogelkop Peninsula, possibly Bomberai and Onin Peninsulas. The black-fronted fig parrot is found in North New Guinea between east Geelvink Bay and Sepik river (Collar, 2020).
B4. Taxonomic Class (0–1) *Bird = 0; mammal = 1*	0	*Bird*
B. Establishment Risk Score **Sum of B1- B4 (1–13)**	1	**Low establishment risk**
Model 2: Seven-Factor Model For Birds And Mammals (Bomford 2008)		
B5. Diet score (0–1) *Specialist = 0; generalist = 1*	1	*Generalist with a broad diet of many food types.* Ggeneralist seedeater. It eats seeds of Ficus, *Glochidion* (known as buttonwood in Australia), *Acacia auriculiformis*, (acacia, earpod wattle, northern black wattle; native to Australia, Indonesia, and Papua New Guinea) as well as inflorescences of *Poikilospermum* (native to India, China and Indonesia) (Collar, 2020).
B6. Habitat score (0–1) *Undisturbed or disturbed habitat*	1	*Can survive and breed in human-disturbed habitats.* Can live in disturbed habitat. The orange-breasted fig parrot is found in lowlands and hills up to 1,100 metres, in rainforests, savanna woodland, Melaleuca swamp forest and partially cleared areas (Collar, 2020).
B7. Migratory score (0–1) *Always migratory = 0; non-migratory = 1*	1	*Non-migratory or facultative migrant in its native range.*

		Non-migratory (IUCN). A resident and partially migratory undertaking seasonal movement for rice harvest and seeding bamboo.
B. ESTABLISHMENT RISK SCORE **SUM OF B1- B7 (1–16)**	4	**Low establishment risk**
STAGE C: PROBABILITY AN ESTABLISHED SPECIES WILL BECOME A PEST		
C1. Taxonomic group (0–4)	3	*Bird in one of the taxa that are particularly prone to cause agricultural damage (Order: Psittaciformes) = 2.* *Bird in on one of the families likely to hybridise with native species (Family: Psittacidae) and has a relative in the same genus among Australian native birds (Cyclopsitta diophthalma) = 1.*
C2. Overseas range size including current and past 1000 years, natural and introduced range (0–2) *Estimate the species overseas range size (including current and past 1000 years, natural and introduced range) in millions of square kilometres*	0	*Overseas geographical range less than 10 million km^2.* Estimated at 0.8 million km^2 including current and past 1,000 years, natural and introduced range.
C3. Diet and feeding (0–3)	0	*Not a mammal.*
C4. Competition with native fauna for tree hollows (0–2)	2	*Can nest or shelter in tree hollows*. N nests in arboreal cavities, usually excavated termitarium, and reports of nesting in epiphytes (World Parrot Trust).
C5. Overseas environmental pest status (0–3) *Has the species been reported to cause declines in abundance of any native species of plant or animal or cause degradation to any natural communities in any country or region of the world?*	0	*Never reported as an environmental pest in any country or region.* No reports found.
C6. Climate match to areas with susceptible native species or communities (0–5)	5	*One or more susceptible native species that are listed as vulnerable or endangered under the Australian Government Environment Protection and Biodiversity Conservation Act has a restricted geographical range that lies with the mapped area of the highest six climate match classes.*

Identify any native Australian animal or plant species or communities that could be susceptible to harm by the exotic species if it were to establish a wild population here.		*Cyclopsitta coxeni* (Coxen's Fig-parrot) – Critically Endangered Communities: No listed vulnerable or endangered communities likely to be at risk.
C7. Overseas primary production pest status (0–3) *Has the species been reported to damage crops or other primary production in any country or region of the world?*	0	*No reports of damage to crops or other primary production in any country or region.*
C8. Climate match to susceptible primary production (0–5) *Assess Potential Commodity Impact Scores for each primary production commodity listed in Table 9, based on species' attributes (diet, behaviour, ecology), excluding risk of spreading disease which is addressed in Question C9.* *0 = 0; 1-19 = 1; 20-49 = 2; 50-99 = 3; 100-149 = 4; ≥150 = 5*	1	Total Commodity Damage Score = 19 (see Table 2)
C9. Spread disease (1–2) *Assess the risk that the species could play a role in the spread of disease or parasites to other animals*	2	*All birds (likely or unknown effect on native species and on livestock and other domestic animals).*
C10. Harm to property (0–3) *Assess the risk that the species could inflict damage on buildings, vehicles, fences, roads, equipment or ornamental gardens by chewing or burrowing or polluting with droppings or nesting material.*	0	*$0.* No reports of damage to property.
C11. Harm to people (0–5) *Assess the risk that, if a wild population established, the species could cause harm to or annoy people. Aggressive behaviour, plus the possession of organs capable of inflicting harm, such as sharp teeth, tusks, claws, spines, a sharp bill, horns, antlers or toxin delivering organs may enable animals to harm people. Any known history of the species attacking, injuring or killing people should also be taken into account (see Stage A, Score A1).*	0	*Nil risk.* The orange-breasted fig parrot poses little risk of harm to people. Even if cornered or handled, as a small parrot they are unlikely to cause injury requiring hospitalisation.

C. PEST RISK SCORE SUM C 1 TO C 11 (1–37)	13	**Moderate pest risk**
STAGE A. PUBLIC SAFETY RISK RANK – RISK TO PUBLIC SAFETY POSED BY CAPTIVE OR RELEASED INDIVIDUALS *0 = Not dangerous; 1 = Moderately dangerous; ≥ 2 = Highly dangerous*	0	Not dangerous
STAGE B. ESTABLISHMENT RISK RANK – RISK OF ESTABLISHING A WILD POPULATION **MODEL 1: FOUR-FACTOR MODEL FOR BIRDS AND MAMMALS (BOMFORD 2008)** *≤ 5 = low establishment risk; 6-8 = moderate establishment risk; 9-10 = serious establishment risk; ≥ 11-13 = extreme establishment risk*	1	Low establishment risk
STAGE B. ESTABLISHMENT RISK RANK – RISK OF ESTABLISHING A WILD POPULATION **MODEL 2: SEVEN-FACTOR MODEL FOR BIRDS AND MAMMALS (BOMFORD 2008)** *≤ 6 = low establishment risk; 7-11 = moderate establishment risk; 12-13 = serious establishment risk; ≥14 = extreme establishment risk*	4	Low establishment risk
STAGE C. PEST RISK RANK - RISK OF BECOMING A PEST FOLLOWING ESTABLISHMENT *< 9 = low pest risk; 9-14 = moderate pest risk; 15-19 = serious pest risk; > 19 = extreme pest risk*	13	Moderate pest risk

ENVIRONMENT AND INVASIVES COMMITTEE THREAT CATEGORY	**MODERATE**

World distribution maps (IUCN Red List, GBIF and Tvardikova) and Climatch world distribution map indicating where meteorological data was sourced for the climate analysis (see B1) (includes current and past 100 years):

Figure 1 - World Distribution Map - IUCN Red List

Figure 2 - World Distribution Map - Climatch

Figure 3 - World Georeferenced records (GBIF)

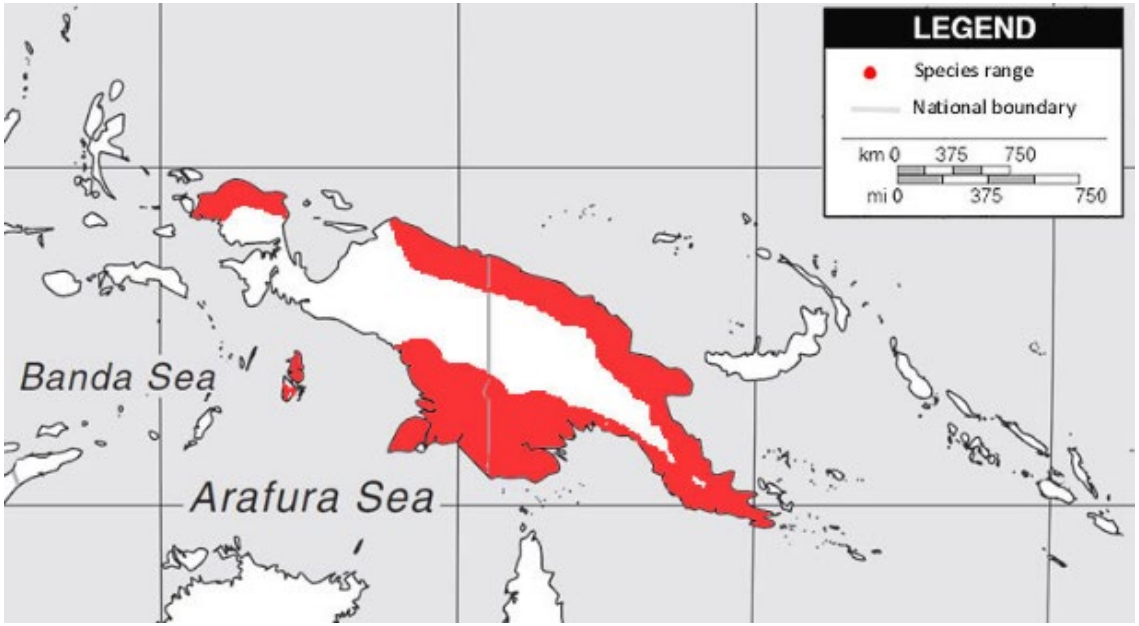
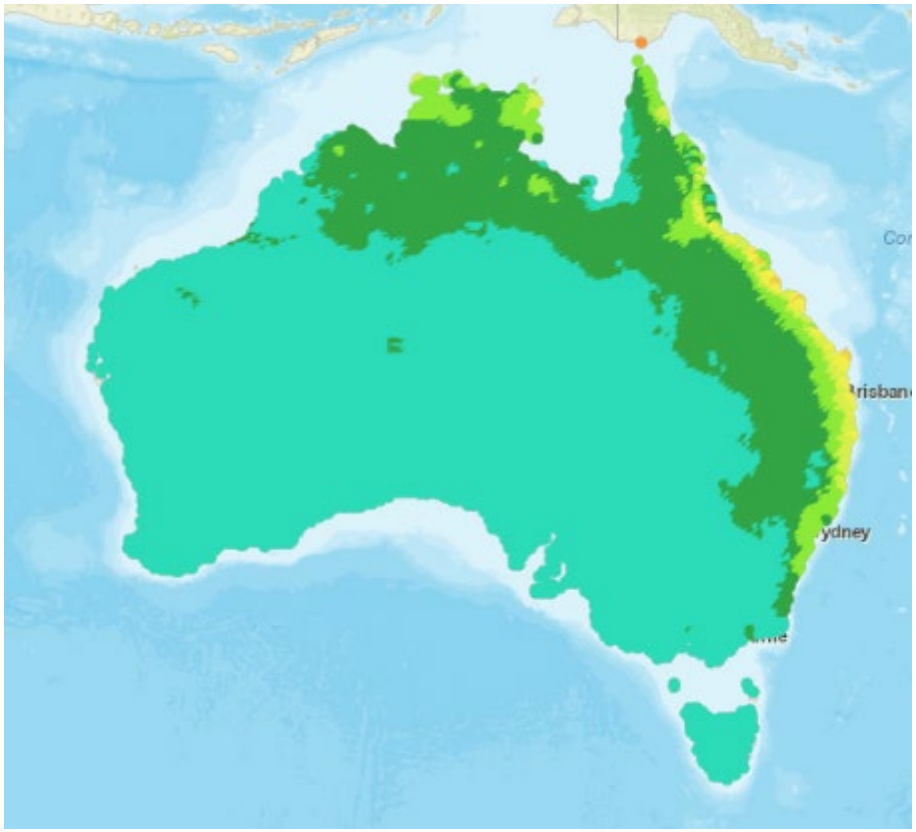


Figure 4 – Tvardikova (2022) – Map of distribution

Climate match between world distribution of species and Australia:

Areas of Australia where the climate appears suitable for *Cyclopsitta gulielmitertii*

Value X = 9



Score	Color	Count
0		0
1		13437
2		4827
3		742
4		152
5		69
6		8
7		1
8		0
9		0
10		0

Species: Orange-breasted Fig Parrot (Cyclopsitta gulielmitertii)
Algorithm: Closest Standard Score
61 source features selected
19236 target features selected
Approximate selected area: 591,809 km^2

Table 1: ABARES recalibration thresholds

Climate Match Score (CMS)	Climatch (50 km) Closest Standard Match Sum Level 6 (Value X)	2021 Recalibrated Climatch v2.0 (20 km) Closest Standard Match Sum Level 6 (Value X)
1 (Very low)	< 100	< 691
2 (Low)	100-599	691-4137
3 (Moderate)	600-899	4138-6209
4 (High)	900-1699	6210-11735
5 (Very high)	1700-2699	11736-18642
6 (Extreme)	≥ 2700	≥ 18643

Table 2: Susceptible Australian Primary Production – Calculating Total Commodity Damage Score

The commodity value index scores in this table are derived from Australian Bureau of Statistics 1999 – 2000 data. The values will require updating if significant change has occurred in the value of the commodity (Bomford 2008).

Industry	**Commodity Value Index 1 (CVI based on best available date)**	**Potential Commodity Impact Score (PCIS 0-3)**	**Climate Match to Commodity Score (CMCS 0–5)**	**Commodity Damage Score (CDS columns 2 X 3 X 4)**
Sheep (includes wool and sheep meat)	10			
Cattle (includes dairy and beef)	10			
Timber (includes native and plantation forests)	10			
Cereal grain (includes wheat, barley sorghum etc): rice	10	1	1	10
Pigs	2			
Poultry and eggs	2			
Aquaculture (includes coastal mariculture)	2			
Cotton	2			
Oilseeds (includes canola, sunflower etc)	2			
Grain legumes (includes soybeans)	2			
Sugarcane	2			
Grapes	2	1	1	2
Other Fruit	2	1	1	2
Vegetables: maize	2	2	1	4
Nuts	1			
Other livestock (includes goats, deer, camels, rabbits)	1			
Honey and beeswax	1			
Other horticulture (includes flowers etc)	1	1	1	1
Total Commodity Damage Score (TCDS)				19

Assess Potential Commodity Impact Scores for each primary production commodity listed in Table 9, based on species' attributes (diet, behaviour, ecology), excluding risk of spreading disease which is addressed in Question C9, and pest status worldwide as:

0. *Nil (species does not have attributes to make it capable of damaging this commodity)*
1. *Low (species has attributes making it capable of damaging this or similar commodities and has had the opportunity but no reports or other evidence that it has caused damage in any country or region*
2. *Moderate–serious (reports of damage to this or similar commodities exist but damage levels have never been high in any country or region and no major control programs against the species have ever been conducted OR the species has attributes making it capable of damaging this or similar commodities but has not had the opportunity)*
3. *Extreme (damage occurs at high levels to this or similar commodities and/or major control programs have been conducted against the species in any country or region and the listed commodity would be vulnerable to the type of harm this species can cause).*

Climate Match to Commodity Score (0–5)

- *None of the commodity is produced in areas where the species has a climate match within the highest eight climate match classes (ie classes 10, 9, 8, 7, 6, 5, 4 and 3) = 0*
- *Less than 10% of the commodity is produced in areas where the species has a climate match within the highest eight climate match classes = 1*
- *Less than 10% of the commodity is produced in areas where the species has a climate match within the highest six climate match classes (ie classes 10, 9, 8, 7, 6 and 5) = 2*
- *Less than 50% of the commodity is produced in areas where the species has a climate match within the highest six climate match classes AND less than 10% of the commodity is produced in areas where the species has a climate match within the highest three climate match classes (ie classes 10, 9 and 8) = 3*
- *Less than 50% of the commodity is produced in areas where the species has a climate match within the highest six climate match classes BUT more than 10% of the commodity is produced in areas where the species has a climate match within the highest three climate match classes = 4*
- *OR More than 50% of the commodity is produced in areas where the species has a climate match within the highest six climate match classes BUT less than 20% of the commodity is produced in areas where the species has a climate match within the highest three climate match classes = 4*
- *More than 20% of the commodity is produced in areas where the species has a climate match within the highest three climate match classes OR overseas range unknown and climate match to Australia unknown = 5.]*

Table 3: Assigning species to EIC Threat Categories (shaded cells relate to assignment of reptiles and amphibians to EIC Threat Categories based on an assessed establishment risk and an allocated pest risk of extreme) – adapted from Bomford 2008

Establishment Risk	Pest Risk	Public Safety Risk	EIC Threat Category	Implication for any proposed import into Australia	Implication for keeping and movement in Australia
Extreme	Extreme	Highly, Moderately or Not Dangerous	**EXTREME**	Prohibited, unless sufficient risk management measures exist to reduce the potential risks to an acceptable level	Limited to those collections approved for keeping particular EXTREME Threat species
Extreme	Serious	Highly, Moderately or Not Dangerous	**EXTREME**		
Extreme	Moderate	Highly, Moderately or Not Dangerous	**EXTREME**		
Extreme	Low	Highly, Moderately or Not Dangerous	**EXTREME**		
Serious	Extreme	Highly, Moderately or Not Dangerous	**EXTREME**		
Serious	Serious	Highly, Moderately or Not Dangerous	**EXTREME**		
Moderate	Extreme	Highly, Moderately or Not Dangerous	**EXTREME**		
Serious	Moderate	Highly, Moderately or Not Dangerous	**SERIOUS**	Import restricted to those collections approved for keeping SERIOUS Threat species	Limited to those collections approved for keeping particular SERIOUS Threat species
Serious	Low	Highly, Moderately or Not Dangerous	**SERIOUS**		
Moderate	Serious	Highly, Moderately or Not Dangerous	**SERIOUS**		
Moderate	Moderate	Highly Dangerous	**SERIOUS**		
Moderate	Low	Highly Dangerous	**SERIOUS**		
Low	Extreme	Highly, Moderately or Not Dangerous	**SERIOUS**		
Low	Serious	Highly, Moderately or Not Dangerous	**SERIOUS**		
Low	Moderate	Highly Dangerous	**SERIOUS**		
Low	Low	Highly Dangerous	**SERIOUS**		
Moderate	Moderate	Moderately or Not Dangerous	**MODERATE**	Import restricted to those collections approved for keeping MODERATE Threat species	Limited to those collections approved for keeping particular MODERATE Threat species
Moderate	Low	Moderately or Not Dangerous	**MODERATE**		
Low	Moderate	Moderately or Not Dangerous	**MODERATE**		
Low	Low	Moderately Dangerous	**MODERATE**		
Low	Low	Not Dangerous	**LOW**	Import permitted	May be limited to those collections approved for keeping particular LOW Threat species
Any Value	Any Value	Unknown	**EXTREME until proven otherwise**	Prohibited, unless sufficient risk management measures exist to reduce the potential risks to an acceptable level	Limited to those collections approved for keeping particular EXTREME Threat species
Unknown	Any Value	Any Value	**EXTREME until proven otherwise**		
Any Value	Unknown	Any Value	**EXTREME until proven otherwise**		
Unassessed	Unassessed	Unassessed	**EXTREME until proven otherwise**		

Adapted from:	Orange-breasted fig-parrot (*Cyclopsitta gulielmitertii*) risk assessment for Australia. Win Kirkpatrick, Invasive Species, Dept of Agriculture and Food, Western Australia (2022)	**By:** Jodi Buchecker	**Date:** Nov 2022

Risk Assessor's details:

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National Risk Assessment: EXTREME

RISK ASSESSMENT FOR AUSTRALIA: Gila Monster (*Heloderma suspectum*)

Class - Reptilia**, Order -** Squamata**, Family -** Helodermatidae**, Genus –** *Heloderma.*

SPECIES: *Heloderma suspectum* (Cope, 1869) **Synonyms:** No synonyms **Subspecies:** *Heloderma suspectum suspectum* (Cope, 1869) *Heloderma suspectum cinctum* (Bogart & Del Campo, 1856) **Common Names:** Gila Monster Banded Gila Monster Reticular Gila Monster	**Species description:** A heavy, typically slow-moving venomous lizard, up to 56 centimetres long (iNaturalist; Smithsonian). Body mass is typically 550 to 800 grams (Animalia), however some can weigh up to 1.4 kilograms (San Diego), even as heavy as 1.8 kilograms (National Geographic). Adults are yellow or pink colours on a black surface. Hatchlings have a less colourful pattern with changes to its adult pattern within the first 6 months. Males often have larger, more triangular-shaped heads than females. The scales of the tail, back and head have pearl-shaped bones (osteoderms) whereas the scales of the belly are free from osteoderms. **General information:** The Gila monster is a carnivorous reptile, native to South-western United States of America and North-western Mexico (Sonora) (Martin, 1935; Stebbins, 2003; Tertiary, 2002; Zurtuche, 1981). Gila monsters are active foraging lizards that feed infrequently on meals weighing up to one-third of their body mass (Christel et al 2007; Beck 1990; Lowe 1986). Their diet consists mostly of eggs of reptiles and ground nesting birds (Lowe 1986; Beck 1990) but shifts seasonally to small mammals when egg availability decreases (Jones, 1983). They spend most of their time (95-98%) at rest in rock shelters or burrows (Beck, 1990; Beck and Jennings, 2003; Beck and Lowe, 1991). From Beck (2005): "The female lays eggs at the end of May into June. A clutch may consist of up to 6 (rarely up to 8) eggs. The incubation in captivity lasts about 5 months, depending on the incubation temperature. The hatchlings are about 16 centimetres in length and can bite and inject venom as soon as they are hatched." Gila monsters produce venom in modified salivary glands at the end of their lower jaw (Beck, 1990). Some deaths due to Gila monster envenomation have been recorded, however there are relatively few incidents of bites because they are slow moving and timid (Zurtuche, 1981). **Longevity:** In captivity, estimates of longevity range from 20-30 years in human care (The Animal Facts) with AnAge reporting 28.9 years (AnAge) and the Smithsonian recording the oldest record of 36 years (Smithsonian).

	Conservation status: **IUCN:** Near Threatened **CITES:** Appendix II
DATE OF ASSESSMENT: Nov 2022 (Jodi Buchecker) **EIC ENDORSEMENT:** 16/06/23 **Risk assessment model used for the assessment:** Bomford 2006, Reptiles Bomford 2008, Birds and Mammals	**The risk assessment model:** Models for assessing the risk that exotic vertebrates could establish in Australia have been developed for mammals, birds (Bomford 2003, 2006, 2008), reptiles and amphibians (Bomford et al 2005, Bomford 2008). Developed by Dr Mary Bomford for the Bureau of Rural Sciences (BRS), the model uses criteria that have been demonstrated to have significant correlation between a risk factor and the establishment of populations of exotic species and the pest potential of those species that do establish. For example, a risk factor for establishment is similarity in climate (temperature and rainfall) within the species' distribution overseas and Australia. For pest potential, the species' overseas pest status is a risk factor. The model is published as 'Risk assessment models for the establishment of exotic vertebrates in Australia and New Zealand' (Bomford 2008) and is available online on the PestSmart website https://pestsmart.org.au/wp-content/uploads/sites/3/2020/06/Risk_Assess_Models_2008_FINAL.pdf **CLIMATE**: In 2021 a new version of the Climatch program used to assess similarity in climate was released by the Australian Bureau of Agricultural Resource Economics and Sciences (ABARES): CLIMATCH v2.0. The increase in resolution in this new version (from 50 km to 20 km) required recalibration of Climate Match Scores. See Table 1. Sixteen climate parameters (variables) of temperature and rainfall are used to estimate the extent of similarity between data from meteorological stations located within the species' world distribution and stations in Australia. Worldwide, data from approximately 19000 locations are available for analysis. The number of locations used in an analysis will vary according to the size of the species' distribution and the number of meteorological stations located within that distribution. To represent the climate match visually, the map of Australia is divided into 19236 grid squares, each measured in 0.2 degrees in both longitude and latitude. CLIMATCH v2.0 calculates a match for each Australian grid by comparing data from all meteorological stations within the species' distribution (excluding any populations in Australia) and allocating a score ranging from ten for the highest level match to zero for the poorest match. Levels of climate match are used in the risk assessment for questions B1 (scores are summed to give a cumulative score), C6, and C8. Climatch v2.0 can be accessed on the ABARES website, agriculture.gov.au/abares. The direct URL is https://climatch.cp1.agriculture.gov.au/.

Reptile Model:

FACTOR	SCORE	DETAIL
STAGE A: RISKS POSED BY CAPTIVE OR RELEASED ANIMALS		
A. Climate match risk score *Map the selected reptile or amphibian species' overseas range, including its entire native and exotic (excluding Australia) ranges over the past 1000 years. Use CLIMATCH v2.0 to determine the climate match between*	39.15	CMRS = 100 x (7,530/19,236) = 39.14535246412976 CMRS = 39.15

this overseas range and Australia, selecting Euclidian Match and using all 16 climate variables for the analysis. *CMS = sum of classes 7 – 10* *CMRS = 100 x (CMS/19236).*		
B. Exotic Elsewhere Risk score (0, 15 or 30) *Score B = A species' Exotic Elsewhere Risk Score, calculated as follows:* • *Species has established breeding self-sustaining exotic population in another country = 30* • *Species has been introduced into another country and records exist of it in the wild, but it is uncertain if a breeding self-sustaining population has established = 15* • *Species has not established an exotic population (including species not known to have been introduced anywhere) = 0*	0	*Has not established an exotic population (including species not known to have been introduced anywhere).*
C. Taxonomic Family Risk Score	0	*Helodermatidae*
ESTABLISHMENT RISK RANK *A species' Establishment Risk Score = Score A + Score B + Score C.* *Establishment Risk Rank — Establishment Risk Score* *Low — ≤ 22* *Moderate — 23-60* *Serious — 61-115* *Extreme — ≥ 116*	39.15	**MODERATE**

Bird and Mammal Model for Reptiles and Amphibians:

B1. Degree of climate match between species overseas range and Australia (1–6) *Map the selected mammal or bird species' overseas range, including its entire native and exotic (excluding Australia) ranges over the past 1000 years.* *Use CLIMATCH v2.0, Value X = sum of classes 6 – 10, see Table 1.*	4	*High climate match to Australia* Value X = 8,294 Climate Match Score = 4

B2. Exotic population established overseas (0–4) *An established exotic population means the introduced species must have bred outside of captivity and must currently maintain a viable free-living population where the animals are not being intentionally fed or sheltered, even though they may be living in a highly disturbed environment with access to non-natural food supplies or shelter.*	0	*No exotic population ever established.*
B3. Overseas range size score (0–2) < 1 = 0; 1– 70 = 1; >70 = 2 *Estimate the species overseas range size* including currently and the past 1000 years; natural and introduced range in millions of square kilometres*	0	*Overseas range less than 1 million kilometres square.* Overseas range for the Gila monster is approximately 580,000 km^2.
ESTABLISHMENT RISK RANK *A species' Establishment Risk Score = Score A + Score B + Score C.* *Establishment Risk Rank — Establishment Risk Score* *Low — ≤ 4* *Moderate — 5-7* *Serious — 8-9* *Extreme — 10-12*	4	**LOW**

ENVIRONMENT AND INVASIVES COMMITTEE THREAT CATEGORY	**EXTREME**

World distribution map (IUCN Red List, Hammerson et al. 2007) and Climatch world distribution map indicating where meteorological data was sourced for the climate analysis (see B1):

Figure 1 - World Distribution Map - IUCN Red List

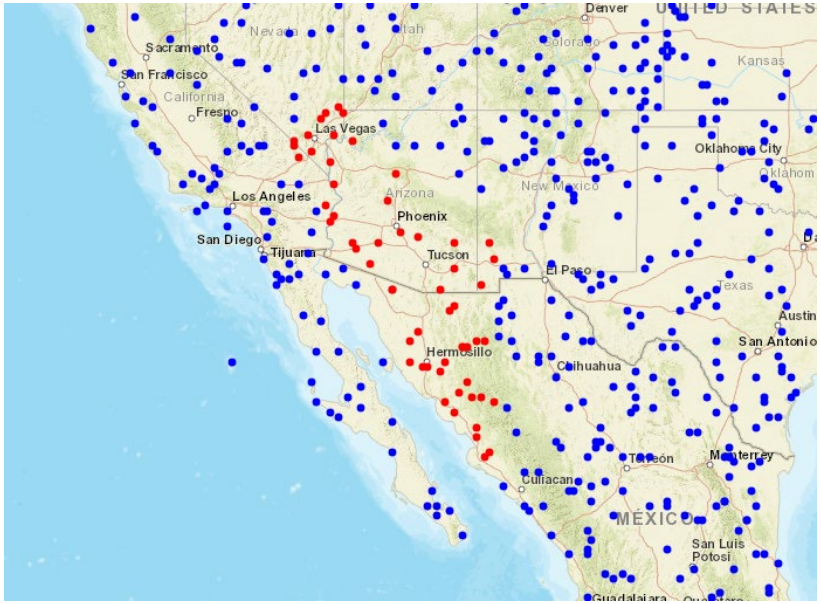
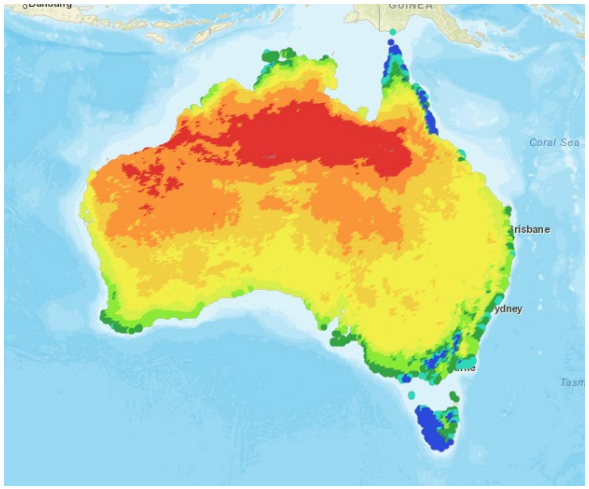


Figure 2 - World Distribution Map - Climatch

Reptile model: Climate match between world distribution of species and Australia:

Areas of Australia where the climate appears suitable for *Heloderma suspectum*

CMS = 7,530



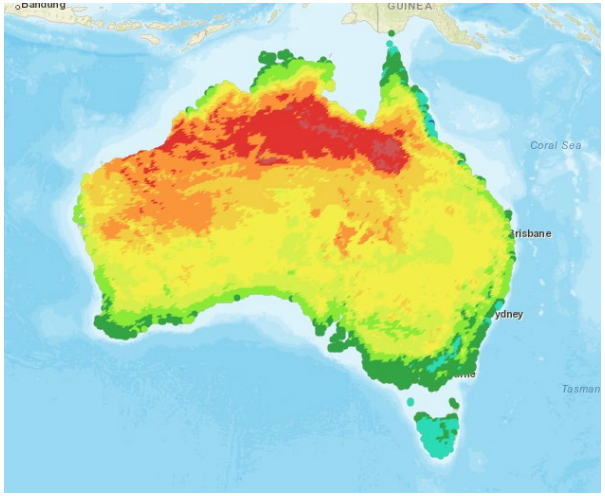
Score	Color	Count
0		223
1		182
2		393
3		673
4		1099
5		5008
6		4128
7		4926
8		2593
9		11
10		0

Species: Gila Monster (Heloderma suspectum)
Algorithm: Euclidean
57 source features selected
19236 target features selected
Approximate selected area: 580,437 km^2

Bird and Mammal model: Climate match between world distribution of species and Australia:

Areas of Australia where the climate appears suitable for *Heloderma suspectum*

Value X = 8,294



Score	Color	Count
0		1
1		244
2		839
3		1349
4		3109
5		5400
6		3293
7		2916
8		1855
9		230
10		0

Species: Gila Monster (Heloderma suspectum)
Algorithm: Closest Standard Score
57 source features selected
19236 target features selected
Approximate selected area: 580,437 km^2

Table 1: ABARES recalibration thresholds

Climate Match Score (CMS)	Climatch (50 km) Closest Standard Match Sum Level 6 (Value X)	2021 Recalibrated Climatch v2.0 (20 km) Closest Standard Match Sum Level 6 (Value X)
1 (Very low)	< 100	< 691
2 (Low)	100-599	691-4137
3 (Moderate)	600-899	4138-6209
4 (High)	900-1699	6210-11735
5 (Very high)	1700-2699	11736-18642
6 (Extreme)	≥ 2700	≥ 18643

Table 2: Assigning species to EIC Threat Categories (shaded cells relate to assignment of reptiles and amphibians to EIC Threat Categories based on an assessed establishment risk and an allocated pest risk of extreme) – adapted from Bomford 2008

Establishment Risk	Pest Risk	Public Safety Risk	EIC Threat Category	Implication for any proposed import into Australia	Implication for keeping and movement in Australia
Extreme	Extreme	Highly, Moderately or Not Dangerous	**EXTREME**	Prohibited, unless sufficient risk management measures exist to reduce the potential risks to an acceptable level	Limited to those collections approved for keeping particular EXTREME Threat species
Extreme	Serious	Highly, Moderately or Not Dangerous	**EXTREME**		
Extreme	Moderate	Highly, Moderately or Not Dangerous	**EXTREME**		
Extreme	Low	Highly, Moderately or Not Dangerous	**EXTREME**		
Serious	Extreme	Highly, Moderately or Not Dangerous	**EXTREME**		
Serious	Serious	Highly, Moderately or Not Dangerous	**EXTREME**		
Moderate	Extreme	Highly, Moderately or Not Dangerous	**EXTREME**		
Serious	Moderate	Highly, Moderately or Not Dangerous	**SERIOUS**	Import restricted to those collections approved for keeping SERIOUS Threat species	Limited to those collections approved for keeping particular SERIOUS Threat species
Serious	Low	Highly, Moderately or Not Dangerous	**SERIOUS**		
Moderate	Serious	Highly, Moderately or Not Dangerous	**SERIOUS**		
Moderate	Moderate	Highly Dangerous	**SERIOUS**		
Moderate	Low	Highly Dangerous	**SERIOUS**		
Low	Extreme	Highly, Moderately or Not Dangerous	**SERIOUS**		
Low	Serious	Highly, Moderately or Not Dangerous	**SERIOUS**		
Low	Moderate	Highly Dangerous	**SERIOUS**		
Low	Low	Highly Dangerous	**SERIOUS**		
Moderate	Moderate	Moderately or Not Dangerous	**MODERATE**	Import restricted to those collections approved for keeping MODERATE Threat species	Limited to those collections approved for keeping particular MODERATE Threat species
Moderate	Low	Moderately or Not Dangerous	**MODERATE**		
Low	Moderate	Moderately or Not Dangerous	**MODERATE**		
Low	Low	Moderately Dangerous	**MODERATE**		
Low	Low	Not Dangerous	**LOW**	Import permitted	May be limited to those collections approved for keeping particular LOW Threat species
Any Value	Any Value	Unknown	**EXTREME until proven otherwise**	Prohibited, unless sufficient risk management measures exist to reduce the potential risks to an acceptable level	Limited to those collections approved for keeping particular EXTREME Threat species
Unknown	Any Value	Any Value	**EXTREME until proven otherwise**		
Any Value	Unknown	Any Value	**EXTREME until proven otherwise**		
Unassessed	Unassessed	Unassessed	**EXTREME until proven otherwise**		

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Date:	Nov 2022
Reviewers:	Win Kirkpatrick, WA DPIRD

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National Risk Assessment: EXTREME

RISK ASSESSMENT FOR AUSTRALIA: Waterbuck (*Kobus ellipsiprymnus*)

Class - Mammalia**, Order -** Artiodactyla**, Family -** Bovidae**, Genus -** *Kobus*.

SPECIES: *Kobus ellipsiprymnus* (Ogilby, 1833) **Synonyms:** None known **Subspecies:** From ITIS (all valid): *Kobus ellipsiprymnus adolfifriderici* (Matschie, 1910) *Kobus ellipsiprymnus annectens* (Schwarz, 1913) *Kobus ellipsiprymnus crawshayi* (P. L. Sclater, 1894) *Kobus ellipsiprymnus defassa* (Rüppell, 1835) *Kobus ellipsiprymnus ellipsiprymnus* (Ogilby, 1833) *Kobus ellipsiprymnus harnieri* (Murie, 1867) *Kobus ellipsiprymnus kondensis* (Matschie, 1911) *Kobus ellipsiprymnus pallidus* (Matschie, 1910) *Kobus ellipsiprymnus penricei* (W. Rothschild, 1895)	**Species description:** Waterbucks are large, long-necked, large-eared antelope. They have long bodies and comparatively short legs (ADW). Males average 236 kilograms and stand about 126 centimetres at the withers. Females are smaller with an average weight of 188 kilograms and average height of 120 centimetres at the withers (Spinage, 1970). The hair is course, and they have a mane on their necks (Estes, 1991). Their coat colour varies from brown to grey and darkens with age (ADW). Males are darker than females (Wintershoek Safaris). The shaggy coat emits a smelly, oily secretion thought to be for waterproofing (AWF). The lower part of the legs are black with white rings above the hooves (Estes, 1991). **Common Waterbuck** (*K. e. ellipsiprymnus*) have a characteristic white ring around their rump while, the **Defassa Waterbuck** (*K. e. defassa*) have a wide white patch on either side of their rump (AWF). Both subspecies have a prominent "bib" under the throat (Tomlinson, 1980), white markings on their muzzle with a white stripe across the eye (resembling an eyebrow). The long, spiral horns, present only on males (females may have a rudimentary horn in the form of a boney lump on the top of their skulls (Wintershoek Safaris)), curve backward, then forward, and are between 55 and 99 centimetres long. The length of the horns is determined by the age of the waterbuck (Kingdon, 1982). **General information:** Waterbuck formerly occurred throughout most of sub-Saharan Africa. Waterbuck have been eliminated widely within its former range but survives in many protected areas and in some other areas which are sparsely populated by humans. The Defassa Waterbuck is found west of the western Rift Valley and south of the Sahel from Eritrea in the east to Guinea Bissau in the west; its most northerly point of distribution is in southern Mali. A population still exists in Niokola-Koba in Senegal. Defassa Waterbuck also range east of the Congo Basin Forest, spreading west below the basin's southern limit through Zambia into Angola. Another branch of the distribution extends northwards, west to the Congo River in Congo Republic. Waterbucks are extinct in Gambia, though vagrants may enter from Senegal (Spinage, 2013). East of the eastern Rift Valley, the Defassa Waterbuck are replaced by the Common Waterbuck, which extends

Kobus ellipsiprymnus thikae (Matschie, 1910) *Kobus ellipsiprymnus tjaederi* (Lönnberg, 1907) *Kobus ellipsiprymnus tschadensis* (Schwarz, 1913) *Kobus ellipsiprymnus unctuosus* (Laurillard, 1842) From IUCN: Two subspecies are recognised (formerly regarded as distinct species): Defassa Waterbuck (*K. e. defassa*) and Common Waterbuck (*K. e. ellipsiprymnus*). Lorenzen et al. (2006) found a high degree of genetic differentiation between the subspecies and strongly confirmed hybridisation in Kenya's Nairobi National Park population. **Common Names:** Waterbuck Common Waterbuck Defassa Waterbuck Crawshay's Waterbuck	southwards to about the Hluhluwe-Umfolozi National Parl in KwaZulu-Natal and central Namibia. Common Waterbuck are extinct in Ethiopia, though Defassa remain (Spinage, 2013). Predominantly a grazer (with browsing tendencies), waterbuck are mostly found in grasslands, savannah woodlands and forest-savannah mosaics near permanent water (East 1999). Waterbucks eat a variety of grasses, both medium and short in length. Their diet is very rich in protein. When the amount of available grass is low, waterbuck eat other herbs to satisfy their needs (Estes, 1991). More than other antelope, *Kobus species.* require a constant supply of drinking water in hot weather (AZA). Waterbucks are rather sedentary in nature. They are gregarious and may form herds consisting of 6 to 30 individuals. These groups are either bachelor herds or nursery herds with females and their offspring. Males mature at 6 years whereas females mature at 3 years (ADW). In equatorial regions, breeding takes place throughout the year, but births are at their peak in the rainy season. The gestational period lasts 7-8 months, followed by the birth of a single calf. After birth the young are hidden for a couple of weeks, with the mother returning during the day to feed and clean the calf (Siyabona). **Longevity:** Maximum recorded longevity in captivity is 30 years (AnAge). 18 years (captivity) (ADW); up to 18 years (AWF). **Conservation status:** **IUCN:** Least Concern (ssp Defassa Waterbuck: Near Threatened) **CITES:** Not listed
DATE OF ASSESSMENT: Jul 2022 (Jodi Buchecker) **EIC ENDORSEMENT:** 16/06/23 **Risk assessment model used for the assessment:** Bomford 2008, Mammals and Birds	**The risk assessment model:** Models for assessing the risk that exotic vertebrates could establish in Australia have been developed for mammals, birds (Bomford 2003, 2006, 2008), reptiles and amphibians (Bomford et al 2005, Bomford 2008). Developed by Dr Mary Bomford for the Bureau of Rural Sciences (BRS), the model uses criteria that have been demonstrated to have significant correlation between a risk factor and the establishment of populations of exotic species and the pest potential of those species that do establish. For example, a risk factor for establishment is similarity in climate (temperature and rainfall) within the species' distribution overseas and Australia. For pest potential, the species' overseas pest status is a risk factor.

	The model is published as 'Risk assessment models for the establishment of exotic vertebrates in Australia and New Zealand' (Bomford 2008) and is available online on the PestSmart website https://pestsmart.org.au/wp-content/uploads/sites/3/2020/06/Risk_Assess_Models_2008_FINAL.pdf **CLIMATE**: In 2021 a new version of the Climatch program used to assess similarity in climate was released by the Australian Bureau of Agricultural Resource Economics and Sciences (ABARES): CLIMATCH v2.0. The increase in resolution in this new version (from 50 km to 20 km) required recalibration of Climate Match Scores. See Table 1. Sixteen climate parameters (variables) of temperature and rainfall are used to estimate the extent of similarity between data from meteorological stations located within the species' world distribution and stations in Australia. Worldwide, data from approximately 19000 locations are available for analysis. The number of locations used in an analysis will vary according to the size of the species' distribution and the number of meteorological stations located within that distribution. To represent the climate match visually, the map of Australia is divided into 19236 grid squares, each measured in 0.2 degrees in both longitude and latitude. CLIMATCH v2.0 calculates a match for each Australian grid by comparing data from all meteorological stations within the species' distribution (excluding any populations in Australia) and allocating a score ranging from ten for the highest level match to zero for the poorest match. Levels of climate match are used in the risk assessment for questions B1 (scores are summed to give a cumulative score), C6, and C8. Climatch v2.0 can be accessed on the ABARES website, agriculture.gov.au/abares. The direct URL is https://climatch.cp1.agriculture.gov.au/.

Bird and Mammal Model:

FACTOR	SCORE	DETAIL
STAGE A: RISKS POSED BY CAPTIVE OR RELEASED ANIMALS		
A1. Risk to people from individual escapees (0–2) *Assess the risk that individuals of the species could harm people. (NB, this question only relates to aggressive behaviour shown by escaped or released individual animals. Question C11 addresses the risk of harm from aggressive behaviour if the species establishes a wild population).* *Aggressive behaviour, size, plus the possession of organs capable of inflicting harm, such as sharp teeth, claws, spines, a sharp bill, or toxin-delivering apparatus may enable individual animals to harm people. Any known history of the species*	1	*Animal that is unlikely to make an unprovoked attack but which can cause serious injury (requiring hospitalisation) or fatality if cornered or handled.* No reference found that waterbucks are particularly aggressive, but they are large animals and males have large horns.

attacking, injuring or killing people should also be taken into account. Assume the individual is not protecting nest or young.		
A2. Risk to public safety from individual captive animals (0–2) *Assess the risk that irresponsible use of products obtained from captive individuals of the species (such as toxins) pose a public safety risk (excluding the safety of anyone entering the animals' cage/enclosure or otherwise coming within reach of the captive animals)*	0	*Nil or low risk (highly unlikely or not possible).*
STAGE A PUBLIC SAFETY RISK SCORE **SUM A1 - A2 (0-4)**	1	**Moderately dangerous**
STAGE B: PROBABILITY ESCAPED OR RELEASED INDIVIDUALS WILL ESTABLISH FREE-LIVING POPULATIONS		
Model 1: FOUR-FACTOR MODEL FOR BIRDS AND MAMMALS (BOMFORD 2008)		
B1. Degree of climate match between species overseas range and Australia (1–6) *Map the selected mammal or bird species' overseas range, including its entire native and exotic (excluding Australia) ranges over the past 1000 years.* *Use CLIMATCH v2.0, Value X = sum of classes 6 – 10, see Table 1.*	4	*High climate match to Australia* Value X = 6,850 Climate Match Score = 4
B2. Exotic population established overseas (0–4) *An established exotic population means the introduced species must have bred outside of captivity and must currently maintain a viable free-living population where the animals are not being intentionally fed or sheltered, even though they may be living in a highly disturbed environment with access to non-natural food supplies or shelter.*	0	*No exotic population ever established.* No reference found that the waterbuck has ever established an overseas population.
B3. Overseas range size score (0–2) < 1 = 0; 1– 70 = 1; >70 = 2	1	*Overseas range between 1 to 70 million square kilometres.*

Estimate the species overseas range size including currently and the past 1000 years; natural and introduced range in millions of square kilometres*		Overseas range approximately 10.5 million km^2 From IUCN: Angola; Benin; Botswana; Burkina Faso; Burundi; Cameroon; Central African Republic; Chad; Congo; Congo, The Democratic Republic of the; Côte d'Ivoire; Eritrea; Eswatini; Ethiopia; Gabon; Ghana; Guinea; Guinea-Bissau; Kenya; Malawi; Mali; Mozambique; Namibia; Niger; Nigeria; Rwanda; Senegal; Sierra Leone; Somalia; South Africa; South Sudan; Sudan; Tanzania, United Republic of; Togo; Uganda; Zambia and Zimbabwe.
B4. Taxonomic Class (0–1) *Bird = 0; mammal = 1*	1	*Mammal*
B. ESTABLISHMENT RISK SCORE SUM OF B1- B4 (1–13)	6	**Moderate establishment risk**
Model 2: Seven-Factor Model For Birds And Mammals (Bomford 2008)		
B5. Diet score (0–1) *Specialist = 0; generalist = 1*	1	*Generalist with a broad diet of many food types.* Broad generalist grazer and occasional browser (Estes, 1991).
B6. Habitat score (0–1) *Undisturbed or disturbed habitat*	1	*Can survive and breed in human-disturbed habitats (including grazing and agricultural lands, forests that are intensively managed or planted for timber harvesting and/or urban–suburban environments) without access to undisturbed (natural) habitats.* Can live in disturbed habitat. Waterbucks compete with cattle in South Africa (Invasives South Africa).
B7. Migratory score (0–1) *Always migratory = 0; non-migratory = 1*	1	*Non-migratory.*
B. ESTABLISHMENT RISK SCORE SUM OF B1- B7 (1–16)	9	**Moderate establishment risk**
STAGE C: PROBABILITY AN ESTABLISHED SPECIES WILL BECOME A PEST		
C1. Taxonomic group (0–4)	4	*Mammal in one of the orders that have been demonstrated to have detrimental effects on prey abundance and/or habitat degradation (Artiodactyla) = 2.*

		Mammal in one of the families that are particularly prone to cause agricultural damage (Bovidae) = 2.
C2. Overseas range size including current and past 1000 years, natural and introduced range (0–2) *Estimate the species overseas range size (including current and past 1000 years, natural and introduced range) in millions of square kilometres*	1	*Overseas geographic range 10–30 million square kilometres.* Approximately 10.5 million km^2 From IUCN: Angola; Benin; Botswana; Burkina Faso; Burundi; Cameroon; Central African Republic; Chad; Congo; Congo, The Democratic Republic of the; Côte d'Ivoire; Eritrea; Eswatini; Ethiopia; Gabon; Ghana; Guinea; Guinea-Bissau; Kenya; Malawi; Mali; Mozambique; Namibia; Niger; Nigeria; Rwanda; Senegal; Sierra Leone; Somalia; South Africa; South Sudan; Sudan; Tanzania, United Republic of; Togo; Uganda; Zambia and Zimbabwe.
C3. Diet and feeding (0–3)	3	*Mammal that is primarily a grazer or browser.* Waterbucks are strict herbivore (mainly grazers but will also browse). They eat a variety of grasses, both medium and short in length. Their diet is very rich in protein. When the amount of available grass is low, waterbuck eat other herbs to satisfy their needs (Estes, 1991).
C4. Competition with native fauna for tree hollows (0–2)	0	*Does not use tree hollows.*
C5. Overseas environmental pest status (0–3) *Has the species been reported to cause declines in abundance of any native species of plant or animal or cause degradation to any natural communities in any country or region of the world?*	0	*Never reported as an environmental pest in any country or region.* No reference found of the waterbuck being reported as an environmental pest.
C6. Climate match to areas with susceptible native species or communities (0–5) *Identify any native Australian animal or plant species or communities that could be susceptible to harm by the exotic species if it were to establish a wild population here.*	5	*The species has more than 138 grid squares within the highest two climate match classes that overlap the distribution of any susceptible native species or ecological communities = 5* Examples of susceptible native species or ecological communities include (DAWE Protected Matters Search Tool):

		Highest areas of climate match overlap with 8 threatened ecological communities (including Poplar Box Grassy Woodland on Alluvial Plains; and Arnhem Plateau Sandstone Shrubland Complex), and with at least 57 threatened animal species (including *Lasiorhinus krefftii* (Northern Hairy-nosed Wombat) – Critically Endangered; and *Petrogale concinna* (Nabarlek) – Critically Endangered)
C7. Overseas primary production pest status (0–3) *Has the species been reported to damage crops or other primary production in any country or region of the world?*	2	*Moderate pest of primary production in any country or region.* Listed as NEMBA (National Environmental Management: Biodiversity Act) Category 2 (permit required) by Invasives South Africa in their National List of Invasive Species due to being "in competition with cattle for grazing". Minor impacts on some crop types (seedlings avocado and coffee, chili and pepper crops) in Ethiopia (Kiros and Bekele, 2021). In Trans Nzoia, a farming district in Kenya, velvet monkeys and waterbucks were cited as leading in crop destruction. Waterbucks were also associated with the spread of ticks (Ogutu, 1997).
C8. Climate match to susceptible primary production (0–5) *Assess Potential Commodity Impact Scores for each primary production commodity listed in Table 9, based on species' attributes (diet, behaviour, ecology), excluding risk of spreading disease which is addressed in Question C9.* *0 = 0; 1-19 = 1; 20-49 = 2; 50-99 = 3; 100-149 = 4; ≥150 = 5*	3	Total Commodity Damage Score = 94 (see Table 2)
C9. Spread disease (1–2) *Assess the risk that the species could play a role in the spread of disease or parasites to other animals*	2	*All mammals (likely or unknown effect on native species and on livestock and other domestic animals).* 27 species of ixodid ticks have been found on waterbucks – a healthy waterbuck may carry over 4,000 ticks in their larval or nymphal stages (Kingdon). Tick-spread diseases are a risk. Waterbucks are suspected of being a wildlife reservoir for tick-transmitted parasites infective to livestock (Githaka, 2014).
C10. Harm to property (0–3)	1	*$1 - $10 million.*

Assess the risk that the species could inflict damage on buildings, vehicles, fences, roads, equipment or ornamental gardens by chewing or burrowing or polluting with droppings or nesting material.		Possible risk to fencing.
C11. Harm to people (0–5) *Assess the risk that, if a wild population established, the species could cause harm to or annoy people. Aggressive behaviour, plus the possession of organs capable of inflicting harm, such as sharp teeth, tusks, claws, spines, a sharp bill, horns, antlers or toxin delivering organs may enable animals to harm people. Any known history of the species attacking, injuring or killing people should also be taken into account (see Stage A, Score A1).*	1	*Very low risk.* No reference found that they are particularly aggressive but large and males have large horns.
C. PEST RISK SCORE SUM C 1 TO C 11 (1–37)	22	**Extreme pest risk**
STAGE A. PUBLIC SAFETY RISK RANK – RISK TO PUBLIC SAFETY POSED BY CAPTIVE OR RELEASED INDIVIDUALS *0 = Not dangerous; 1 = Moderately dangerous; ≥ 2 = Highly dangerous*	1	Moderately dangerous
STAGE B. ESTABLISHMENT RISK RANK – RISK OF ESTABLISHING A WILD POPULATION **MODEL 1: FOUR-FACTOR MODEL FOR BIRDS AND MAMMALS (BOMFORD 2008)** *≤ 5 = low establishment risk; 6-8 = moderate establishment risk; 9-10 = serious establishment risk; ≥ 11-13 = extreme establishment risk*	6	Moderate establishment risk
STAGE B. ESTABLISHMENT RISK RANK – RISK OF ESTABLISHING A WILD POPULATION **MODEL 2: SEVEN-FACTOR MODEL FOR BIRDS AND MAMMALS (BOMFORD 2008)**	9	Moderate establishment risk

≤ 6 = low establishment risk; 7-11 = moderate establishment risk; 12-13 = serious establishment risk; ≥14 = extreme establishment risk		
STAGE C. PEST RISK RANK - RISK OF BECOMING A PEST FOLLOWING ESTABLISHMENT *< 9 = low pest risk; 9-14 = moderate pest risk; 15-19 = serious pest risk; > 19 = extreme pest risk*	22	Extreme pest risk

ENVIRONMENT AND INVASIVES COMMITTEE THREAT CATEGORY	**EXTREME**

World distribution map (IUCN Red List) and Climatch world distribution map indicating where meteorological data was sourced for the climate analysis (see B1):

Figure 1 - World Distribution Map - IUCN Red List

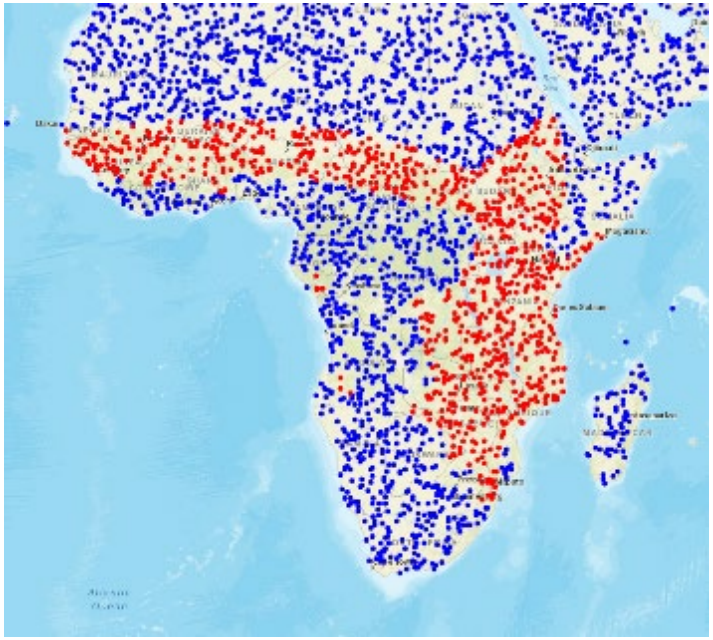
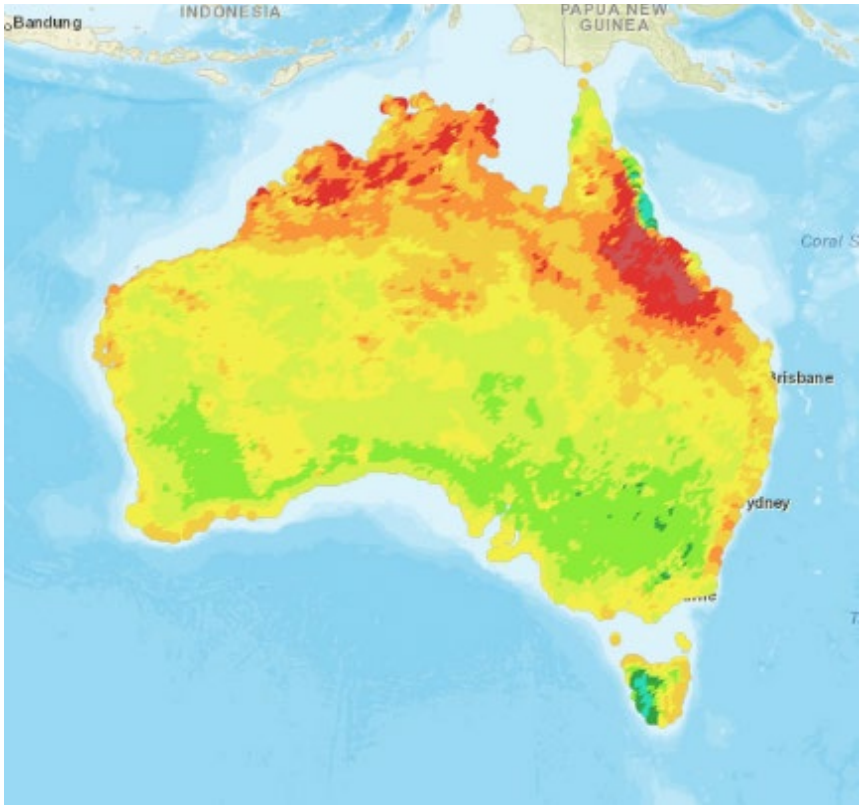


Figure 2 - World Distribution Map - Climatch

Climate match between world distribution of species and Australia:

Areas of Australia where the climate appears suitable for *Kobus ellipsiprymnus*

Value X = 6,850



Score	Color	Count
0		0
1		40
2		67
3		2365
4		4939
5		4975
6		3473
7		2292
8		864
9		221
10		0

Species: Kobus ellipsiprymnus (Waterbuck)
Algorithm: Closest Standard Score
929 source features selected
19236 target features selected
Approximate selected area: 10,555,353 km^2

Table 1: ABARES recalibration thresholds

Climate Match Score (CMS)	Climatch (50 km) Closest Standard Match Sum Level 6 (Value X)	2021 Recalibrated Climatch v2.0 (20 km) Closest Standard Match Sum Level 6 (Value X)
1 (Very low)	< 100	< 691
2 (Low)	100-599	691-4137
3 (Moderate)	600-899	4138-6209
4 (High)	900-1699	6210-11735
5 (Very high)	1700-2699	11736-18642
6 (Extreme)	≥ 2700	≥ 18643

Table 2: Susceptible Australian Primary Production – Calculating Total Commodity Damage Score

The commodity value index scores in this table are derived from Australian Bureau of Statistics 1999 – 2000 data. The values will require updating if significant change has occurred in the value of the commodity (Bomford 2008).

Industry	**Commodity Value Index 1 (CVI based on best available date)**	**Potential Commodity Impact Score (PCIS 0-3)**	**Climate Match to Commodity Score (CMCS 0–5)**	**Commodity Damage Score (CDS columns 2 X 3 X 4)**
Sheep (includes wool and sheep meat)	10	1	2	20
Cattle (includes dairy and beef)	10	1	3	30
Timber (includes native and plantation forests)	10			
Cereal grain (includes wheat, barley sorghum etc)	10	2	2	40
Pigs	2			
Poultry and eggs	2			
Aquaculture (includes coastal mariculture)	2			
Cotton	2			
Oilseeds (includes canola, sunflower etc)	2	1	0	
Grain legumes (includes soybeans)	2	1	1	2
Sugarcane	2			
Grapes	2			
Other Fruit	2			
Vegetables	2			
Nuts	1			
Other livestock (includes goats, deer, camels, rabbits)	1			
Honey and beeswax	1			
Other horticulture (includes flowers etc)	1	1	2	2
Total Commodity Damage Score (TCDS)				94

Assess Potential Commodity Impact Scores for each primary production commodity listed in Table 9, based on species' attributes (diet, behaviour, ecology), excluding risk of spreading disease which is addressed in Question C9, and pest status worldwide as:

0. *Nil (species does not have attributes to make it capable of damaging this commodity)*
1. *Low (species has attributes making it capable of damaging this or similar commodities and has had the opportunity but no reports or other evidence that it has caused damage in any country or region*
2. *Moderate–serious (reports of damage to this or similar commodities exist but damage levels have never been high in any country or region and no major control programs against the species have ever been conducted OR the species has attributes making it capable of damaging this or similar commodities but has not had the opportunity)*
3. *Extreme (damage occurs at high levels to this or similar commodities and/or major control programs have been conducted against the species in any country or region and the listed commodity would be vulnerable to the type of harm this species can cause).*

Climate Match to Commodity Score (0–5)

- *None of the commodity is produced in areas where the species has a climate match within the highest eight climate match classes (ie classes 10, 9, 8, 7, 6, 5, 4 and 3) = 0*
- *Less than 10% of the commodity is produced in areas where the species has a climate match within the highest eight climate match classes = 1*
- *Less than 10% of the commodity is produced in areas where the species has a climate match within the highest six climate match classes (ie classes 10, 9, 8, 7, 6 and 5) = 2*
- *Less than 50% of the commodity is produced in areas where the species has a climate match within the highest six climate match classes AND less than 10% of the commodity is produced in areas where the species has a climate match within the highest three climate match classes (ie classes 10, 9 and 8) = 3*
- *Less than 50% of the commodity is produced in areas where the species has a climate match within the highest six climate match classes BUT more than 10% of the commodity is produced in areas where the species has a climate match within the highest three climate match classes = 4*
- *OR More than 50% of the commodity is produced in areas where the species has a climate match within the highest six climate match classes BUT less than 20% of the commodity is produced in areas where the species has a climate match within the highest three climate match classes = 4*
- *More than 20% of the commodity is produced in areas where the species has a climate match within the highest three climate match classes OR overseas range unknown and climate match to Australia unknown = 5.]*

Table 3: Assigning species to EIC Threat Categories (shaded cells relate to assignment of reptiles and amphibians to EIC Threat Categories based on an assessed establishment risk and an allocated pest risk of extreme) – adapted from Bomford 2008

Establishment Risk	Pest Risk	Public Safety Risk	EIC Threat Category	Implication for any proposed import into Australia	Implication for keeping and movement in Australia
Extreme	Extreme	Highly, Moderately or Not Dangerous	**EXTREME**	Prohibited, unless sufficient risk management measures exist to reduce the potential risks to an acceptable level	Limited to those collections approved for keeping particular EXTREME Threat species
Extreme	Serious	Highly, Moderately or Not Dangerous	**EXTREME**		
Extreme	Moderate	Highly, Moderately or Not Dangerous	**EXTREME**		
Extreme	Low	Highly, Moderately or Not Dangerous	**EXTREME**		
Serious	Extreme	Highly, Moderately or Not Dangerous	**EXTREME**		
Serious	Serious	Highly, Moderately or Not Dangerous	**EXTREME**		
Moderate	Extreme	Highly, Moderately or Not Dangerous	**EXTREME**		
Serious	Moderate	Highly, Moderately or Not Dangerous	**SERIOUS**	Import restricted to those collections approved for keeping SERIOUS Threat species	Limited to those collections approved for keeping particular SERIOUS Threat species
Serious	Low	Highly, Moderately or Not Dangerous	**SERIOUS**		
Moderate	Serious	Highly, Moderately or Not Dangerous	**SERIOUS**		
Moderate	Moderate	Highly Dangerous	**SERIOUS**		
Moderate	Low	Highly Dangerous	**SERIOUS**		
Low	Extreme	Highly, Moderately or Not Dangerous	**SERIOUS**		
Low	Serious	Highly, Moderately or Not Dangerous	**SERIOUS**		
Low	Moderate	Highly Dangerous	**SERIOUS**		
Low	Low	Highly Dangerous	**SERIOUS**		
Moderate	Moderate	Moderately or Not Dangerous	**MODERATE**	Import restricted to those collections approved for keeping MODERATE Threat species	Limited to those collections approved for keeping particular MODERATE Threat species
Moderate	Low	Moderately or Not Dangerous	**MODERATE**		
Low	Moderate	Moderately or Not Dangerous	**MODERATE**		
Low	Low	Moderately Dangerous	**MODERATE**		
Low	Low	Not Dangerous	**LOW**	Import permitted	May be limited to those collections approved for keeping particular LOW Threat species
Any Value	Any Value	Unknown	**EXTREME until proven otherwise**	Prohibited, unless sufficient risk management measures exist to reduce the potential risks to an acceptable level	Limited to those collections approved for keeping particular EXTREME Threat species
Unknown	Any Value	Any Value	**EXTREME until proven otherwise**		
Any Value	Unknown	Any Value	**EXTREME until proven otherwise**		
Unassessed	Unassessed	Unassessed	**EXTREME until proven otherwise**		

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AnAge Waterbuck (Kobus ellipsiprymnus) longevity, ageing, and life history (senescence.info)

ADW Animal Diversity Web ADW: Kobus ellipsiprymnus: INFORMATION (animaldiversity.org)

AWF Waterbuck | African Wildlife Foundation (awf.org)

AZA Minimum Husbandry Guidelines for Keeping Antelopes and Gazelles in Captivity Husbandry_Guidelines (antelopetag.com)

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Wintershoek Safaris Waterbuck | Wintershoek Safaris

National Risk Assessment: EXTREME

RISK ASSESSMENT FOR AUSTRALIA: Ocelot (*Leopardus pardalis*)

Class - Mammalia**, Order -** Carnivora**, Family -** Felidae**, Genus -** *Leopardus*.

SPECIES: *Leopardus pardalis* (Linnaeus, 1758) **Synonyms:** *Felis pardalis* (Linnaeus, 1758) *Leopardus pardalis aequatorialis* (Mearns, 1903) *Leopardus pardalis albescens* (Pucheran, 1855) *Leopardus pardalis mearnsi* (Allen, 1904) *Leopardus pardalis melanurus* (Ball, 1844) *Leopardus pardalis nelsoni* (Goldman, 1925) *Leopardus pardalis pseudopardalis* (Boitard, 1842) Leopardus pardalis pusaeus (Thomas, 1914) *Leopardus pardalis sonoriensis* (Goldman, 1925) *Leopardus pardalis steinbachi* (Pocock, 1941) **Subspecies:** *Leopardus pardalis mitis* (F. G. Cuvier, 1820)	**Species description:** A small to mid-sized wild cat, the ocelot's fur is extensively marked with solid black markings on a yellowish, tawny, creamy, reddish grey or grey background colour. Each ocelot has a unique colour pattern, which can be used to identify individuals (Emmons, 1998; iNaturalist; Kittle, 2011). The spots on the limbs and head are small, but markings on the flanks back, and cheeks, are open or closed stripes and bands. Several dark stripes run from the back of the neck to the tip of the tail. The neck and underside are white, and the insides of the legs are marked with horizontal streaks. Round ears are marked with bright white spots. The tail is typically short with black rings or bars on the top side (IUCN/SSC Cat Specialist Group). The body has a notably strong odour (iNaturalist). Weight estimates range between 11-16 kilograms (San Diego Zoo); 6.6-15.5 kilograms (GBIF); 7-18 kilograms (iNaturalist) and 8.5 to 16 kilograms (Kittle, 2011). Males typically weigh more than females (IUCN/SSC Cat Specialist Group) with estimates ranging between 7-12 kilograms for females and 8-18 kilograms males on iNaturalist, to 6.6-11.3 kilograms for females and for males between 7-15.5 kilograms on GBIF. **General information:** The ocelot occurs in a broad range of tropical and subtropical habitats, including dense thorny chaparral in southern Texas, lowland riverine rain forest in Peru, moist subtropical forest in Belize, shrub woodlands and gallery forest in Venezuela, seasonally flooded marshes and semi-deciduous forest in the Brazilian Pantanal, and subtropical forest in southern Brazil (Kittle, 2011). Despite the diversity of habitats, they occupy (suggesting they are habitat generalists), close monitoring of radio-collared animals indicates they are highly dependent on dense ground or forest cover. They therefore occupy a much narrower range of microhabitats than would have been predicted by their wide geographic distribution. Ocelots are recorded from sea level to about 1,200 metres. Occasionally, ocelots have been recorded at higher elevations up to 3,800 metres (IUCN/SSC Cat Specialist Group). Ocelots are reportedly strong swimmers, and, in some areas, they live in seasonally inundated environments (Wilson, 2009).

Leopardus pardalis pardalis (Linnaeus, 1758) **Common Names:** Ocelot	The ocelot is usually solitary (IUCN/SSC Cat Specialist Group; iNaturalist). They are not however always antisocial, especially between related cats (Dillon, 2008; Emmons, 1988). Breeding females occupy mutually exclusive territories. Adult males occupy large territories that overlap 3 or more female home ranges (Dillon, 2008; Emmons, 1988). Although it can be active during both day and night, it is typically most active at night or crepuscular (Emmons, 1988). Ocelots often rest during the daytime in clumps of vines in trees, brush piles, under tree falls, on elevated fallen tree trunks, among the roots of large trees, and even in concrete culverts (Wilson, 2009). Ocelots have a long gestation period (79-85 days (Kittle, 2011; Wilson, 2009)). Litter size is small, with one young per litter being the norm (Wilson, 2009) but sometimes 2 (AnAge) or up to 3 (Kittle, 2011). Young remain dependent on their mothers for 6 to 12 months and disperse from her territory when they are 2-3 years old (Wilson, 2009). Weaning is given by AnAge as 106 days and inter-litter interval as 452 days. **Longevity:** Maximum recorded longevity in captivity is 28.2 years (AnAge). In the wild up to 10 years whereas in captivity up to 20 years (IUCN/SSC Cat Specialist Group). In the wild between 7 and 10 years, in captivity 21.5 years (Kittle, 2011). **Conservation status:** **IUCN:** Least Concern **CITES**: Appendix I
DATE OF ASSESSMENT: Nov 2022 (Jodi Buchecker) **EIC ENDORSEMENT:** 16/06/23 **Risk assessment model used for the assessment:** Bomford 2008, Mammals and Birds	**The risk assessment model:** Models for assessing the risk that exotic vertebrates could establish in Australia have been developed for mammals, birds (Bomford 2003, 2006, 2008), reptiles and amphibians (Bomford et al 2005, Bomford 2008). Developed by Dr Mary Bomford for the Bureau of Rural Sciences (BRS), the model uses criteria that have been demonstrated to have significant correlation between a risk factor and the establishment of populations of exotic species and the pest potential of those species that do establish. For example, a risk factor for establishment is similarity in climate (temperature and rainfall) within the species' distribution overseas and Australia. For pest potential, the species' overseas pest status is a risk factor. The model is published as 'Risk assessment models for the establishment of exotic vertebrates in Australia and New Zealand' (Bomford 2008) and is available online on the PestSmart website https://pestsmart.org.au/wp-content/uploads/sites/3/2020/06/Risk_Assess_Models_2008_FINAL.pdf **CLIMATE**: In 2021 a new version of the Climatch program used to assess similarity in climate was released by the Australian Bureau of Agricultural Resource Economics and Sciences (ABARES): CLIMATCH v2.0. The increase in resolution in this new version (from 50 km to 20 km) required recalibration of Climate Match Scores. See Table 1. Sixteen climate parameters

	(variables) of temperature and rainfall are used to estimate the extent of similarity between data from meteorological stations located within the species' world distribution and stations in Australia. Worldwide, data from approximately 19000 locations are available for analysis. The number of locations used in an analysis will vary according to the size of the species' distribution and the number of meteorological stations located within that distribution. To represent the climate match visually, the map of Australia is divided into 19236 grid squares, each measured in 0.2 degrees in both longitude and latitude. CLIMATCH v2.0 calculates a match for each Australian grid by comparing data from all meteorological stations within the species' distribution (excluding any populations in Australia) and allocating a score ranging from ten for the highest level match to zero for the poorest match. Levels of climate match are used in the risk assessment for questions B1 (scores are summed to give a cumulative score), C6, and C8. Climatch v2.0 can be accessed on the ABARES website, agriculture.gov.au/abares. The direct URL is https://climatch.cp1.agriculture.gov.au/.

Bird and Mammal Model:		
FACTOR	**SCORE**	**DETAIL**
STAGE A: RISKS POSED BY CAPTIVE OR RELEASED ANIMALS		
A1. Risk to people from individual escapees (0–2) *Assess the risk that individuals of the species could harm people. (NB, this question only relates to aggressive behaviour shown by escaped or released individual animals. Question C11 addresses the risk of harm from aggressive behaviour if the species establishes a wild population).* *Aggressive behaviour, size, plus the possession of organs capable of inflicting harm, such as sharp teeth, claws, spines, a sharp bill, or toxin-delivering apparatus may enable individual animals to harm people. Any known history of the species attacking, injuring or killing people should also be taken into account. Assume the individual is not protecting nest or young.*	1	*Animal that is unlikely to make an unprovoked attack, but which can cause serious injury (requiring hospitalisation) or fatality if cornered or handled.* Ocelots are generally shy and secretive, rarely being sighted in the wild (Emmons, 1988). Even though they are small to medium-sized wild cat species (weight ranges from 7-18 kilograms (iNaturalist) to 6.6-15.5 kilograms (GBIF)), they have sharp claws and teeth that could cause serious injury (requiring hospitalisation).
A2. Risk to public safety from individual captive animals (0–2) *Assess the risk that irresponsible use of products obtained from captive individuals of the species (such as toxins) pose a public safety risk (excluding the safety of anyone entering the animals' cage/enclosure or otherwise coming within reach of the captive animals)*	0	*Nil or low risk (highly unlikely or not possible).*

STAGE A PUBLIC SAFETY RISK SCORE **SUM A1 - A2 (0-4)**	1	**Moderately dangerous**
STAGE B: PROBABILITY ESCAPED OR RELEASED INDIVIDUALS WILL ESTABLISH FREE-LIVING POPULATIONS		
Model 1: FOUR-FACTOR MODEL FOR BIRDS AND MAMMALS (BOMFORD 2008)		
B1. Degree of climate match between species overseas range and Australia (1–6) *Map the selected mammal or bird species' overseas range, including its entire native and exotic (excluding Australia) ranges over the past 1000 years.* *Use CLIMATCH v2.0, Value X = sum of classes 6 – 10, see Table 1.*	5	*Very High climate match to Australia* Value X = 14,582 Climate Match Score = 5
B2. Exotic population established overseas (0–4) *An established exotic population means the introduced species must have bred outside of captivity and must currently maintain a viable free-living population where the animals are not being intentionally fed or sheltered, even though they may be living in a highly disturbed environment with access to non-natural food supplies or shelter.*	0	*No exotic population ever established.*
B3. Overseas range size score (0–2) < 1 = 0; 1– 70 = 1; >70 = 2 *Estimate the species overseas range size* including currently and the past 1000 years; natural and introduced range in millions of square kilometres*	1	*Overseas range between 1 to 70 million square kilometres.* Approximately 16.5 million km^2.
B4. Taxonomic Class (0–1) *Bird = 0; mammal = 1*	1	*Mammal*
B. ESTABLISHMENT RISK SCORE **SUM OF B1- B4 (1–13)**	7	**Moderate establishment risk**

Model 2: Seven-Factor Model For Birds And Mammals (Bomford 2008)		
B5. Diet score (0–1) *Specialist = 0; generalist = 1*	1	*Generalist with a broad diet of many food types.* Generalist carnivore and will hunt and eat any kind of mammal, bird, or reptile of appropriate size (Paviolo, 2015). Has been known to target large ungulates such as sheep, deer, peccaries, anteaters, monkeys, and iguanas (iNaturalist).
B6. Habitat score (0–1) *Undisturbed or disturbed habitat*	1	*Can survive and breed in human-disturbed habitats (including grazing and agricultural lands, forests that are intensively managed or planted for timber harvesting and/or urban–suburban environments) without access to undisturbed (natural) habitats.* Can live in disturbed habitats and has been recorded in oil palm landscapes and big cattle ranches in the Colombian Llanos and inter-Andean valleys (Boron, 2013). It is known to sometimes sleep in concrete culverts (Wilson, 2009).
B7. Migratory score (0–1) *Always migratory = 0; non-migratory = 1*	1	*Non-migratory.* The ocelot is not a migrant (Paviolo, 2015).
B. ESTABLISHMENT RISK SCORE **SUM OF B1- B7 (1–16)**	10	**Serious establishment risk**
STAGE C: PROBABILITY AN ESTABLISHED SPECIES WILL BECOME A PEST		
C1. Taxonomic group (0–4)	2	*Mammal in one of the orders that have been demonstrated to have detrimental effects on prey abundance and/or habitat degradation (Carnivora).*
C2. Overseas range size including current and past 1000 years, natural and introduced range (0–2) *Estimate the species overseas range size (including current and past 1000 years, natural and introduced range) in millions of square kilometres*	1	*Overseas geographic range 10–30 million square kilometres.* Approximately 16.5 million km^2
C3. Diet and feeding (0–3)	3	*Mammal that is a strict carnivore and will climb trees.*

		Will hunt and eat any kind of mammal, bird, or reptile of appropriate size. It will typically prey on animals that weigh less than 1 kilograms (Abreu, 2008; iNaturalist) with most prey being smaller than 100 grams (Abreu, 2008). Small terrestrial mammals make up the bulk of the diet (Emmons, 1988), but the ocelot may consume larger sized prey (>800 grams) (Paviolo, 2015), such as sheep, deer, peccaries, anteaters, monkeys, and iguanas' (iNaturalist).
C4. Competition with native fauna for tree hollows (0–2)	0	*Does not use tree hollows.*
C5. Overseas environmental pest status (0–3) *Has the species been reported to cause declines in abundance of any native species of plant or animal or cause degradation to any natural communities in any country or region of the world?*	0	*Never reported as an environmental pest in any country or region.*
C6. Climate match to areas with susceptible native species or communities (0–5) *Identify any native Australian animal or plant species or communities that could be susceptible to harm by the exotic species if it were to establish a wild population here.*	5	*The species has more than 139 grid squares within the highest two climate match classes that overlap the distribution of any susceptible native species or ecological communities = 5* Examples of susceptible native species or ecological communities include (DAWE Protected Matters Search Tool): *Pedionomus torquatus* (Plains-wanderer) – Endangered *Petauroides volans* (Greater Glider) – Vulnerable
C7. Overseas primary production pest status (0–3) *Has the species been reported to damage crops or other primary production in any country or region of the world?*	1	*Minor pest of primary production in any country or region.* Recorded as a minor pest to primary production overseas and is known to take poultry (IUCN/SSC Cat Specialist Group; San Diego Wildlife Alliance; Sunquist, 2002).
C8. Climate match to susceptible primary production (0–5) *Assess Potential Commodity Impact Scores for each primary production commodity listed in Table 9, based on species'*	1	Total Commodity Damage Score = 17 (see Table 2)

attributes (diet, behaviour, ecology), excluding risk of spreading disease which is addressed in Question C9. *0 = 0; 1-19 = 1; 20-49 = 2; 50-99 = 3; 100-149 = 4; ≥150 = 5*		
C9. Spread disease (1–2) *Assess the risk that the species could play a role in the spread of disease or parasites to other animals*	2	*All mammals (likely or unknown effect on native species and on livestock and other domestic animals).*
C10. Harm to property (0–3) *Assess the risk that the species could inflict damage on buildings, vehicles, fences, roads, equipment or ornamental gardens by chewing or burrowing or polluting with droppings or nesting material.*	0	*$0.* Nil harm to property.
C11. Harm to people (0–5) *Assess the risk that, if a wild population established, the species could cause harm to or annoy people. Aggressive behaviour, plus the possession of organs capable of inflicting harm, such as sharp teeth, tusks, claws, spines, a sharp bill, horns, antlers or toxin delivering organs may enable animals to harm people. Any known history of the species attacking, injuring or killing people should also be taken into account (see Stage A, Score A1).*	3	*Injuries or harm moderate but unlikely to be fatal and few people exposed. Moderate risk = 3.* Ocelots are relatively small (weight range 7 to 18 kilograms) and are generally shy and secretive. However, they do have sharp teeth and claws and can be aggressive when cornered or protecting young.
C. PEST RISK SCORE **SUM C 1 TO C 11 (1–37)**	18	**Serious pest risk**
STAGE A. PUBLIC SAFETY RISK RANK – RISK TO PUBLIC SAFETY POSED BY CAPTIVE OR RELEASED INDIVIDUALS *0 = Not dangerous; 1 = Moderately dangerous; ≥ 2 = Highly dangerous*	1	Moderately dangerous
STAGE B. ESTABLISHMENT RISK RANK – RISK OF ESTABLISHING A WILD POPULATION **MODEL 1: FOUR-FACTOR MODEL FOR BIRDS AND MAMMALS (BOMFORD 2008)**	7	Moderate establishment risk

≤ 5 = low establishment risk; 6-8 = moderate establishment risk; 9-10 = serious establishment risk; ≥ 11-13 = extreme establishment risk		
STAGE B. ESTABLISHMENT RISK RANK – RISK OF ESTABLISHING A WILD POPULATION **MODEL 2: SEVEN-FACTOR MODEL FOR BIRDS AND MAMMALS (BOMFORD 2008)** *≤ 6 = low establishment risk; 7-11 = moderate establishment risk; 12-13 = serious establishment risk; ≥14 = extreme establishment risk*	10	Serious establishment risk
STAGE C. PEST RISK RANK - RISK OF BECOMING A PEST FOLLOWING ESTABLISHMENT *< 9 = low pest risk; 9-14 = moderate pest risk; 15-19 = serious pest risk; > 19 = extreme pest risk*	18	Serious pest risk

ENVIRONMENT AND INVASIVES COMMITTEE THREAT CATEGORY	**EXTREME**

World distribution map (IUCN Red List); current and historic range in USA (Haines 2006); and Climatch world distribution map indicating where meteorological data was sourced for the climate analysis (see B1):

Figure 1 - World Distribution Map - IUCN Red List

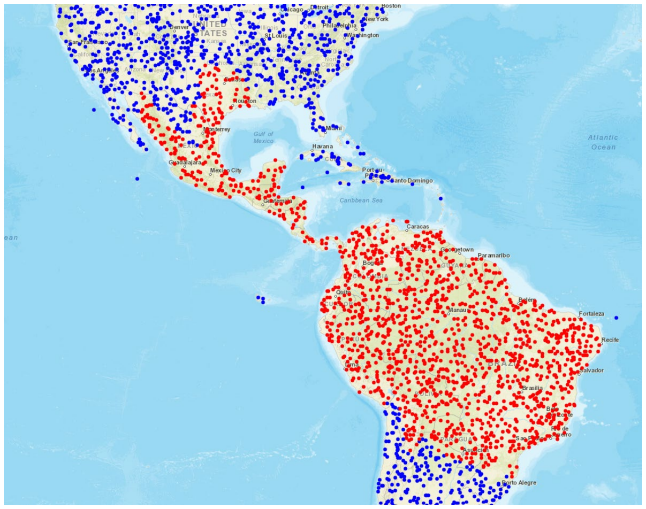


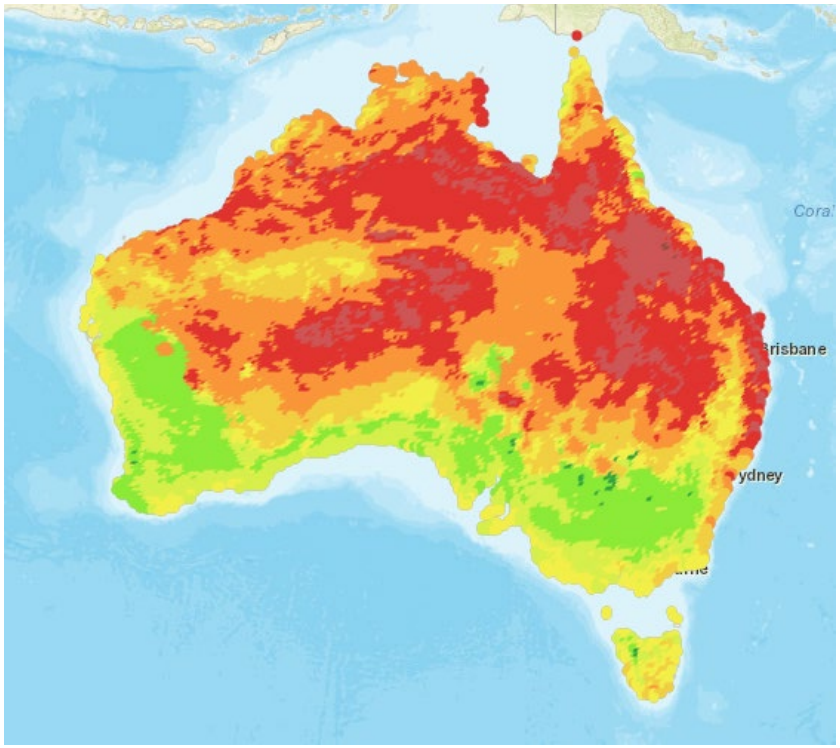
Figure 2 – World Distribution map – Climatch

Figure 3 – Haines (2006) – Ocelot current and historic range in the United States of America.

Climate match between world distribution of species and Australia:

Areas of Australia where the climate appears suitable for *Leopardus pardalis*

Value X = 14,582



Score	Color	Count
0		0
1		0
2		31
3		1999
4		1474
5		1150
6		2474
7		5506
8		5159
9		1439
10		4

Species: Ocelot (Leopardus pardalis)
Algorithm: Closest Standard Score
1602 source features selected
19236 target features selected
Approximate selected area: 16,440,787 km^2

Table 1: ABARES recalibration thresholds

Climate Match Score (CMS)	Climatch (50 km) Closest Standard Match Sum Level 6 (Value X)	2021 Recalibrated Climatch v2.0 (20 km) Closest Standard Match Sum Level 6 (Value X)
1 (Very low)	< 100	< 691
2 (Low)	100-599	691-4137
3 (Moderate)	600-899	4138-6209
4 (High)	900-1699	6210-11735
5 (Very high)	1700-2699	11736-18642
6 (Extreme)	≥ 2700	≥ 18643

Table 2: Susceptible Australian Primary Production – Calculating Total Commodity Damage Score

The commodity value index scores in this table are derived from Australian Bureau of Statistics 1999 – 2000 data. The values will require updating if significant change has occurred in the value of the commodity (Bomford 2008).

Industry	**Commodity Value Index 1 (CVI based on best available date)**	**Potential Commodity Impact Score (PCIS 0-3)**	**Climate Match to Commodity Score (CMCS 0–5)**	**Commodity Damage Score (CDS columns 2 X 3 X 4)**
Sheep (includes wool and sheep meat)	10	1	1	10
Cattle (includes dairy and beef)	10			
Timber (includes native and plantation forests)	10			
Cereal grain (includes wheat, barley sorghum etc)	10			
Pigs	2			
Poultry and eggs	2	3	1	6
Aquaculture (includes coastal mariculture)	2			
Cotton	2			
Oilseeds (includes canola, sunflower etc)	2			
Grain legumes (includes soybeans)	2			
Sugarcane	2			
Grapes	2			
Other Fruit	2			
Vegetables	2			
Nuts	1			
Other livestock (includes goats, deer, camels, rabbits)	1	1	1	1
Honey and beeswax	1			
Other horticulture (includes flowers etc)	1			
Total Commodity Damage Score (TCDS)				17

Assess Potential Commodity Impact Scores for each primary production commodity listed in Table 9, based on species' attributes (diet, behaviour, ecology), excluding risk of spreading disease, which is addressed in Question C9, and pest status worldwide as:

0. *Nil (species does not have attributes to make it capable of damaging this commodity)*
1. *Low (species has attributes making it capable of damaging this or similar commodities and has had the opportunity but no reports or other evidence that it has caused damage in any country or region*
2. *Moderate–serious (reports of damage to this or similar commodities exist but damage levels have never been high in any country or region and no major control programs against the species have ever been conducted OR the species has attributes making it capable of damaging this or similar commodities but has not had the opportunity)*
3. *Extreme (damage occurs at high levels to this or similar commodities and/or major control programs have been conducted against the species in any country or region and the listed commodity would be vulnerable to the type of harm this species can cause).*

Climate Match to Commodity Score (0–5)

- *None of the commodity is produced in areas where the species has a climate match within the highest eight climate match classes (ie classes 10, 9, 8, 7, 6, 5, 4 and 3) = 0*
- *Less than 10% of the commodity is produced in areas where the species has a climate match within the highest eight climate match classes = 1*
- *Less than 10% of the commodity is produced in areas where the species has a climate match within the highest six climate match classes (ie classes 10, 9, 8, 7, 6 and 5) = 2*
- *Less than 50% of the commodity is produced in areas where the species has a climate match within the highest six climate match classes AND less than 10% of the commodity is produced in areas where the species has a climate match within the highest three climate match classes (ie classes 10, 9 and 8) = 3*
- *Less than 50% of the commodity is produced in areas where the species has a climate match within the highest six climate match classes BUT more than 10% of the commodity is produced in areas where the species has a climate match within the highest three climate match classes = 4*
- *OR More than 50% of the commodity is produced in areas where the species has a climate match within the highest six climate match classes BUT less than 20% of the commodity is produced in areas where the species has a climate match within the highest three climate match classes = 4*
- *More than 20% of the commodity is produced in areas where the species has a climate match within the highest three climate match classes OR overseas range unknown and climate match to Australia unknown = 5.]*

Table 3: Assigning species to EIC Threat Categories (shaded cells relate to assignment of reptiles and amphibians to EIC Threat Categories based on an assessed establishment risk and an allocated pest risk of extreme) – adapted from Bomford 2008

Establishment Risk	Pest Risk	Public Safety Risk	EIC Threat Category	Implication for any proposed import into Australia	Implication for keeping and movement in Australia
Extreme	Extreme	Highly, Moderately or Not Dangerous	**EXTREME**	Prohibited, unless sufficient risk management measures exist to reduce the potential risks to an acceptable level	Limited to those collections approved for keeping particular EXTREME Threat species
Extreme	Serious	Highly, Moderately or Not Dangerous	**EXTREME**		
Extreme	Moderate	Highly, Moderately or Not Dangerous	**EXTREME**		
Extreme	Low	Highly, Moderately or Not Dangerous	**EXTREME**		
Serious	Extreme	Highly, Moderately or Not Dangerous	**EXTREME**		
Serious	Serious	Highly, Moderately or Not Dangerous	**EXTREME**		
Moderate	Extreme	Highly, Moderately or Not Dangerous	**EXTREME**		
Serious	Moderate	Highly, Moderately or Not Dangerous	**SERIOUS**	Import restricted to those collections approved for keeping SERIOUS Threat species	Limited to those collections approved for keeping particular SERIOUS Threat species
Serious	Low	Highly, Moderately or Not Dangerous	**SERIOUS**		
Moderate	Serious	Highly, Moderately or Not Dangerous	**SERIOUS**		
Moderate	Moderate	Highly Dangerous	**SERIOUS**		
Moderate	Low	Highly Dangerous	**SERIOUS**		
Low	Extreme	Highly, Moderately or Not Dangerous	**SERIOUS**		
Low	Serious	Highly, Moderately or Not Dangerous	**SERIOUS**		
Low	Moderate	Highly Dangerous	**SERIOUS**		
Low	Low	Highly Dangerous	**SERIOUS**		
Moderate	Moderate	Moderately or Not Dangerous	**MODERATE**	Import restricted to those collections approved for keeping MODERATE Threat species	Limited to those collections approved for keeping particular MODERATE Threat species
Moderate	Low	Moderately or Not Dangerous	**MODERATE**		
Low	Moderate	Moderately or Not Dangerous	**MODERATE**		
Low	Low	Moderately Dangerous	**MODERATE**		
Low	Low	Not Dangerous	**LOW**	Import permitted	May be limited to those collections approved for keeping particular LOW Threat species
Any Value	Any Value	Unknown	**EXTREME until proven otherwise**	Prohibited, unless sufficient risk management measures exist to reduce the potential risks to an acceptable level	Limited to those collections approved for keeping particular EXTREME Threat species
Unknown	Any Value	Any Value	**EXTREME until proven otherwise**		
Any Value	Unknown	Any Value	**EXTREME until proven otherwise**		
Unassessed	Unassessed	Unassessed	**EXTREME until proven otherwise**		

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National Risk Assessment: LOW

RISK ASSESSMENT FOR AUSTRALIA: Red-handed Tamarin (*Saguinus midas*)

Class - Mammalia**, Order -** Primate**, Family -** Callitrichidae**, Genus -** *Saguinus*.

SPECIES: *Saguinus midas* (Linnaeus, 1758) **Synonyms:** *Simia lacepedii* (Fischer, 1806) *Simia midas* (Linnaeus, 1758) *Midas rufimanus* (Saint-Hilaire, 1812) *Cebus tamarin* (Link, 1795) *Leontocebus midas egens* (Thomas, 1912) *Leontopithecus midas* (Linnaeus, 1758) **Subspecies:** *Leontocebus midas egens* (Thomas, 1912) **Common Names:** Red-handed Tamarin Golden-handed Tamarin Midas Tamarin Yellow-handed Tamarin	**Species description:** Red-handed tamarins are small (105-700 grams) arboreal, New World Monkeys (Garber, 1992). Body measurement is less than 30 centimetres (average 265 millimetres) and their tail can be twice that long (Hesterman, 2022; Cloyd, 2000). Their fur is dark brown or black with contrasting golden-orange hair on their hands and feet and some grey marbling on the mid and lower back. The dark face is hairless, and the big ears stick out of the fur (Hesterman, 2022). Instead of nails on their fingers and toes (except for the big toe which has a flat nail), they have claws (Garber, 1992). The thumb is not opposable (Cloyd, 2000). **General information:** The species is endemic to a large part of the Guiana Shield, including Suriname, French Guiana, Guyana, and several states of northern Brazil (Amapá, Amazonas, Pará) (Mittermeier et al., 2021). The red-handed tamarin mainly occupies the lower canopy and understory, 10-20 metres above the ground of primary, secondary, disturbed forest, and forest edge, but moves into the upper canopy of the forest to feed on fruits. They sleep in dense vegetation and liana tangles in the middle and lower canopy. It is common in high and low rainforest, savanna forest, mountain savanna forest, liana forest, and various secondary formations. It sometimes enters marsh forest and swamp forest (GBIF). As omnivorous, the red-handed tamarin's diet consists of leaves, plant exudates, fruit, flowers, eggs, insects and other arthropods, frogs, spiders, lizards, and nectar (Cloyd, 2000; Mittermeier, 2021). Red-handed tamarins are monogamous, co-operative breeders. Groups are typically comprised of a single breeding pair and mixed-sex members, that are reproductively suppressed and assist to rear their offspring. They nearly always produce twins or triplets (Hesterman, 2022). **Longevity:** Maximum longevity in captivity is recorded to be up to 21 years (AnAge). **Conservation status:** **IUCN:** Least Concern

	CITES: Appendix II
DATE OF ASSESSMENT: Oct 2022 (Jodi Buchecker) **EIC ENDORSEMENT:** 16/06/23 **Risk assessment model used for the assessment:** Bomford 2008, Mammals and Birds	**The risk assessment model:** Models for assessing the risk that exotic vertebrates could establish in Australia have been developed for mammals, birds (Bomford 2003, 2006, 2008), reptiles and amphibians (Bomford et al 2005, Bomford 2008). Developed by Dr Mary Bomford for the Bureau of Rural Sciences (BRS), the model uses criteria that have been demonstrated to have significant correlation between a risk factor and the establishment of populations of exotic species and the pest potential of those species that do establish. For example, a risk factor for establishment is similarity in climate (temperature and rainfall) within the species' distribution overseas and Australia. For pest potential, the species' overseas pest status is a risk factor. The model is published as 'Risk assessment models for the establishment of exotic vertebrates in Australia and New Zealand' (Bomford 2008) and is available online on the PestSmart website https://pestsmart.org.au/wp-content/uploads/sites/3/2020/06/Risk_Assess_Models_2008_FINAL.pdf **CLIMATE**: In 2021 a new version of the Climatch program used to assess similarity in climate was released by the Australian Bureau of Agricultural Resource Economics and Sciences (ABARES): CLIMATCH v2.0. The increase in resolution in this new version (from 50 km to 20 km) required recalibration of Climate Match Scores. See Table 1. Sixteen climate parameters (variables) of temperature and rainfall are used to estimate the extent of similarity between data from meteorological stations located within the species' world distribution and stations in Australia. Worldwide, data from approximately 19000 locations are available for analysis. The number of locations used in an analysis will vary according to the size of the species' distribution and the number of meteorological stations located within that distribution. To represent the climate match visually, the map of Australia is divided into 19236 grid squares, each measured in 0.2 degrees in both longitude and latitude. CLIMATCH v2.0 calculates a match for each Australian grid by comparing data from all meteorological stations within the species' distribution (excluding any populations in Australia) and allocating a score ranging from ten for the highest level match to zero for the poorest match. Levels of climate match are used in the risk assessment for questions B1 (scores are summed to give a cumulative score), C6, and C8. Climatch v2.0 can be accessed on the ABARES website, agriculture.gov.au/abares. The direct URL is https://climatch.cp1.agriculture.gov.au/.

Bird and Mammal Model:

FACTOR	SCORE	DETAIL
STAGE A: RISKS POSED BY CAPTIVE OR RELEASED ANIMALS		
A1. Risk to people from individual escapees (0–2) *Assess the risk that individuals of the species could harm people. (NB, this question only relates to*	0	*All other animals posing a lower risk of harm to people (ie animals that will not make unprovoked attacks causing injury requiring medical attention, and which, even if cornered or handled, are unlikely to cause injury requiring hospitalisation).*

aggressive behaviour shown by escaped or released individual animals. Question C11 addresses the risk of harm from aggressive behaviour if the species establishes a wild population). *Aggressive behaviour, size, plus the possession of organs capable of inflicting harm, such as sharp teeth, claws, spines, a sharp bill, or toxin-delivering apparatus may enable individual animals to harm people. Any known history of the species attacking, injuring or killing people should also be taken into account. Assume the individual is not protecting nest or young.*		Red-handed Tamarins have small sharp claws and teeth and are capable of inflicting minor wounds on humans (EAZA, 2017; Wissman, 2006). Their very small size, however, prevents serious injuries (Hesterman, 2022). Although any bite or scratch from a primate should be referred for medical treatment (Riesland & Wilde, 2015), it is unlikely that Red-handed Tamarins would make unprovoked attacks. There are only two incidents on public record of tamarins (*S. oedipus*) biting a person on the hand, and both were in response to being grabbed (HSI, 2011; PETA, 2018).
A2. Risk to public safety from individual captive animals (0–2) *Assess the risk that irresponsible use of products obtained from captive individuals of the species (such as toxins) pose a public safety risk (excluding the safety of anyone entering the animals' cage/enclosure or otherwise coming within reach of the captive animals)*	0	*Nil or low risk (highly unlikely or not possible).*
STAGE A PUBLIC SAFETY RISK SCORE **SUM A1 - A2 (0-4)**	0	**Not dangerous**
STAGE B: PROBABILITY ESCAPED OR RELEASED INDIVIDUALS WILL ESTABLISH FREE-LIVING POPULATIONS		
Model 1: FOUR-FACTOR MODEL FOR BIRDS AND MAMMALS (BOMFORD 2008)		
B1. Degree of climate match between species overseas range and Australia (1–6) *Map the selected mammal or bird species' overseas range, including its entire native and exotic (excluding Australia) ranges over the past 1000 years.* *Use CLIMATCH v2.0, Value X = sum of classes 6 – 10, see Table 1.*	1	*Very Low match to Australia* Value X = 0 Climate Match Score = 1
B2. Exotic population established overseas (0–4)	0	*No exotic population ever established.*

An established exotic population means the introduced species must have bred outside of captivity and must currently maintain a viable free-living population where the animals are not being intentionally fed or sheltered, even though they may be living in a highly disturbed environment with access to non-natural food supplies or shelter.		No reference found and not listed on the Global Invasive Species Database (GISD, 2022).
B3. Overseas range size score (0–2) < 1 = 0; 1– 70 = 1; >70 = 2 *Estimate the species overseas range size* including currently and the past 1000 years; natural and introduced range in millions of square kilometres*	0	*Overseas range less than 1 million km^2.* Overseas range includes Brazil, Guyana, Cayenne, Surinam, north of the Amazon and east of the Rio Negro.
B4. Taxonomic Class (0–1) *Bird = 0; mammal = 1*	1	*Mammal*
B. ESTABLISHMENT RISK SCORE SUM OF B1- B4 (1–13)	2	**Low establishment risk**
Model 2: Seven-Factor Model For Birds And Mammals (Bomford 2008)		
B5. Diet score (0–1) *Specialist = 0; generalist = 1*	1	*Generalist with a broad diet of many food types.* Omnivore. Its diet consists of leaves, plant exudates, fruit, flowers, eggs, insects and other arthropods, frogs, spiders, lizards, and nectar (Cloyd, 2000; Mittermeier, 2021).
B6. Habitat score (0–1) *Undisturbed or disturbed habitat*	1	*Can survive and breed in human-disturbed habitats (including grazing and agricultural lands, forests that are intensively managed or planted for timber harvesting and/or urban–suburban environments) without access to undisturbed (natural) habitats.* Can live in disturbed habitat such as forest edges and disturbed forests (Cloyd, 2000; Mittermeier, 2021).
B7. Migratory score (0–1) *Always migratory = 0; non-migratory = 1*	1	*Non-migratory.*
B. ESTABLISHMENT RISK SCORE SUM OF B1- B7 (1–16)	5	**Low establishment risk**

STAGE C: PROBABILITY AN ESTABLISHED SPECIES WILL BECOME A PEST		
C1. Taxonomic group (0–4)	0	*Other taxonomic group.*
C2. Overseas range size including current and past 1000 years, natural and introduced range (0–2) *Estimate the species overseas range size (including current and past 1000 years, natural and introduced range) in millions of square kilometres*	0	*Overseas geographic range less than 10 million square kilometres.* Overseas range estimated to be ess than 1 million km^2. The red-handed tamarin is endemic to a large part of the Guiana Shield, including Suriname, French Guiana, Guyana, and several states of northern Brazil (Amapá, Amazonas, Pará) (Mittermeier et al., 2021).
C3. Diet and feeding (0–3)	1	*Mammal that is a non-strict carnivore (mixed animal-plant matter in diet).* Red-handed tamarins are omnivorous, with a diet that consists of leaves, plant exudates, fruit, flowers, eggs, insects and other arthropods, frogs, spiders, lizards, and nectar (Mittermeier 2021; Cloyd 2000).
C4. Competition with native fauna for tree hollows (0–2)	0	*Does not use tree hollows.*
C5. Overseas environmental pest status (0–3) *Has the species been reported to cause declines in abundance of any native species of plant or animal or cause degradation to any natural communities in any country or region of the world?*	0	*Never reported as an environmental pest in any country or region.* No reference found.
C6. Climate match to areas with susceptible native species or communities (0–5) *Identify any native Australian animal or plant species or communities that could be susceptible to harm by the exotic species if it were to establish a wild population here.*	0	*The species has no grid squares within the highest six climate match classes (ie in classes 10, 9, 8, 7, 6, and 5) that overlap the distribution of any susceptible native species or ecological communities = 0*
C7. Overseas primary production pest status (0–3)	0	*No reports of damage to crops or other primary production in any country or region.*

Has the species been reported to damage crops or other primary production in any country or region of the world?		No reference found of this species being a pest to primary production.
C8. Climate match to susceptible primary production (0–5) *Assess Potential Commodity Impact Scores for each primary production commodity listed in Table 9, based on species' attributes (diet, behaviour, ecology), excluding risk of spreading disease which is addressed in Question C9.* *0 = 0; 1-19 = 1; 20-49 = 2; 50-99 = 3; 100-149 = 4; ≥150 = 5*	0	Total Commodity Damage Score = 0 (see Table 2)
C9. Spread disease (1–2) *Assess the risk that the species could play a role in the spread of disease or parasites to other animals*	2	*All mammals (likely or unknown effect on native species and on livestock and other domestic animals).*
C10. Harm to property (0–3) *Assess the risk that the species could inflict damage on buildings, vehicles, fences, roads, equipment or ornamental gardens by chewing or burrowing or polluting with droppings or nesting material.*	0	*$0.* Nil risk.
C11. Harm to people (0–5) *Assess the risk that, if a wild population established, the species could cause harm to or annoy people. Aggressive behaviour, plus the possession of organs capable of inflicting harm, such as sharp teeth, tusks, claws, spines, a sharp bill, horns, antlers or toxin delivering organs may enable animals to harm people. Any known history of the species attacking, injuring or killing people should also be taken into account (see Stage A, Score A1).*	2	*Injuries, harm or annoyance likely to be minor and few people exposed: Low risk = 2.* Red tamarins have small sharp claws and teeth and are capable of inflicting minor wounds on humans. However, their very small size prevents serious injuries. Bacterial, protozoan, and viral diseases reported in Callitrichids include Salmonella, Shigella, Campylobacter, Yersinia, Pasteurella, Klebsiella, Bordetella and Tularemia and Giardia (Bielle et al 1999; Guerra et al 2016; Laidoudi et al., 2021; Renquist & Whitney, 1987; Siegell-Willott, 2006; Wissman, 2006). This group of Primates are particularly susceptible to *Encephalitozoon cuniculi* (Kvapil et al., 2021), whereas cases of Tuberculosis are infrequent (EAZA, 2017).
C. PEST RISK SCORE	5	**Low pest risk**

SUM C 1 TO C 11 (1–37)		
STAGE A. PUBLIC SAFETY RISK RANK – RISK TO PUBLIC SAFETY POSED BY CAPTIVE OR RELEASED INDIVIDUALS *0 = Not dangerous; 1 = Moderately dangerous; ≥ 2 = Highly dangerous*	0	Not dangerous
STAGE B. ESTABLISHMENT RISK RANK – RISK OF ESTABLISHING A WILD POPULATION **MODEL 1: FOUR-FACTOR MODEL FOR BIRDS AND MAMMALS (BOMFORD 2008)** *≤ 5 = low establishment risk; 6-8 = moderate establishment risk; 9-10 = serious establishment risk; ≥ 11-13 = extreme establishment risk*	2	Low establishment risk
STAGE B. ESTABLISHMENT RISK RANK – RISK OF ESTABLISHING A WILD POPULATION **MODEL 2: SEVEN-FACTOR MODEL FOR BIRDS AND MAMMALS (BOMFORD 2008)** *≤ 6 = low establishment risk; 7-11 = moderate establishment risk; 12-13 = serious establishment risk; ≥14 = extreme establishment risk*	5	Low establishment risk
STAGE C. PEST RISK RANK - RISK OF BECOMING A PEST FOLLOWING ESTABLISHMENT *< 9 = low pest risk; 9-14 = moderate pest risk; 15-19 = serious pest risk; > 19 = extreme pest risk*	5	Low pest risk

ENVIRONMENT AND INVASIVES COMMITTEE THREAT CATEGORY	**LOW**

World distribution map (IUCN Red List) and Climatch world distribution map indicating where meteorological data was sourced for the climate analysis (see B1):

Figure 1 - World Distribution Map - IUCN Red List

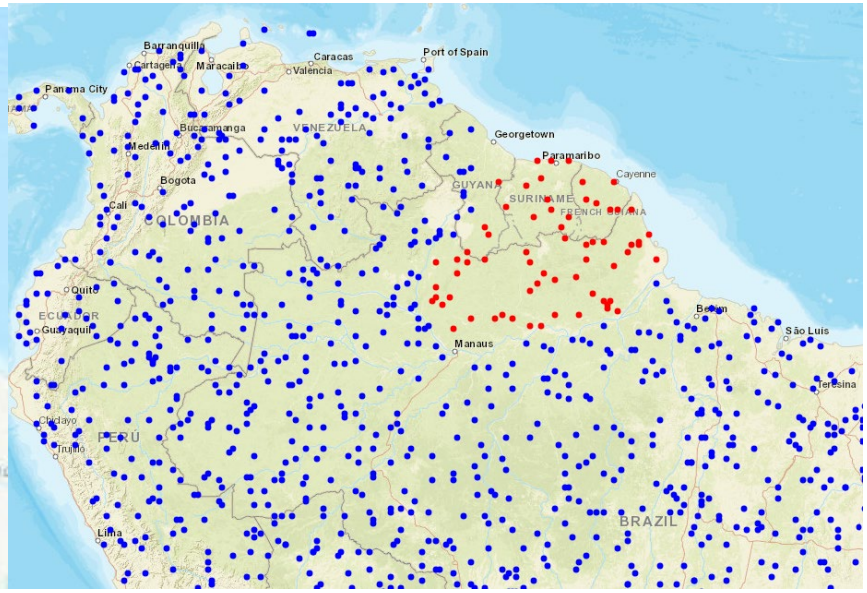
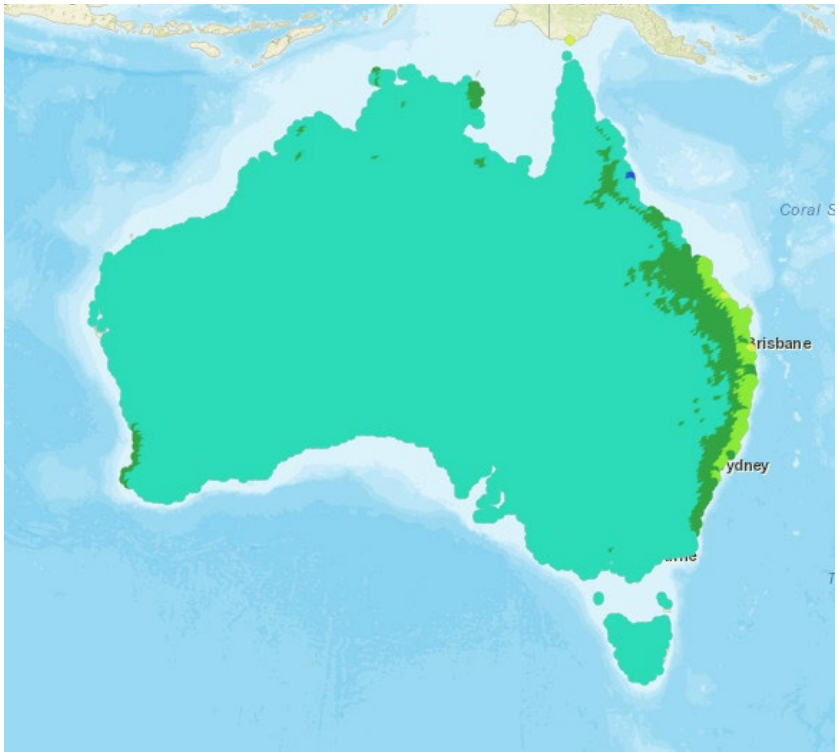


Figure 2 - World Distribution Map - Climatch

Climate match between world distribution of species and Australia:

Areas of Australia where the climate appears suitable for *Kobus ellipsiprymnus*

Value X = 0



Score	Color	Count
0		2
1		18235
2		846
3		149
4		4
5		0
6		0
7		0
8		0
9		0
10		0

Species: Red-handed Tamarin (Saguinus midas)
Algorithm: Closest Standard Score
66 source features selected
19236 target features selected
Approximate selected area: 944,360 km^2

Table 1: ABARES recalibration thresholds

Climate Match Score (CMS)	Climatch (50 km) Closest Standard Match Sum Level 6 (Value X)	2021 Recalibrated Climatch v2.0 (20 km) Closest Standard Match Sum Level 6 (Value X)
1 (Very low)	< 100	< 691
2 (Low)	100-599	691-4137
3 (Moderate)	600-899	4138-6209
4 (High)	900-1699	6210-11735
5 (Very high)	1700-2699	11736-18642
6 (Extreme)	≥ 2700	≥ 18643

Table 2: Susceptible Australian Primary Production – Calculating Total Commodity Damage Score

The commodity value index scores in this table are derived from Australian Bureau of Statistics 1999 – 2000 data. The values will require updating if significant change has occurred in the value of the commodity (Bomford 2008).

Industry	**Commodity Value Index 1 (CVI based on best available date)**	**Potential Commodity Impact Score (PCIS 0-3)**	**Climate Match to Commodity Score (CMCS 0–5)**	**Commodity Damage Score (CDS columns 2 X 3 X 4)**
Sheep (includes wool and sheep meat)	10			
Cattle (includes dairy and beef)	10			
Timber (includes native and plantation forests)	10			
Cereal grain (includes wheat, barley sorghum etc)	10			
Pigs	2			
Poultry and eggs	2			
Aquaculture (includes coastal mariculture)	2			
Cotton	2			
Oilseeds (includes canola, sunflower etc)	2			
Grain legumes (includes soybeans)	2			
Sugarcane	2			
Grapes	2	1	0	0
Other Fruit	2	1	0	0
Vegetables	2			
Nuts	1			
Other livestock (includes goats, deer, camels, rabbits)	1			
Honey and beeswax	1			
Other horticulture (includes flowers etc)	1			
Total Commodity Damage Score (TCDS)				0

Assess Potential Commodity Impact Scores for each primary production commodity listed in Table 9, based on species' attributes (diet, behaviour, ecology), excluding risk of spreading disease which is addressed in Question C9, and pest status worldwide as:

0. *Nil (species does not have attributes to make it capable of damaging this commodity)*
1. *Low (species has attributes making it capable of damaging this or similar commodities and has had the opportunity but no reports or other evidence that it has caused damage in any country or region*
2. *Moderate–serious (reports of damage to this or similar commodities exist but damage levels have never been high in any country or region and no major control programs against the species have ever been conducted OR the species has attributes making it capable of damaging this or similar commodities but has not had the opportunity)*
3. *Extreme (damage occurs at high levels to this or similar commodities and/or major control programs have been conducted against the species in any country or region and the listed commodity would be vulnerable to the type of harm this species can cause).*

Climate Match to Commodity Score (0–5)

- *None of the commodity is produced in areas where the species has a climate match within the highest eight climate match classes (ie classes 10, 9, 8, 7, 6, 5, 4 and 3) = 0*
- *Less than 10% of the commodity is produced in areas where the species has a climate match within the highest eight climate match classes = 1*
- *Less than 10% of the commodity is produced in areas where the species has a climate match within the highest six climate match classes (ie classes 10, 9, 8, 7, 6 and 5) = 2*
- *Less than 50% of the commodity is produced in areas where the species has a climate match within the highest six climate match classes AND less than 10% of the commodity is produced in areas where the species has a climate match within the highest three climate match classes (ie classes 10, 9 and 8) = 3*
- *Less than 50% of the commodity is produced in areas where the species has a climate match within the highest six climate match classes BUT more than 10% of the commodity is produced in areas where the species has a climate match within the highest three climate match classes = 4*
- *OR More than 50% of the commodity is produced in areas where the species has a climate match within the highest six climate match classes BUT less than 20% of the commodity is produced in areas where the species has a climate match within the highest three climate match classes = 4*
- *More than 20% of the commodity is produced in areas where the species has a climate match within the highest three climate match classes OR overseas range unknown and climate match to Australia unknown = 5.]*

Table 3: Assigning species to EIC Threat Categories (shaded cells relate to assignment of reptiles and amphibians to EIC Threat Categories based on an assessed establishment risk and an allocated pest risk of extreme) – adapted from Bomford 2008

Establishment Risk	Pest Risk	Public Safety Risk	EIC Threat Category	Implication for any proposed import into Australia	Implication for keeping and movement in Australia
Extreme	Extreme	Highly, Moderately or Not Dangerous	**EXTREME**	Prohibited, unless sufficient risk management measures exist to reduce the potential risks to an acceptable level	Limited to those collections approved for keeping particular EXTREME Threat species
Extreme	Serious	Highly, Moderately or Not Dangerous	**EXTREME**		
Extreme	Moderate	Highly, Moderately or Not Dangerous	**EXTREME**		
Extreme	Low	Highly, Moderately or Not Dangerous	**EXTREME**		
Serious	Extreme	Highly, Moderately or Not Dangerous	**EXTREME**		
Serious	Serious	Highly, Moderately or Not Dangerous	**EXTREME**		
Moderate	Extreme	Highly, Moderately or Not Dangerous	**EXTREME**		
Serious	Moderate	Highly, Moderately or Not Dangerous	**SERIOUS**	Import restricted to those collections approved for keeping SERIOUS Threat species	Limited to those collections approved for keeping particular SERIOUS Threat species
Serious	Low	Highly, Moderately or Not Dangerous	**SERIOUS**		
Moderate	Serious	Highly, Moderately or Not Dangerous	**SERIOUS**		
Moderate	Moderate	Highly Dangerous	**SERIOUS**		
Moderate	Low	Highly Dangerous	**SERIOUS**		
Low	Extreme	Highly, Moderately or Not Dangerous	**SERIOUS**		
Low	Serious	Highly, Moderately or Not Dangerous	**SERIOUS**		
Low	Moderate	Highly Dangerous	**SERIOUS**		
Low	Low	Highly Dangerous	**SERIOUS**		
Moderate	Moderate	Moderately or Not Dangerous	**MODERATE**	Import restricted to those collections approved for keeping MODERATE Threat species	Limited to those collections approved for keeping particular MODERATE Threat species
Moderate	Low	Moderately or Not Dangerous	**MODERATE**		
Low	Moderate	Moderately or Not Dangerous	**MODERATE**		
Low	Low	Moderately Dangerous	**MODERATE**		
Low	Low	Not Dangerous	**LOW**	Import permitted	May be limited to those collections approved for keeping particular LOW Threat species
Any Value	Any Value	Unknown	**EXTREME until proven otherwise**	Prohibited, unless sufficient risk management measures exist to reduce the potential risks to an acceptable level	Limited to those collections approved for keeping particular EXTREME Threat species
Unknown	Any Value	Any Value	**EXTREME until proven otherwise**		
Any Value	Unknown	Any Value	**EXTREME until proven otherwise**		
Unassessed	Unassessed	Unassessed	**EXTREME until proven otherwise**		

Risk Assessor's details:

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Date:	Oct 2022
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National Risk Assessment: MODERATE

RISK ASSESSMENT FOR AUSTRALIA: Violet-eared Waxbill (*Uraeginthus granatinus*)

Class - Aves**, Order -** Passeriformes**, Family -** Estrildidae**, Genus -** *Uraeginthus*.

SPECIES: *Uraeginthus granatinus* (Linnaeus, 1766) **Synonyms:** *Uraeginthus granatina* (Linnaeus, 1766) *Granatina granatina* (Linnaeus, 1766) **Subspecies:** *Uraeginthus granatinus granatina* (Linnaeus, 1766) *Uraeginthus granatinus retusus* (Clancey, 1961) *Uraeginthus granatinus siccatus* (Clancey, 1959) **Common Names:** Violet-eared Waxbill Common Grenadier	**Species description:** The violet-eared waxbill grows to an average length 14 centimetres and weighs between 9.5-13.9 grams. In males, the crown is deep blue. The back and upperparts are chestnut, rump and upper tail coverts are deep blue and the long graduated tail is black (del Hoyo). **General information:** The violet-eared waxbill is endemic to Southern Africa and can be found in Angola, Namibia, Botswana, Zambia, Zimbabwe, South Africa and Mozambique (Birdlife International, 2016). It is locally common but nowhere numerous (del Hoyo, Elliot and Christie, 2010; Stevenson and Fanshawe, 2002). The violet-eared waxbill inhabits Acacia savannah and thorn thickets, woodland, thickets in regenerating teak forests and cultivation (del Hoyo, Elliot and Christie, 2010). It can also be found in deserts and Xeric shrublands, flooded grasslands and savannas, tropical and subtropical grasslands, savannas, and shrublands (Encyclopedia of Life, 2015). The violet-eared waxbill has a diet of grass seeds and forbs such as *Portulac oleracea* and *Panicum* species. It will also take termites, small caterpillars, ants and beetles, fruits of small trees and flowers of grasses. They feed on the ground, jumping up to take grass stems before going to the ground to remove the seeds (del Hoyo, Elliot and Christie, 2010). The nest of the violet-eared waxbill is a loose ball of grass stems lined with feathers, with side entry, and situated low down to 3 metres in a bush (del Hoyo, Elliot and Christie, 2010). The violet-eared waxbill is a host of brood-parasite species such as the Shaft-tailed whydah (*Vidua regia*) (Hall and Moreau, 1970). The *Vidua* nestlings mimic the mouth pattern and colour of the host species (del Hoyo, Elliot and Christie, 2010). **Longevity:** No record (Tacutu, 2018). **Conservation status:**

	IUCN: Least Concern - This species has an extremely large range, and hence does not approach the thresholds for Vulnerable under the range size criterion (Birdlife International, 2016) **CITES:** Not listed (UNEP-WCMC (Comps.), 2015)
DATE OF ORIGINAL ASSESSMENT: 10/07/2018 **DATE OF CURRENT ASSESSMENT:** Dec 2022 (Jodi Buchecker) **EIC ENDORSEMENT:** 16/06/23 **Risk assessment model used for the assessment:** Bomford 2008, Mammals and Birds	**The risk assessment model:** Models for assessing the risk that exotic vertebrates could establish in Australia have been developed for mammals, birds (Bomford 2003, 2006, 2008), reptiles and amphibians (Bomford et al 2005, Bomford 2008). Developed by Dr Mary Bomford for the Bureau of Rural Sciences (BRS), the model uses criteria that have been demonstrated to have significant correlation between a risk factor and the establishment of populations of exotic species and the pest potential of those species that do establish. For example, a risk factor for establishment is similarity in climate (temperature and rainfall) within the species' distribution overseas and Australia. For pest potential, the species' overseas pest status is a risk factor. The model is published as 'Risk assessment models for the establishment of exotic vertebrates in Australia and New Zealand' (Bomford 2008) and is available online on the PestSmart website https://pestsmart.org.au/wp-content/uploads/sites/3/2020/06/Risk_Assess_Models_2008_FINAL.pdf **CLIMATE**: In 2021 a new version of the Climatch program used to assess similarity in climate was released by the Australian Bureau of Agricultural Resource Economics and Sciences (ABARES): CLIMATCH v2.0. The increase in resolution in this new version (from 50 km to 20 km) required recalibration of Climate Match Scores. See Table 1. Sixteen climate parameters (variables) of temperature and rainfall are used to estimate the extent of similarity between data from meteorological stations located within the species' world distribution and stations in Australia. Worldwide, data from approximately 19000 locations are available for analysis. The number of locations used in an analysis will vary according to the size of the species' distribution and the number of meteorological stations located within that distribution. To represent the climate match visually, the map of Australia is divided into 19236 grid squares, each measured in 0.2 degrees in both longitude and latitude. CLIMATCH v2.0 calculates a match for each Australian grid by comparing data from all meteorological stations within the species' distribution (excluding any populations in Australia) and allocating a score ranging from ten for the highest level match to zero for the poorest match. Levels of climate match are used in the risk assessment for questions B1 (scores are summed to give a cumulative score), C6, and C8. Climatch v2.0 can be accessed on the ABARES website, agriculture.gov.au/abares. The direct URL is https://climatch.cp1.agriculture.gov.au/.

Bird and Mammal Model:

FACTOR	SCORE	DETAIL
STAGE A: RISKS POSED BY CAPTIVE OR RELEASED ANIMALS		

A1. Risk to people from individual escapees (0–2) *Assess the risk that individuals of the species could harm people. (NB, this question only relates to aggressive behaviour shown by escaped or released individual animals. Question C11 addresses the risk of harm from aggressive behaviour if the species establishes a wild population).* *Aggressive behaviour, size, plus the possession of organs capable of inflicting harm, such as sharp teeth, claws, spines, a sharp bill, or toxin-delivering apparatus may enable individual animals to harm people. Any known history of the species attacking, injuring or killing people should also be taken into account. Assume the individual is not protecting nest or young.*	0	*All other animals posing a lower risk of harm to people (i.e. animals that will not make unprovoked attacks causing injury).* The violet-eared waxbill is a small passerine bird weighing 13.9 grams (del Hoyo, Elliot and Christie, 2010).
A2. Risk to public safety from individual captive animals (0–2) *Assess the risk that irresponsible use of products obtained from captive individuals of the species (such as toxins) pose a public safety risk (excluding the safety of anyone entering the animals' cage/enclosure or otherwise coming within reach of the captive animals)*	0	*Nil or low risk (highly unlikely or not possible).*
STAGE A PUBLIC SAFETY RISK SCORE **SUM A1 - A2 (0-4)**	0	**Not dangerous**
STAGE B: PROBABILITY ESCAPED OR RELEASED INDIVIDUALS WILL ESTABLISH FREE-LIVING POPULATIONS		
Model 1: FOUR-FACTOR MODEL FOR BIRDS AND MAMMALS (BOMFORD 2008)		
B1. Degree of climate match between species overseas range and Australia (1–6) *Map the selected mammal or bird species' overseas range, including its entire native and exotic (excluding Australia) ranges over the past 1000 years.* *Use CLIMATCH v2.0, Value X = sum of classes 6 – 10, see Table 1.*	4	*High climate match to Australia* Value X = 8,251 Climate Match Score = 4

B2. Exotic population established overseas (0–4) *An established exotic population means the introduced species must have bred outside of captivity and must currently maintain a viable free-living population where the animals are not being intentionally fed or sheltered, even though they may be living in a highly disturbed environment with access to non-natural food supplies or shelter.*	0	*No exotic population ever established.* No reports of established populations outside its natural range (Birdlife International, 2016; del Hoyo, Elliot and Christie, 2010; Long, 1981).
B3. Overseas range size score (0–2) < 1 = 0; 1– 70 = 1; >70 = 2 *Estimate the species overseas range size* including currently and the past 1000 years; natural and introduced range in millions of square kilometres*	1	*Overseas range between 1-70 million km^2.* The estimated overseas range for the violet-eared waxbill is approximately 3.9 million km^2. This includes current and past 1,000 years, natural and introduced range. The violet-eared waxbill is endemic to Southern Africa and can be found in Angola, Namibia, Botswana, Zambia, Zimbabwe, South Africa and Mozambique (Birdlife International, 2016).
B4. Taxonomic Class (0–1) *Bird = 0; mammal = 1*	0	*Bird*
B. ESTABLISHMENT RISK SCORE **SUM OF B1- B4 (1–13)**	5	**Low establishment risk**
Model 2: Seven-Factor Model For Birds And Mammals (Bomford 2008)		
B5. Diet score (0–1) *Specialist = 0; generalist = 1*	1	*Generalist with a broad diet of many food types.* Diet of grass seeds and forbs such as *Portulac oleracea* and *Panicum* species. It will also take termites, small caterpillars, ants and beetles, fruits of small trees and flowers of grasses. They feed on the ground, jumping up to take grass stems before going to the ground to remove the seeds (del Hoyo, Elliot and Christie, 2010).
B6. Habitat score (0–1) *Undisturbed or disturbed habitat*	1	*Can live in disturbed habitats.* The violet-eared waxbill inhabits Acacia savannah and thorn thickets, woodland, thickets in regenerating teak forests and cultivation (del Hoyo, Elliot and Christie, 2010). It can also

		be found in deserts and Xeric shrublands, flooded grasslands and savannas, tropical and subtropical grasslands, savannas, and shrublands (Encyclopedia of Life, 2015).
B7. Migratory score (0–1) *Always migratory = 0; non-migratory = 1*	1	*Non-migratory.* Resident (del Hoyo, Elliot and Christie, 2010).
B. ESTABLISHMENT RISK SCORE SUM OF B1- B7 (1–16)	8	**Moderate establishment risk**
STAGE C: PROBABILITY AN ESTABLISHED SPECIES WILL BECOME A PEST		
C1. Taxonomic group (0–4)	0	*Other taxonomic group.* Order Passeriformes, Family Estrildidae (ITIS Global, 2018) .
C2. Overseas range size including current and past 1000 years, natural and introduced range (0–2) *Estimate the species overseas range size (including current and past 1000 years, natural and introduced range) in millions of square kilometres*	0	*Overseas geographical range less than 10 million km^2.* Overseas distribution in southern Africa *estimated at 3.9 million km^2* (see B2), (del Hoyo, Elliot and Christie, 2010).
C3. Diet and feeding (0–3)	0	*Not a mammal.*
C4. Competition with native fauna for tree hollows (0–2)	0	*Does not use tree hollows.* Nest is a loose ball of grass stems lined with feathers, with side entry, and situated low down to 3 metres in a bush (del Hoyo, Elliot and Christie, 2010).
C5. Overseas environmental pest status (0–3) *Has the species been reported to cause declines in abundance of any native species of plant or animal or cause degradation to any natural communities in any country or region of the world?*	0	*This species has never been reported as an environmental pest in any country or region.* No reports found.

C6. Climate match to areas with susceptible native species or communities (0–5) *Identify any native Australian animal or plant species or communities that could be susceptible to harm by the exotic species if it were to establish a wild population here.*	5	*The species has more than 138 grid squares within the highest two climate match classes that overlap the distribution of any susceptible native species or ecological communities = 5* Endangered Gouldian Finch (*Erythrura gouldiae*) (with a distribution restricted to the Top End of Western Australia, Northern Territory and Queensland) feeds exclusively on seed from a restricted range of grass species (Dostine and Franklin, 2002; Dostine et.al., 2001; Tidemann, 1996) and susceptible to competition for seed (Barrett et al., 2003, Christidis and Boles, 2008; del Hoyo, Elliot and Christie., 2010) Northern Australian and southern Western Australia finch species (such as Western Bristlebird (*Dasyornis longirostris* – Endagered), Double-barred Finch (*Taeniopygia* bichenovii – Least Concern) and Red-eared Firefinch (*Stagonopleura oculata* – Least Concern)) are potentially at risk from food competition with the violet-eared waxbill.
C7. Overseas primary production pest status (0–3) *Has the species been reported to damage crops or other primary production in any country or region of the world?*	0	*No reports of damage to crops or other primary production in any country or region.* No reports of damage found for this species.
C8. Climate match to susceptible primary production (0–5) *Assess Potential Commodity Impact Scores for each primary production commodity listed in Table 9, based on species' attributes (diet, behaviour, ecology), excluding risk of spreading disease which is addressed in Question C9.* *0 = 0; 1-19 = 1; 20-49 = 2; 50-99 = 3; 100-149 = 4; ≥150 = 5*	2	Total Commodity Damage Score = 24 (see Table 2) The species has similar attributes (diet of seeds, ground feeding) making it capable of damaging cereal and oilseed primary production, as other African ploceid species (including village weavers, sparrows and bishops). These species are known to cause considerable local damage wherever they are abundant (Bruggers and Jaeger, 1981).
C9. Spread disease (1–2) *Assess the risk that the species could play a role in the spread of disease or parasites to other animals*	2	*All birds (likely or unknown effect on native species and on livestock and other domestic animals).*
C10. Harm to property (0–3) *Assess the risk that the species could inflict damage on buildings, vehicles, fences, roads, equipment or ornamental*	0	*$0* No reports of damage to property.

gardens by chewing or burrowing or polluting with droppings or nesting material.		
C11. Harm to people (0–5) *Assess the risk that, if a wild population established, the species could cause harm to or annoy people. Aggressive behaviour, plus the possession of organs capable of inflicting harm, such as sharp teeth, tusks, claws, spines, a sharp bill, horns, antlers or toxin delivering organs may enable animals to harm people. Any known history of the species attacking, injuring or killing people should also be taken into account (see Stage A, Score A1).*	0	*Nil risk* No reports of zoonoses found.
C. PEST RISK SCORE **SUM C 1 TO C 11 (1–37)**	9	**Moderate pest risk**
STAGE A. PUBLIC SAFETY RISK RANK – RISK TO PUBLIC SAFETY POSED BY CAPTIVE OR RELEASED INDIVIDUALS *0 = Not dangerous; 1 = Moderately dangerous; ≥ 2 = Highly dangerous*	0	Not dangerous
STAGE B. ESTABLISHMENT RISK RANK – RISK OF ESTABLISHING A WILD POPULATION **MODEL 1: FOUR-FACTOR MODEL FOR BIRDS AND MAMMALS (BOMFORD 2008)** *≤ 5 = low establishment risk; 6-8 = moderate establishment risk; 9-10 = serious establishment risk; ≥ 11-13 = extreme establishment risk*	5	Low establishment risk
STAGE B. ESTABLISHMENT RISK RANK – RISK OF ESTABLISHING A WILD POPULATION **MODEL 2: SEVEN-FACTOR MODEL FOR BIRDS AND MAMMALS (BOMFORD 2008)** *≤ 6 = low establishment risk; 7-11 = moderate establishment risk; 12-13 = serious establishment risk; ≥14 = extreme establishment risk*	8	Moderate establishment risk

STAGE C. PEST RISK RANK - RISK OF BECOMING A PEST FOLLOWING ESTABLISHMENT *< 9 = low pest risk; 9-14 = moderate pest risk; 15-19 = serious pest risk; > 19 = extreme pest risk*	9	Moderate pest risk

ENVIRONMENT AND INVASIVES COMMITTEE THREAT CATEGORY	**MODERATE**

World distribution map (IUCN Red List and Kirkpatrick) and Climatch world distribution map indicating where meteorological data was sourced for the climate analysis (see B1):

Figure 1 - World Distribution Map - IUCN Red List

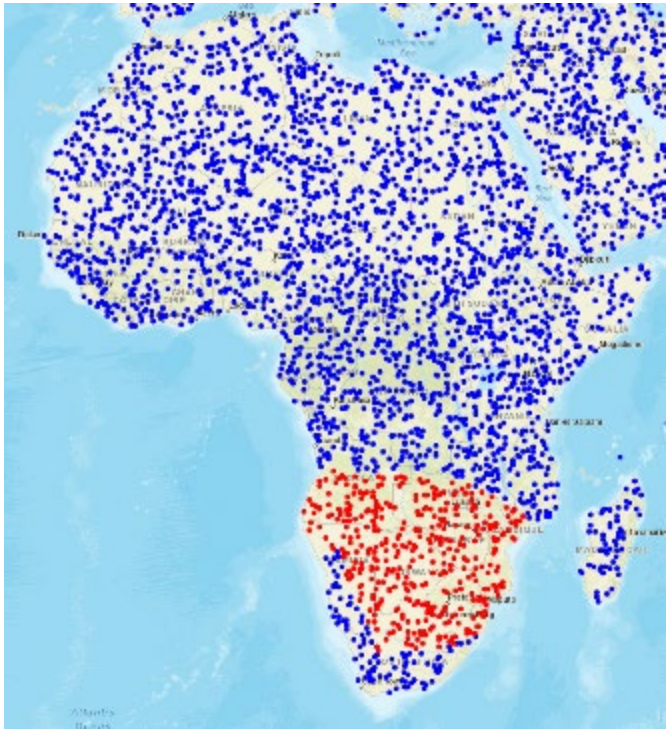
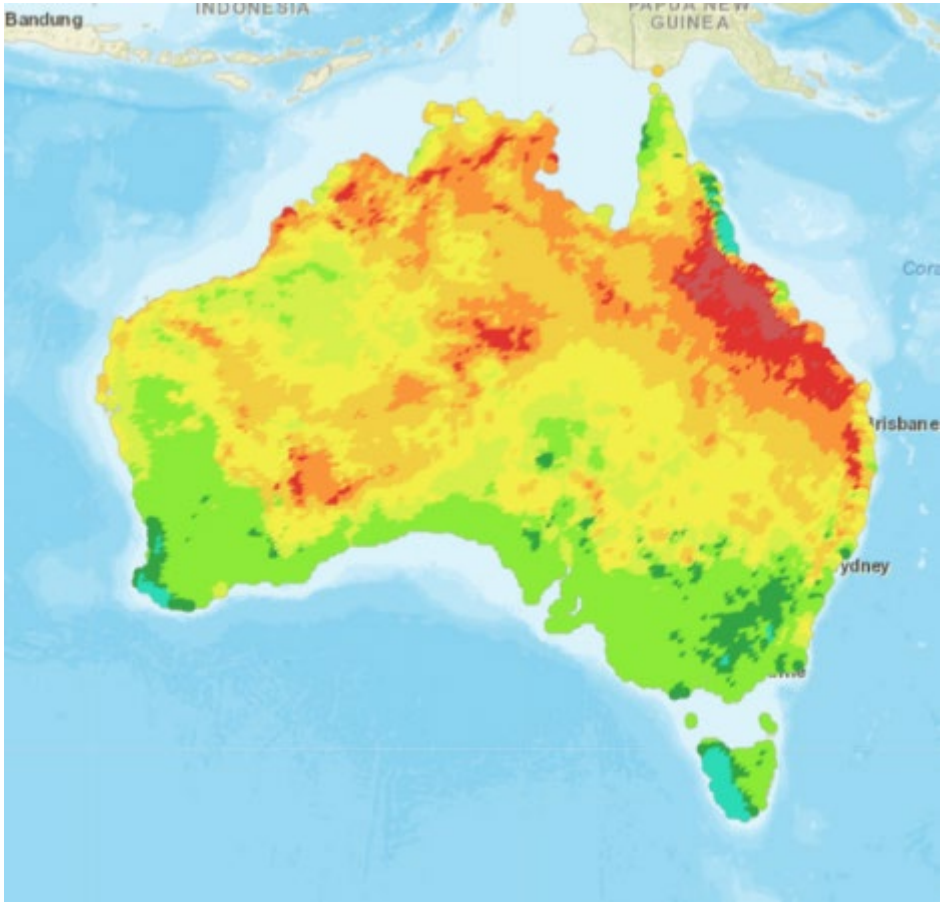


Figure 2 - World Distribution Map - Climatch

Climate match between world distribution of species and Australia:

Areas of Australia where the climate appears suitable for *Uraeginthus granatinus*

Value X = 8,251



Score	Color	Count
0		0
1		124
2		459
3		3202
4		2355
5		4845
6		4576
7		2582
8		830
9		263
10		0

Species: Violet-eared Waxbill (Uraeginthus granatinus)
Algorithm: Closest Standard Score
394 source features selected
19236 target features selected
Approximate selected area: 4,260,928 km^2

Table 1: ABARES recalibration thresholds

Climate Match Score (CMS)	Climatch (50 km) Closest Standard Match Sum Level 6 (Value X)	2021 Recalibrated Climatch v2.0 (20 km) Closest Standard Match Sum Level 6 (Value X)
1 (Very low)	< 100	< 691
2 (Low)	100-599	691-4137
3 (Moderate)	600-899	4138-6209
4 (High)	900-1699	6210-11735
5 (Very high)	1700-2699	11736-18642
6 (Extreme)	≥ 2700	≥ 18643

Table 2: Susceptible Australian Primary Production – Calculating Total Commodity Damage Score

The commodity value index scores in this table are derived from Australian Bureau of Statistics 1999 – 2000 data. The values will require updating if significant change has occurred in the value of the commodity (Bomford 2008).

Industry	**Commodity Value Index 1 (CVI based on best available date)**	**Potential Commodity Impact Score (PCIS 0-3)**	**Climate Match to Commodity Score (CMCS 0–5)**	**Commodity Damage Score (CDS columns 2 X 3 X 4)**
Sheep (includes wool and sheep meat)	10			
Cattle (includes dairy and beef)	10			
Timber (includes native and plantation forests)	10			
Cereal grain (includes wheat, barley sorghum etc)	10	1	2	20
Pigs	2			
Poultry and eggs	2			
Aquaculture (includes coastal mariculture)	2			
Cotton	2			
Oilseeds (includes canola, sunflower etc)	2	1	2	4
Grain legumes (includes soybeans)	2			
Sugarcane	2			
Grapes	2			
Other Fruit	2			
Vegetables	2			
Nuts	1			
Other livestock (includes goats, deer, camels, rabbits)	1			
Honey and beeswax	1			
Other horticulture (includes flowers etc)	1			
Total Commodity Damage Score (TCDS)				24

Assess Potential Commodity Impact Scores for each primary production commodity listed in Table 9, based on species' attributes (diet, behaviour, ecology), excluding risk of spreading disease which is addressed in Question C9, and pest status worldwide as:

0. *Nil (species does not have attributes to make it capable of damaging this commodity)*
1. *Low (species has attributes making it capable of damaging this or similar commodities and has had the opportunity but no reports or other evidence that it has caused damage in any country or region*
2. *Moderate–serious (reports of damage to this or similar commodities exist but damage levels have never been high in any country or region and no major control programs against the species have ever been conducted OR the species has attributes making it capable of damaging this or similar commodities but has not had the opportunity)*
3. *Extreme (damage occurs at high levels to this or similar commodities and/or major control programs have been conducted against the species in any country or region and the listed commodity would be vulnerable to the type of harm this species can cause).*

Climate Match to Commodity Score (0–5)

- *None of the commodity is produced in areas where the species has a climate match within the highest eight climate match classes (ie classes 10, 9, 8, 7, 6, 5, 4 and 3) = 0*
- *Less than 10% of the commodity is produced in areas where the species has a climate match within the highest eight climate match classes = 1*
- *Less than 10% of the commodity is produced in areas where the species has a climate match within the highest six climate match classes (ie classes 10, 9, 8, 7, 6 and 5) = 2*
- *Less than 50% of the commodity is produced in areas where the species has a climate match within the highest six climate match classes AND less than 10% of the commodity is produced in areas where the species has a climate match within the highest three climate match classes (ie classes 10, 9 and 8) = 3*
- *Less than 50% of the commodity is produced in areas where the species has a climate match within the highest six climate match classes BUT more than 10% of the commodity is produced in areas where the species has a climate match within the highest three climate match classes = 4*
- *OR More than 50% of the commodity is produced in areas where the species has a climate match within the highest six climate match classes BUT less than 20% of the commodity is produced in areas where the species has a climate match within the highest three climate match classes = 4*
- *More than 20% of the commodity is produced in areas where the species has a climate match within the highest three climate match classes OR overseas range unknown and climate match to Australia unknown = 5.]*

Table 3: Assigning species to EIC Threat Categories (shaded cells relate to assignment of reptiles and amphibians to EIC Threat Categories based on an assessed establishment risk and an allocated pest risk of extreme) – adapted from Bomford 2008

Establishment Risk	Pest Risk	Public Safety Risk	EIC Threat Category	Implication for any proposed import into Australia	Implication for keeping and movement in Australia
Extreme	Extreme	Highly, Moderately or Not Dangerous	**EXTREME**	Prohibited, unless sufficient risk management measures exist to reduce the potential risks to an acceptable level	Limited to those collections approved for keeping particular EXTREME Threat species
Extreme	Serious	Highly, Moderately or Not Dangerous	**EXTREME**		
Extreme	Moderate	Highly, Moderately or Not Dangerous	**EXTREME**		
Extreme	Low	Highly, Moderately or Not Dangerous	**EXTREME**		
Serious	Extreme	Highly, Moderately or Not Dangerous	**EXTREME**		
Serious	Serious	Highly, Moderately or Not Dangerous	**EXTREME**		
Moderate	Extreme	Highly, Moderately or Not Dangerous	**EXTREME**		
Serious	Moderate	Highly, Moderately or Not Dangerous	**SERIOUS**	Import restricted to those collections approved for keeping SERIOUS Threat species	Limited to those collections approved for keeping particular SERIOUS Threat species
Serious	Low	Highly, Moderately or Not Dangerous	**SERIOUS**		
Moderate	Serious	Highly, Moderately or Not Dangerous	**SERIOUS**		
Moderate	Moderate	Highly Dangerous	**SERIOUS**		
Moderate	Low	Highly Dangerous	**SERIOUS**		
Low	Extreme	Highly, Moderately or Not Dangerous	**SERIOUS**		
Low	Serious	Highly, Moderately or Not Dangerous	**SERIOUS**		
Low	Moderate	Highly Dangerous	**SERIOUS**		
Low	Low	Highly Dangerous	**SERIOUS**		
Moderate	Moderate	Moderately or Not Dangerous	**MODERATE**	Import restricted to those collections approved for keeping MODERATE Threat species	Limited to those collections approved for keeping particular MODERATE Threat species
Moderate	Low	Moderately or Not Dangerous	**MODERATE**		
Low	Moderate	Moderately or Not Dangerous	**MODERATE**		
Low	Low	Moderately Dangerous	**MODERATE**		
Low	Low	Not Dangerous	**LOW**	Import permitted	May be limited to those collections approved for keeping particular LOW Threat species
Any Value	Any Value	Unknown	**EXTREME until proven otherwise**	Prohibited, unless sufficient risk management measures exist to reduce the potential risks to an acceptable level	Limited to those collections approved for keeping particular EXTREME Threat species
Unknown	Any Value	Any Value	**EXTREME until proven otherwise**		
Any Value	Unknown	Any Value	**EXTREME until proven otherwise**		
Unassessed	Unassessed	Unassessed	**EXTREME until proven otherwise**		

Risk Assessor's details:

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Date:	Dec 2022
Reviewers:	Helen Hodgkins, DCCEEW

Adapted from:	RISK ASSESSMENT – Common Grenadier (*Uraeginthus granatinus*) Linnaeus, 1766. Win Kirkpatrick, Invasive Species, Dept of Agriculture and Food, Western Australia (2017)	**By:** Jodi Buchecker	**Date:** Dec 2022

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National Risk Assessment: MODERATE

RISK ASSESSMENT FOR AUSTRALIA: Purple Grenadier (*Uraeginthus ianthinogaster*)

Class - Aves**, Order -** Passeriformes**, Family -** Estrildidae**, Genus -** *Uraeginthus*.

SPECIES: *Uraeginthus ianthinogaster* (Reichenow, 1879) **Synonyms:** *Granatina ianthinogaster* (Reichenow, 1879) (Clements 2014, Avibase Bird Check Lists of the World 2015) **Subspecies:** *G. i. ugandae* (van Somren, 1919) *G. i. roosevelti* (Mearns, 1913) *G. i. hawker* (Lort Phillips, 1898) *G. i. rothschildi* (van Somren, 1919) (Avibase Bird Check Lists of the World, 2015) **Common Names:** Purple Grenadier Purple Waxbill	**Species description:** The purple grenadier grows to a length 13-14.5 centimetres and weighs between 12-17 grams. In males, the crown, upperparts, and sides of the throat are brown in colour. There is a blue stripe which runs from the bill across the top of the eye and the upper cheeks are also blue. The breast, underparts, rump, and upper tail coverts are purplish-blue, with blotches of brown throughout. The wings are dark brown. The tail is black, edged with purplish-blue. The bill is red with a purplish sheen. In females, the overall colour is brown, which is darker on the wings. There are two purple stripes above and below the eyes, with light white spotting. Rows of white spotting also occur on the breast, belly, and flanks. The rump and upper tail coverts are purplish-blue; the tail is black with bluish edging. The bill is also red, but lighter than that of the male. Juveniles are similar to females in colour, but with no markings, and the bill is black (del Hoyo, Elliot and Christie, 2010; Kingston, 1998; Stevenson and Fanshawe, 2002). **General information:** The purple grenadier is native to East Africa. It can be found in Ethiopia, Kenya, Somalia, South Sudan, Sudan, Tanzania and the United Republic of Uganda (BirdLife International 2016). The purple grenadier is found in subtropical and tropical (lowland) dry shrub land in Ethiopia, Kenya, Somalia, South Sudan, Tanzania and Uganda (Encylopedea of Life, 2015). It inhabits open woodland, bush, cultivation, and riverine woodland, and including semi-arid areas, up to 2,300 metres in elevation (del Hoyo, Elliot and Christie, 2010; Stevenson and Fanshawe, 2002). *U. ianthinogaster* along with *U. granatina* (Violet-eared Waxbill) are more confined to thorn country than other members of the genus (excepting *U. cyanocepahus* (Blue-capped cordon-bleu), penetrating into more arid steppe country of Somalia and the Kalahari Desert (Hall and Moreau, 1970). The purple grenadier is common within its range but can be secretive in habit (del Hoyo, Elliot and Christie, 2010; Stevenson and Fanshawe, 2002) Diet of small grass seeds and termites. The purple grenadier feeds on the ground and in thickets, in pairs and small groups (del Hoyo, Elliot and Christie, 2010).

	Builds a dome-shaped nest made of grass stems and lined with feathers, in a fork of a low bush, or under tall grass under a bush. The nest has side entrances and sometimes a spout (del Hoyo, Elliot and Christie, 2010). The purple grenadier nests will hosts brood-parasite species *Vidua fisheri* (Straw-tailed Whydah) and *V. regia* (Shaft-tailed Whydah) (Hall and Moreau, 1970). The *Vidua* species' nestlings mimic the mouth pattern and colour of the host species (del Hoyo, Elliot and Christie, 2010). **Longevity:** No record for wild birds (Tacutu, 2013). **Conservation status:** **IUCN:** Least Concern - This species has an extremely large range, and hence does not approach the thresholds for Vulnerable under the range size criterion (BirdLife International, 2016). **CITES:** Not listed (UNEP-WCMC, 2015)
DATE OF ORIGINAL ASSESSMENT: 26/04/2018 **DATE OF CURRENT ASSESSMENT:** Dec 2022 (Jodi Buchecker) **EIC ENDORSEMENT:** 16/06/23 **Risk assessment model used for the assessment:** Bomford 2008, Mammals and Birds	**The risk assessment model:** Models for assessing the risk that exotic vertebrates could establish in Australia have been developed for mammals, birds (Bomford 2003, 2006, 2008), reptiles and amphibians (Bomford et al 2005, Bomford 2008). Developed by Dr Mary Bomford for the Bureau of Rural Sciences (BRS), the model uses criteria that have been demonstrated to have significant correlation between a risk factor and the establishment of populations of exotic species and the pest potential of those species that do establish. For example, a risk factor for establishment is similarity in climate (temperature and rainfall) within the species' distribution overseas and Australia. For pest potential, the species' overseas pest status is a risk factor. The model is published as 'Risk assessment models for the establishment of exotic vertebrates in Australia and New Zealand' (Bomford 2008) and is available online on the PestSmart website https://pestsmart.org.au/wp-content/uploads/sites/3/2020/06/Risk_Assess_Models_2008_FINAL.pdf **CLIMATE**: In 2021 a new version of the Climatch program used to assess similarity in climate was released by the Australian Bureau of Agricultural Resource Economics and Sciences (ABARES): CLIMATCH v2.0. The increase in resolution in this new version (from 50 km to 20 km) required recalibration of Climate Match Scores. See Table 1. Sixteen climate parameters (variables) of temperature and rainfall are used to estimate the extent of similarity between data from meteorological stations located within the species' world distribution and stations in Australia. Worldwide, data from approximately 19000 locations are available for analysis. The number of locations used in an analysis will vary according to the size of the species' distribution and the number of meteorological stations located within that distribution. To represent the climate match visually, the map of Australia is divided into 19236 grid squares, each measured in 0.2 degrees in both longitude and latitude.

	CLIMATCH v2.0 calculates a match for each Australian grid by comparing data from all meteorological stations within the species' distribution (excluding any populations in Australia) and allocating a score ranging from ten for the highest level match to zero for the poorest match. Levels of climate match are used in the risk assessment for questions B1 (scores are summed to give a cumulative score), C6, and C8. Climatch v2.0 can be accessed on the ABARES website, agriculture.gov.au/abares. The direct URL is https://climatch.cp1.agriculture.gov.au/.

Bird and Mammal Model:

FACTOR	SCORE	DETAIL
STAGE A: RISKS POSED BY CAPTIVE OR RELEASED ANIMALS		
A1. Risk to people from individual escapees (0–2) *Assess the risk that individuals of the species could harm people. (NB, this question only relates to aggressive behaviour shown by escaped or released individual animals. Question C11 addresses the risk of harm from aggressive behaviour if the species establishes a wild population).* *Aggressive behaviour, size, plus the possession of organs capable of inflicting harm, such as sharp teeth, claws, spines, a sharp bill, or toxin-delivering apparatus may enable individual animals to harm people. Any known history of the species attacking, injuring or killing people should also be taken into account. Assume the individual is not protecting nest or young.*	0	*All other animals posing a lower risk of harm to people (i.e. animals that will not make unprovoked attacks causing injury).* The purple grenadier is a small passerine bird weighing between 12-17 grams (del Hoyo, Elliot and Christie, 2010).
A2. Risk to public safety from individual captive animals (0–2) *Assess the risk that irresponsible use of products obtained from captive individuals of the species (such as toxins) pose a public safety risk (excluding the safety of anyone entering the animals' cage/enclosure or otherwise coming within reach of the captive animals)*	0	*Nil or low risk (highly unlikely or not possible).*
STAGE A PUBLIC SAFETY RISK SCORE	0	**Not dangerous**

SUM A1 - A2 (0-4)		
STAGE B: PROBABILITY ESCAPED OR RELEASED INDIVIDUALS WILL ESTABLISH FREE-LIVING POPULATIONS		
Model 1: FOUR-FACTOR MODEL FOR BIRDS AND MAMMALS (BOMFORD 2008)		
B1. Degree of climate match between species overseas range and Australia (1–6) *Map the selected mammal or bird species' overseas range, including its entire native and exotic (excluding Australia) ranges over the past 1000 years.* *Use CLIMATCH v2.0, Value X = sum of classes 6 – 10, see Table 1.*	2	*Low climate match to Australia* Value X = 3,625 Climate Match Score = 2
B2. Exotic population established overseas (0–4) *An established exotic population means the introduced species must have bred outside of captivity and must currently maintain a viable free-living population where the animals are not being intentionally fed or sheltered, even though they may be living in a highly disturbed environment with access to non-natural food supplies or shelter.*	0	*No exotic population ever established.* No reports of the purple grenadier establishing populations outside its natural range (BirdLife International, 2016; del Hoyo, Elliot and Christie, 2010; Long, 1981).
B3. Overseas range size score (0–2) < 1 = 0; 1– 70 = 1; >70 = 2 *Estimate the species overseas range size* including currently and the past 1000 years; natural and introduced range in millions of square kilometres*	1	*Overseas range between 1-70 million km^2.* The estimated overseas range including current and past 1, 000 years, natural and introduced range is 1.5 million km^2. Native to East Africa - Ethiopia; Kenya; Somalia; South Sudan; Sudan; Tanzania, United Republic of Uganda (BirdLife International 2016). Found in subtropical and tropical (lowland) dry shrub land in Ethiopia, Kenya, Somalia, South Sudan, Tanzania and Uganda with an estimated global extent of occurrence of 1,500,000 km² (Encylopedea of Life, 2015).
B4. Taxonomic Class (0–1) *Bird = 0; mammal = 1*	0	*Bird*
B. ESTABLISHMENT RISK SCORE **SUM OF B1- B4 (1–13)**	3	**Low establishment risk**

Model 2: Seven-Factor Model For Birds And Mammals (Bomford 2008)		
B5. Diet score (0–1) *Specialist = 0; generalist = 1*	1	*Generalist with a broad diet of many food types.* Diet of small grass seeds and termites. The purple grenadier feeds on the ground and in thickets, in pairs and small groups (del Hoyo, Elliot and Christie, 2010).
B6. Habitat score (0–1) *Undisturbed or disturbed habitat*	1	*Can live in disturbed habitats.* The purple grenadier inhabits open woodland, bush, cultivation, and riverine woodland, and including semi-arid areas, up to 2,300 metres in elevation (del Hoyo, Elliot and Christie, 2010; Stevenson and Fanshawe, 2002). *U. ianthinogaster* along with *U. granatina* (Violet-eared Waxbill) are more confined to thorn country than other members of the genus (excepting *U. cyanocepahus* (Blue-capped cordon-bleu), penetrating into more arid steppe country of Somalia and the Kalahari Desert (Hall and Moreau, 1970). The purple grenadier can become quite tame around human habitation (Kingston, 1998).
B7. Migratory score (0–1) *Always migratory = 0; non-migratory = 1*	1	*Non-migratory.* Resident (del Hoyo, Elliot and Christie, 2010).
B. ESTABLISHMENT RISK SCORE SUM OF B1- B7 (1–16)	6	**Low establishment risk**
STAGE C: PROBABILITY AN ESTABLISHED SPECIES WILL BECOME A PEST		
C1. Taxonomic group (0–4)	0	*Other taxonomic group.* Order Passeriformes, Family Estrildidae (ITIS, 2018).
C2. Overseas range size including current and past 1000 years, natural and introduced range (0–2) *Estimate the species overseas range size (including current and past 1000 years, natural and introduced range) in millions of square kilometres*	0	*Overseas geographical range less than 10 million km^2.* Overseas distribution in eastern Africa estimated at 1.5 million km^2 (del Hoyo, Elliot and Christie, 2010) (see B3 for details).

C3. Diet and feeding (0–3)	0	*Not a mammal.*
C4. Competition with native fauna for tree hollows (0–2)	0	*Does not use tree hollows.* Builds a dome-shaped nest made of grass stems and lined with feathers, in a fork of a low bush, or under tall grass under a bush. The nest has side entrances and sometimes a spout (del Hoyo, Elliot and Christie, 2010).
C5. Overseas environmental pest status (0–3) *Has the species been reported to cause declines in abundance of any native species of plant or animal or cause degradation to any natural communities in any country or region of the world?*	0	*This species has never been reported as an environmental pest in any country or region* No reports found.
C6. Climate match to areas with susceptible native species or communities (0–5) *Identify any native Australian animal or plant species or communities that could be susceptible to harm by the exotic species if it were to establish a wild population here.*	5	*The species has more than 139 grid squares within the highest two climate match classes that overlap the distribution of any susceptible native species or ecological communities = 5.* Endangered Gouldian Finch (*Erythrura gouldiae*) (with a distribution restricted to the Top End of Western Australia, Northern Territory and Queensland) feeds exclusively on seed from a restricted range of grass species (Dostine and Franklin, 2002; Dostine et.al., 2001; Tidemann, 1996) and would be susceptible to competition from the purple grenadier for seed (Barrett et al., 2003, Christidis and Boles, 2008; del Hoyo, Elliot and Christie., 2010) Northern Australian and southern Western Australia finch species (such as Western Bristlebird (*Dasyornis longirostris* – Endagered), Double-barred Finch (*Taeniopygia* bichenovii – Least Concern) and Red-eared Firefinch (*Stagonopleura oculata* – Least Concern)) are potentially at risk from food competition with the purple grenadier.
C7. Overseas primary production pest status (0–3) *Has the species been reported to damage crops or other primary production in any country or region of the world?*	0	*No reports of damage to crops or other primary production in any country or region.* No reports of damage found for this species.

C8. Climate match to susceptible primary production (0–5) *Assess Potential Commodity Impact Scores for each primary production commodity listed in Table 9, based on species' attributes (diet, behaviour, ecology), excluding risk of spreading disease which is addressed in Question C9.* *0 = 0; 1-19 = 1; 20-49 = 2; 50-99 = 3; 100-149 = 4; ≥150 = 5*	2	Total Commodity Damage Score = 24 (see Table 2) The purple grenadier has similar attributes (diet of seeds, ground feeding) making it capable of damaging cereal and oilseed primary production, as other African ploceid species (including village weavers, sparrows and bishops). These species are known to cause considerable local damage wherever they are abundant (Bruggers and Jaeger, 1981).
C9. Spread disease (1–2) *Assess the risk that the species could play a role in the spread of disease or parasites to other animals*	2	*All birds (likely or unknown effect on native species and on livestock and other domestic animals).*
C10. Harm to property (0–3) *Assess the risk that the species could inflict damage on buildings, vehicles, fences, roads, equipment or ornamental gardens by chewing or burrowing or polluting with droppings or nesting material.*	0	*$0.* No reports of damage to property.
C11. Harm to people (0–5) *Assess the risk that, if a wild population established, the species could cause harm to or annoy people. Aggressive behaviour, plus the possession of organs capable of inflicting harm, such as sharp teeth, tusks, claws, spines, a sharp bill, horns, antlers or toxin delivering organs may enable animals to harm people. Any known history of the species attacking, injuring or killing people should also be taken into account (see Stage A, Score A1).*	0	*Nil risk.* No reports of zoonoses found.
C. PEST RISK SCORE **SUM C 1 TO C 11 (1–37)**	9	**Moderate pest risk**
STAGE A. PUBLIC SAFETY RISK RANK – RISK TO PUBLIC SAFETY POSED BY CAPTIVE OR RELEASED INDIVIDUALS *0 = Not dangerous; 1 = Moderately dangerous; ≥ 2 = Highly dangerous*	0	Not dangerous

STAGE B. ESTABLISHMENT RISK RANK – RISK OF ESTABLISHING A WILD POPULATION **MODEL 1: FOUR-FACTOR MODEL FOR BIRDS AND MAMMALS (BOMFORD 2008)** *≤ 5 = low establishment risk; 6-8 = moderate establishment risk; 9-10 = serious establishment risk; ≥ 11-13 = extreme establishment risk*	3	Low establishment risk
STAGE B. ESTABLISHMENT RISK RANK – RISK OF ESTABLISHING A WILD POPULATION **MODEL 2: SEVEN-FACTOR MODEL FOR BIRDS AND MAMMALS (BOMFORD 2008)** *≤ 6 = low establishment risk; 7-11 = moderate establishment risk; 12-13 = serious establishment risk; ≥14 = extreme establishment risk*	6	Low establishment risk
STAGE C. PEST RISK RANK - RISK OF BECOMING A PEST FOLLOWING ESTABLISHMENT *< 9 = low pest risk; 9-14 = moderate pest risk; 15-19 = serious pest risk; > 19 = extreme pest risk*	9	Moderate pest risk

ENVIRONMENT AND INVASIVES COMMITTEE THREAT CATEGORY	**MODERATE**

World distribution map (IUCN Red List) and World distribution map indicating where meteorological data was sourced for the climate analysis (see B1):

Figure 1 - World Distribution Map - IUCN Red List

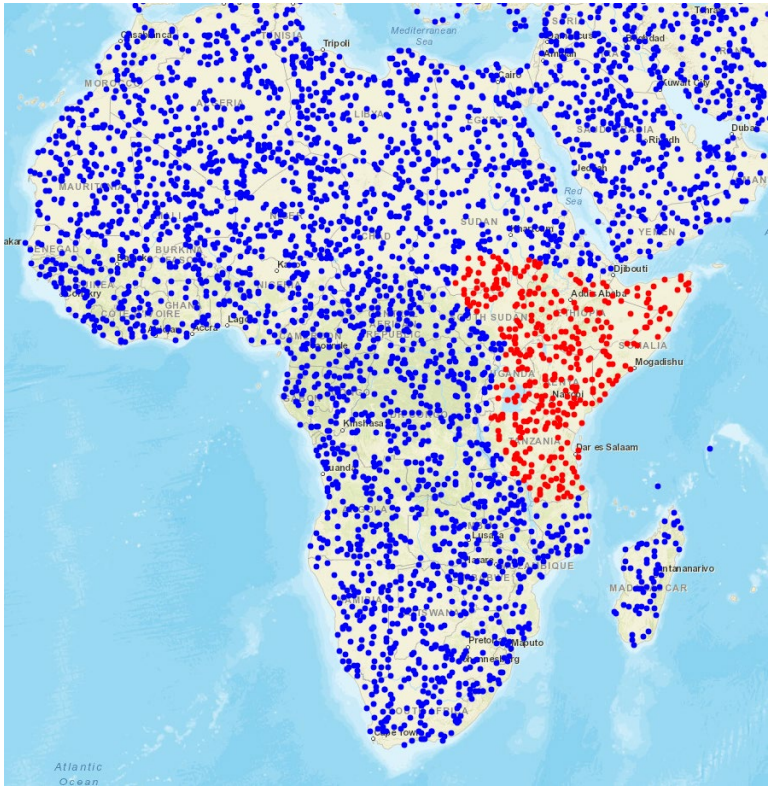
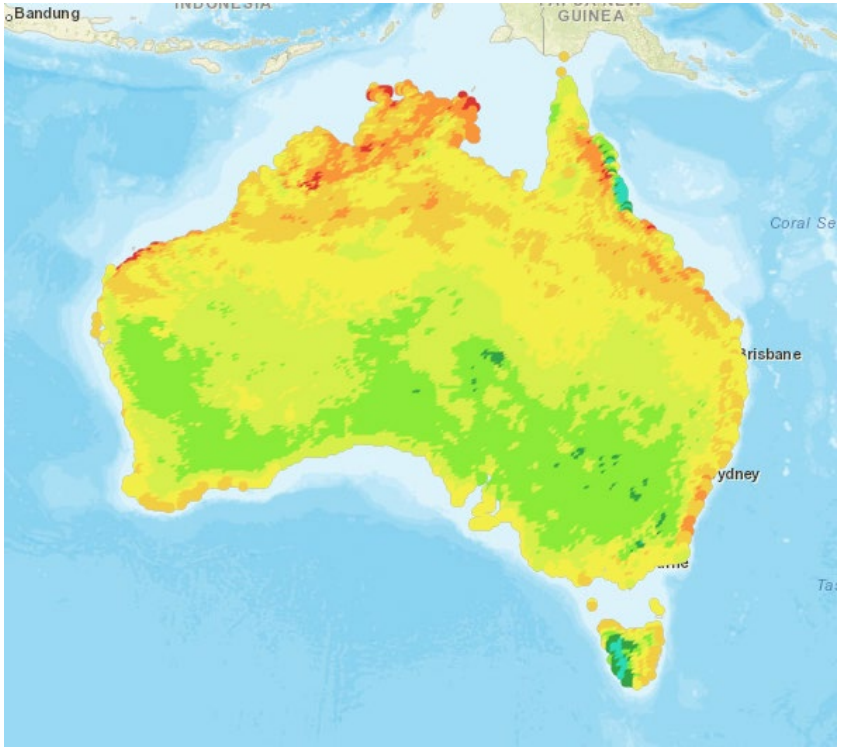


Figure 2 - World Distribution Map - Climatch

Climate match between world distribution of species and Australia:

Areas of Australia where the climate appears suitable for *Uraeginthus ianthinogaster*

Value X = 3,625



Score	Color	Count
0		0
1		40
2		101
3		4325
4		5388
5		5757
6		2888
7		677
8		58
9		2
10		0

Species: Purple Grenadier (Uraeginthus ianthinogaster)
Algorithm: Closest Standard Score
385 source features selected
19236 target features selected
Approximate selected area: 4,243,904 km^2

Table 1: ABARES recalibration thresholds

Climate Match Score (CMS)	Climatch (50 km) Closest Standard Match Sum Level 6 (Value X)	2021 Recalibrated Climatch v2.0 (20 km) Closest Standard Match Sum Level 6 (Value X)
1 (Very low)	< 100	< 691
2 (Low)	100-599	691-4137
3 (Moderate)	600-899	4138-6209
4 (High)	900-1699	6210-11735
5 (Very high)	1700-2699	11736-18642
6 (Extreme)	≥ 2700	≥ 18643

Table 2: Susceptible Australian Primary Production – Calculating Total Commodity Damage Score

The commodity value index scores in this table are derived from Australian Bureau of Statistics 1999 – 2000 data. The values will require updating if significant change has occurred in the value of the commodity (Bomford 2008).

Industry	**Commodity Value Index 1 (CVI based on best available date)**	**Potential Commodity Impact Score (PCIS 0-3)**	**Climate Match to Commodity Score (CMCS 0–5)**	**Commodity Damage Score (CDS columns 2 X 3 X 4)**
Sheep (includes wool and sheep meat)	10			
Cattle (includes dairy and beef)	10			
Timber (includes native and plantation forests)	10			
Cereal grain (includes wheat, barley sorghum etc)	10	1	2	20
Pigs	2			
Poultry and eggs	2			
Aquaculture (includes coastal mariculture)	2			
Cotton	2			
Oilseeds (includes canola, sunflower etc)	2	1	2	4
Grain legumes (includes soybeans)	2			
Sugarcane	2			
Grapes	2			
Other Fruit	2			
Vegetables	2			
Nuts	1			
Other livestock (includes goats, deer, camels, rabbits)	1			
Honey and beeswax	1			
Other horticulture (includes flowers etc)	1			
Total Commodity Damage Score (TCDS)				24

Assess Potential Commodity Impact Scores for each primary production commodity listed in Table 9, based on species' attributes (diet, behaviour, ecology), excluding risk of spreading disease which is addressed in Question C9, and pest status worldwide as:

0. *Nil (species does not have attributes to make it capable of damaging this commodity)*
1. *Low (species has attributes making it capable of damaging this or similar commodities and has had the opportunity but no reports or other evidence that it has caused damage in any country or region*
2. *Moderate–serious (reports of damage to this or similar commodities exist but damage levels have never been high in any country or region and no major control programs against the species have ever been conducted OR the species has attributes making it capable of damaging this or similar commodities but has not had the opportunity)*
3. *Extreme (damage occurs at high levels to this or similar commodities and/or major control programs have been conducted against the species in any country or region and the listed commodity would be vulnerable to the type of harm this species can cause).*

Climate Match to Commodity Score (0–5)

- *None of the commodity is produced in areas where the species has a climate match within the highest eight climate match classes (ie classes 10, 9, 8, 7, 6, 5, 4 and 3) = 0*
- *Less than 10% of the commodity is produced in areas where the species has a climate match within the highest eight climate match classes = 1*
- *Less than 10% of the commodity is produced in areas where the species has a climate match within the highest six climate match classes (ie classes 10, 9, 8, 7, 6 and 5) = 2*
- *Less than 50% of the commodity is produced in areas where the species has a climate match within the highest six climate match classes AND less than 10% of the commodity is produced in areas where the species has a climate match within the highest three climate match classes (ie classes 10, 9 and 8) = 3*
- *Less than 50% of the commodity is produced in areas where the species has a climate match within the highest six climate match classes BUT more than 10% of the commodity is produced in areas where the species has a climate match within the highest three climate match classes = 4*
- *OR More than 50% of the commodity is produced in areas where the species has a climate match within the highest six climate match classes BUT less than 20% of the commodity is produced in areas where the species has a climate match within the highest three climate match classes = 4*
- *More than 20% of the commodity is produced in areas where the species has a climate match within the highest three climate match classes OR overseas range unknown and climate match to Australia unknown = 5.]*

Table 3: Assigning species to EIC Threat Categories (shaded cells relate to assignment of reptiles and amphibians to EIC Threat Categories based on an assessed establishment risk and an allocated pest risk of extreme) – adapted from Bomford 2008

Establishment Risk	Pest Risk	Public Safety Risk	EIC Threat Category	Implication for any proposed import into Australia	Implication for keeping and movement in Australia
Extreme	Extreme	Highly, Moderately or Not Dangerous	**EXTREME**	Prohibited, unless sufficient risk management measures exist to reduce the potential risks to an acceptable level	Limited to those collections approved for keeping particular EXTREME Threat species
Extreme	Serious	Highly, Moderately or Not Dangerous	**EXTREME**		
Extreme	Moderate	Highly, Moderately or Not Dangerous	**EXTREME**		
Extreme	Low	Highly, Moderately or Not Dangerous	**EXTREME**		
Serious	Extreme	Highly, Moderately or Not Dangerous	**EXTREME**		
Serious	Serious	Highly, Moderately or Not Dangerous	**EXTREME**		
Moderate	Extreme	Highly, Moderately or Not Dangerous	**EXTREME**		
Serious	Moderate	Highly, Moderately or Not Dangerous	**SERIOUS**	Import restricted to those collections approved for keeping SERIOUS Threat species	Limited to those collections approved for keeping particular SERIOUS Threat species
Serious	Low	Highly, Moderately or Not Dangerous	**SERIOUS**		
Moderate	Serious	Highly, Moderately or Not Dangerous	**SERIOUS**		
Moderate	Moderate	Highly Dangerous	**SERIOUS**		
Moderate	Low	Highly Dangerous	**SERIOUS**		
Low	Extreme	Highly, Moderately or Not Dangerous	**SERIOUS**		
Low	Serious	Highly, Moderately or Not Dangerous	**SERIOUS**		
Low	Moderate	Highly Dangerous	**SERIOUS**		
Low	Low	Highly Dangerous	**SERIOUS**		
Moderate	Moderate	Moderately or Not Dangerous	**MODERATE**	Import restricted to those collections approved for keeping MODERATE Threat species	Limited to those collections approved for keeping particular MODERATE Threat species
Moderate	Low	Moderately or Not Dangerous	**MODERATE**		
Low	Moderate	Moderately or Not Dangerous	**MODERATE**		
Low	Low	Moderately Dangerous	**MODERATE**		
Low	Low	Not Dangerous	**LOW**	Import permitted	May be limited to those collections approved for keeping particular LOW Threat species
Any Value	Any Value	Unknown	**EXTREME until proven otherwise**	Prohibited, unless sufficient risk management measures exist to reduce the potential risks to an acceptable level	Limited to those collections approved for keeping particular EXTREME Threat species
Unknown	Any Value	Any Value	**EXTREME until proven otherwise**		
Any Value	Unknown	Any Value	**EXTREME until proven otherwise**		
Unassessed	Unassessed	Unassessed	**EXTREME until proven otherwise**		

Risk Assessor's details:

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Date:	Dec 2022
Reviewers:	Rachel Robbins, DCCEEW

Adapted from:	RISK ASSESSMENT - Purple Grenadier (*Uraeginthus ianthinogaster*) Reichenow, 1879. Win Kirkpatrick, Invasive Species, Dept of Agriculture and Food, Western Australia (2017)	**By:** Jodi Buchecker	**Date:** Dec 2022

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