Contents

National Risk Assessment: SERIOUS

RISK ASSESSMENT FOR AUSTRALIA: **Redpoll (*Acanthis flammea*)**

Class - Aves**, Order -** Passeriformes**, Family -** Fringillidae**, Genus -** *Acanthis*.

SPECIES: *Acanthis flammea* (Linnaeus, 1758) **Synonyms:** *Carduelis flammea* (Linnaeus, 1758) *Fringilla flammea* (Linnaeus, 1758) *Acanthis linaria* (Linnaeus, 1758) *Carduelis rostrata* (Coues, 1861) *Carduelis islandica* (Hantzsch, 1904) *Acanthis islandica* (Hantzsch, 1904) *Acanthis hornemanni* (Holbøll, 1843) *Carduelis hornemanni* (Holbøll, 1843) *Carduelis cabaret* (Müller, 1776) *Acanthis cabaret* (Müller, 1776) *Fringilla carduelis* (Linnaeus, 1758) **Subspecies:** *Acanthis flammea flammea* (Mealy Redpoll) (Linnaeus, 1758) *Acanthis flammea rostrata* (Greenland Redpoll) (Coues, 1861) *Acanthis flammea cabaret* (Müller, 1776) *Acanthis flammea islandica* (restricted to dark birds breeding in Iceland, may not be a valid subspecies) (Hantzsch, 1904) *Acanthis flammea exilipes* (Coues, 1862)	**Species description:** The redpoll is a small finch, 12-14 centimetres long and weighing 10-17 grams (del Hoyo et al., 2010). The upperparts are grey, brown with black streaks, two buff coloured wing bars, dark streaks on the whitish flanks, and a dark brown forked tail. The bill is small, conical and yellow with a black tip. The legs and feet are dark. This species is sexually dimorphic. Males have a bright red cap on the forehead and a small black patch under the chin and surrounding the bill. A pink or red wash on the chest and flanks is highly variable, and the underparts are white with brown streaks (NZ Birds, 2011; Cornell University, 2011). Females are similar to males but have less red wash on the chest and the cap is noticeably duller. In the summer, redpolls are duller and rarely have any pink in their plumage (Mayntz, 2001). Immature males resemble adult females (Cornell University, 2011). There are two breeding subspecies in North America. The small-billed and smaller *A.f. flammea* has less coarse streaking and is widespread across Canada to Alaska. The large-billed and larger *A.f. rostrata* has coarser streaking underneath and is found on Baffin Island and Greenland. Redpolls are busy, acrobatic little finches, spending much of their time flitting about, feeding and calling. Even at rest, much fidgeting and twittering is evident (Knox, 2000). They are highly social birds, particularly during the non-breeding season when they aggregate into flocks, often with other species of finches (Novel Guide, 2011). **General information:** This species is very wide-ranging with a circumboreal distribution in northern North America and northern Eurasia. It occurs in Newfoundland, northern Quebec and Labrador (Canadian provinces), across the rest of northern Canada to Alaska, and through Siberia and northern Russia to northern Europe and Iceland. It is an irregular migrant to lower latitudes in the winter and may occur as far south in the United States as California, Oklahoma, and the Carolinas, throughout southern Europe, Russia, the Caucasus, and central China. During the summer, redpolls are found in boreal and taiga regions of both the Old and New World Arctic, where they are often among the most common breeding passerines. In North America, their distribution shows significant overlap with human populations only in winter, and then only in alternating irruption

Acanthis flammea hornemanni (Holbøll, 1843) **Common Names:** Common Redpoll Redpoll Lesser Redpoll Mealy Redpoll Greenland Redpoll North-western Redpoll Hoary Redpoll	years. The irruption cycle is driven by widespread failure in seed-crop production among high-latitude tree species, especially spruce (*Picea* species) and birch (*Betula* species), which forces these birds to winter farther south (Knox, 2000). These irruptions can take the redpoll as far south as southern Canada, the northern United States of America and most of Eurasia. These birds are remarkably resistant to cold temperatures and winter movements are mainly driven by the availability of food (del Hoyo et al., 2010). Redpolls occur from sea-level up to 200 metres in Greenland, up to 1,100 metres in Russia, up to 1,350 metres in Alaska, and in the southern Russian Republic of Altai, they breed in alpine meadows between 1,850 and 2,100 metres. In the non-breeding season, they occur in similar habitats of coastal and lowland open birch woods, heaths and commons (del Hoyo et al., 2010). Redpolls were introduced into New Zealand and are now widespread throughout the North and South Islands, as well as offshore islands. The redpoll is also found on Kermadec, Chatham, Snares, Antipodes, Auckland, Campbell (New Zealand), Lord Howe and Macquarie Islands (Australia). The geographic range of the redpoll is estimated around 18,700,000 square kilometres (Birdlife International, 2009). Redpolls feed mainly on seeds, buds and small invertebrates. Wintering birds in Alaska, where temperatures drop to -62 degrees Centigrade, need to forage up to 8.5 hours per day to sustain energy levels. Redpolls forage in trees, low vegetation and seeding plants and on the ground. In the northern tundra, they forage in low vegetation and on the ground throughout the year. Elsewhere, they usually feed on the ground in autumn and winter when the tree seeds are finished or fallen. In Alaska, they forage in holes in or under the snow. They actively and acrobatically cling to and hang upside-down on cones, catkins and outermost twigs, and perch nimbly on vertical and bent twigs. They feed singly, in pairs and in small groups. In the non-breeding season, they may form flocks of up to several hundred individuals, and exceptionally larger flocks in severe weather and at preferred foraging areas (del Hoyo et al., 2010). Individuals move up to 20 kilometres while foraging during breeding season (Nature Serve Explorer, 2010). The age at first breeding is 1 year. The redpoll breeding season is in late April to August. In the north of the breeding range, they raise a single brood and elsewhere two broods (possibly only in years with a good food supply). Redpolls are mostly monogamous, although very occasionally polygamous. They are solitary or very loosely colonial. Pair formation takes place before break-up of the winter flock, and pair-bonding endures for a single season. Clutches are 4-6 eggs, variably bluish white to pale bluish green, blotched violet, pink with purple-brown spots and lines. Incubation is by the female, fed on the nest by the male, for a period of 11-12 days. The nestling period is 9-14 days and chicks may leave the nest before they are capable of flying. They are fully independent at 26 days and the second nest may be

	started during the nestling period of the first brood. In years with high redpoll populations, many eggs are unfertilised and fail to hatch or are taken by predators (del Hoyo et al., 2010). Redpolls are popular in aviculture and in captivity are known to hybridise with the canary, goldfinch, bullfinch, greenfinch, linnet, twite, siskin and chaffinch. These hybrids are not fertile (Bernard Williams pers. com.). Unlike many small birds, redpolls are not aggressive towards other bird species and easily share space with other small bird species. They form flocks throughout the year, even during the nesting season, and they can become tame in the backyard (Mayntz, 2001). In New Zealand in areas where large numbers occur redpolls are sometimes considered a pest by farmers because of the damage caused to fruit trees when their buds are eaten. As a result, they are occasionally shot, poisoned or trapped (Higgins et al., 2006; Novel Guide, 2011). Strawberry growers consider them to be a serious pest as they eat the seeds in the fruit. They also eat the buds, blossoms and young fruits of other orchard crops, especially apricots and peaches. They also eat grass seed sown in forest clearings (Higgins et al., 2006). In central Otago (New Zealand), redpolls have made heavy attacks on blossoms and young fruits in orchards. The damage is said to have been severe to apricots, but several types of fruit have been attacked. Control measures have been implemented in some areas and in 1961 more than 2,500 birds were destroyed in nine orchards in one attempt to lessen the damage (Long, 1981). The redpoll exists on Macquarie Island and therefore technically is already found naturalised in Tasmania. Although it is not the subject of an eradication program it is referenced in the Pest Eradication Plan and deaths due to primary or secondary poisoning for rats and rabbits are considered "not a negative impact". **Longevity:** The maximum recorded longevity for this species is 10.7 years in captivity (AnAge, 2011). **Conservation status:** **IUCN:** Least Concern **CITES:** Not listed
DATE OF ORIGINAL ASSESSMENT: 24 May 2011	**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

DATE OF CURRENT ASSESSMENT: Dec 2020 (Jodi Buchecker) **EIC ENDORSEMENT:** 17/11/21 **Risk assessment model used for the assessment:** Bomford 2008, Mammals and Birds	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 (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).* The redpoll is a small bird that does not pose a risk to humans. Therefore, the redpoll is assessed as low risk.

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, CMS = sum of classes 6 – 10, see Table 1.*	2	*Low climate match to Australia* Value X = 3,454 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.*	4	*Exotic population established on a larger island (> 50 000 km2) or anywhere on a continent (including elsewhere on the land mass where the natural distribution of the animal is, if this population is due to human introduction and is geographically separate from the natural range of the species).* Established populations in New Zealand on the mainland and the following islands: Macquarie, Chatham, Snares, Kermadec, Antipodes, Auckland, Campbell Island. The redpoll has been recorded as a vagrant on Kermadec Island and Lord Howe Island (Australia) (Angus, 2013).
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 km^2.* The redpoll's overseas range was estimated to be approximately 44,868,069 km^2.

B4. Taxonomic Class (0–1) *Bird = 0; mammal = 1*	0	*Bird*
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.* The redpoll mainly feeds on seeds, buds and small invertebrates.
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.
B7. Migratory score (0–1) *Always migratory = 0; non-migratory = 1*	1	*Non-migratory.* The redpoll is resident, migratory and irruptive.
B. ESTABLISHMENT RISK SCORE SUM OF B1- B7 (1–16)	10	**Moderate establishment risk**
STAGE C: PROBABILITY AN ESTABLISHED SPECIES WILL BECOME A PEST		
C1. Taxonomic group (0–4)	2	*Bird in one of the taxa that are particularly prone to cause agricultural damage (Fringillidae).* No native species of the same genus recorded in Australia.
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*	2	*Overseas geographic range greater than 30 million square kilometres.* Approximately 44,868,069 km^2.

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.* Redpoll nests are made from plant material.
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 evidence of the redpoll ever having been an environmental pest in the wild.
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 (DAWE Protected Matters Search Tool) include: *Cyclopsitta coxeni* (Coxen's Fig-Parrot) – Critically Endangered *Lathamus discolor* (Swift Parrot) – 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.* In New Zealand, redpolls have caused significant damage to fruit crops. Strawberry growers consider them to be a serious pest as they eat the seeds in the fruit. In central Otago (New Zealand), common redpolls have made heavy attacks on blossoms and young fruits in orchards. The damage is said to have been severe to apricots, but several types of fruit have been attacked. Redpolls may also eat newly sown grass seed (Angus, 2013).
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.*	3	Total commodity damage score = 52 (see Table 2)

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 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.* Low 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).*	0	*Nil risk.*
C. PEST RISK SCORE **SUM C 1 TO C 11 (1–37)**	16	**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*	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*	7	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)** *≤ 6 = low establishment risk; 7-11 = moderate establishment risk; 12-13 = serious establishment risk; ≥14 = extreme establishment risk*	10	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*	16	Serious pest risk

ENVIRONMENT AND INVASIVES COMMITTEE THREAT CATEGORY	**SERIOUS**

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

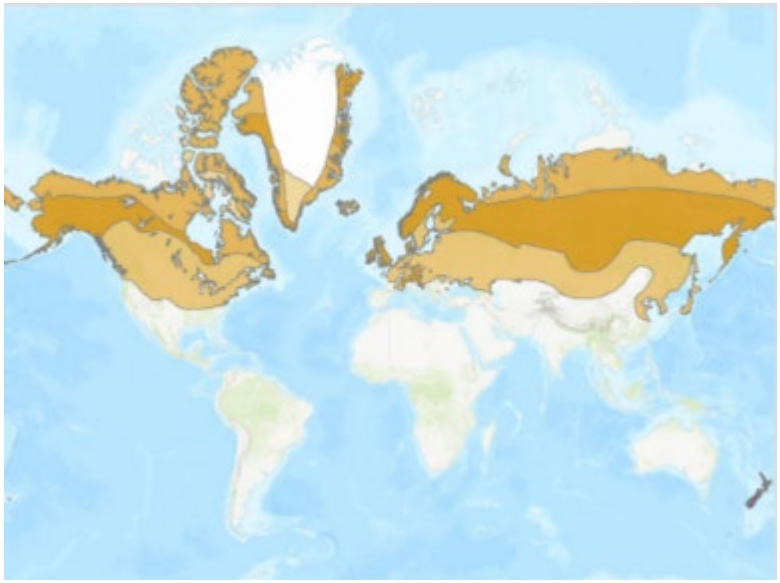


Figure 1 - World Distribution Map - IUCN Red List

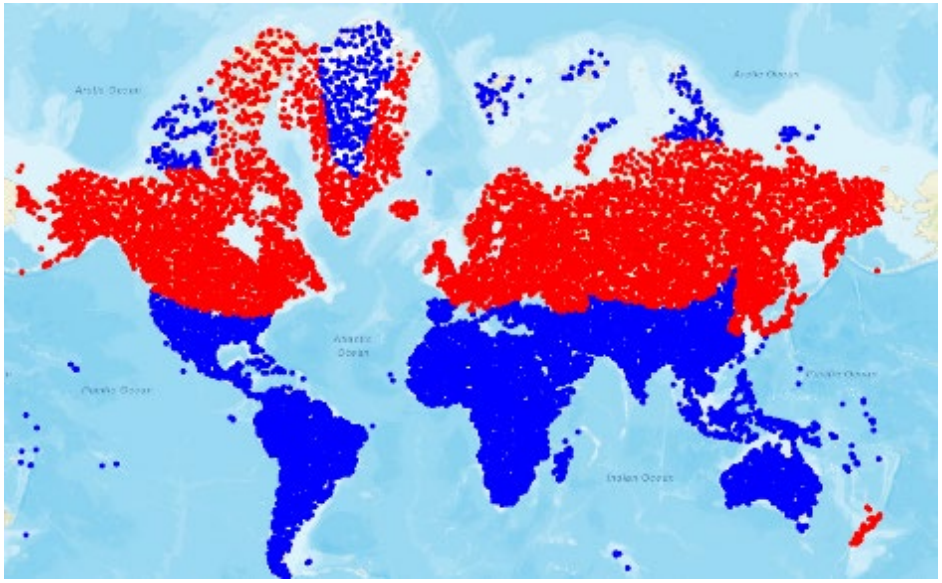
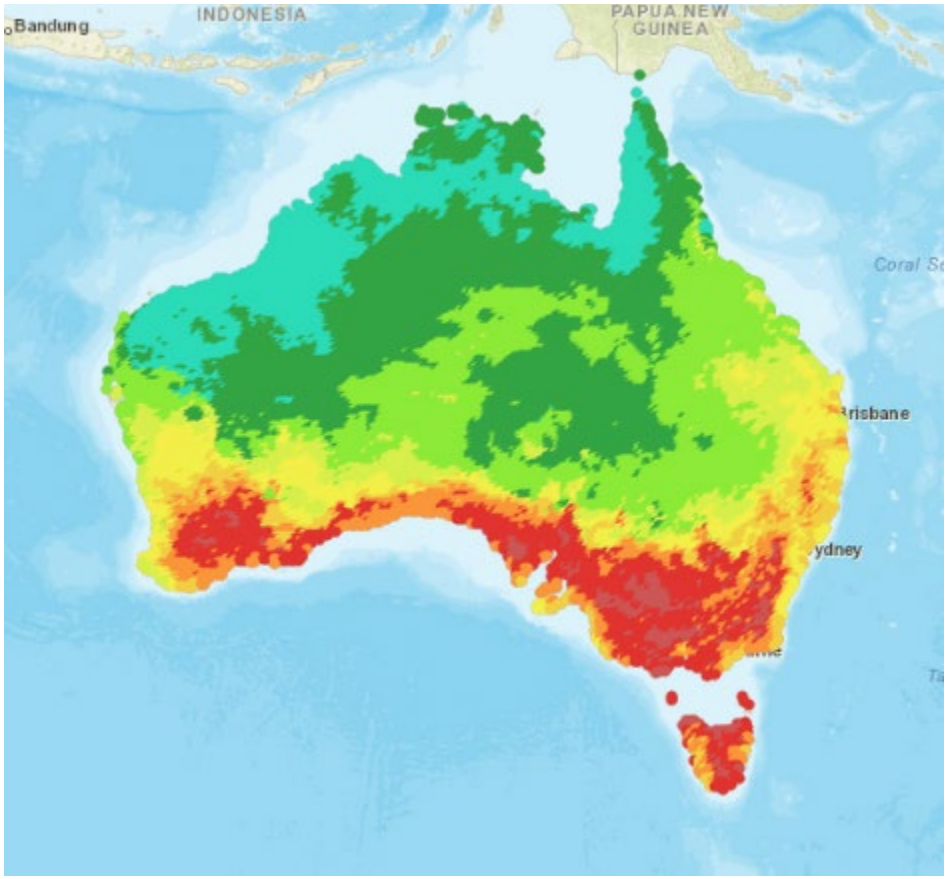


Figure 2 - World Distribution Map - Climatch

Climate match between world distribution of species and Australia:
Areas of Australia where the climate appears suitable for *Acanthis flammea*
CMS = 3,454



Score	Color	Count
0		0
1		2980
2		5961
3		4298
4		1332
5		1211
6		740
7		884
8		1477
9		353
10		0

Species: Acanthis flammea (Redpoll)
Algorithm: Closest Standard Score
8511 source features selected
19236 target features selected
Approximate selected area: 44,868,069 km^2

Table 1: ABARES recalibration thresholds

Climate Match Score (CMS)	Current Bomford 2008 model classes (50 km)	Recalibrated classes to Climatch v2.0 (20 km)
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 2005 – 2006 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)**
Cattle (includes dairy and beef)	*11*			
Timber (includes native and plantation forests)	*10*			
Cereal grain (includes wheat, barley sorghum etc)	*8*			
Sheep (includes wool and sheep meat)	*5*			
Fruit (includes wine grapes)	*4*	2	4	32
Vegetables	*3*	1	4	12
Poultry and eggs	*2*			
Aquaculture(includes coastal mariculture)	*2*			
Oilseeds (includes canola, sunflower etc)	*1*			
Grain legumes (includes soybeans)	*1*			
Sugarcane	*1*			
Cotton	*1*			
Other crops and horticulture (includes nuts tobacco and flowers etc)	*1*	2	4	8
Pigs	*1*			
Other livestock (includes goats, deer, camels, rabbits)	*0.5*			
Bees (included honey, beeswax and pollination)	*0.5*			
Total Commodity Damage Score (TCDS)				52

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:	Latitude 42 (2011) Pest Risk Assessment: Common Redpoll (*Carduelis flammea*). Latitude 42 Environmental Consultants Pty Ltd. Hobart, Tasmania.	**By:** Jodi Buchecker	**Date:** Dec 2020

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National Risk Assessment: EXTREME

RISK ASSESSMENT FOR AUSTRALIA: Cheetah (*Acinonyx jubatus*)

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

SPECIES: *Acinonyx jubatus* (Schreber, 1775) **Synonyms:** *Felis jubata* (Schreber, 1775) **Subspecies:** *A. j. hecki* (Hilzheimer, 1913): Northwest Africa *A. j. fearsoni* (Smith, 1834): East Africa *A. j. jubatus* (Schreber, 1775): Southern Africa *A. j. soemmerringi* (Fitzinger, 1855): Northeast Africa *A. j. venaticus* (Griffith, 1821): North Africa to central India **Common Names:** Cheetah Hunting leopard	**Species description:** Cheetahs are slim with a small, rounded head and short ears. Their faces are distinctly marked with a black lachrymal stripe from the anterior corner of the eye alongside the length of the muzzle. The small, rounded ears have lightly coloured inner fur. This contrasts to the posterior side of the ears, where a black patch of fur is located within the main dorsal colour of the ear. Their monomorphic pelage is pale yellow, grey, or fawn on the dorsal surface, speckled with small, round, unarranged black spots across their body which are set close together. This colouration extends to their tails; the tail the same colour as the dorsal and covered in black spots. The ventral surface is paler in colouration to the dorsal colour, often white or a pale tan. The posterior third of the tail has a series of dark or black rings terminating with a white tip. The cheetah has relatively long legs in relation to their body size and narrow paws in comparison to other cats. The paws of the cheetah are narrow in comparison to other cats. The front paws have four toes and a dew claw, and the hind paws have four toes. As cheetahs have weakly retractile claws with no protective skin folds their claws are slightly curved and blunted from contact with the ground. The cheetahs body length ranges from 112 to 150 centimetres and they have a shoulder height between 67 to 84 centimetres. The cheetahs tail length measure between 60 and 80 centimetres. On average the male is larger than the female and can weigh between 21 to 72 kilograms. **General information:** The historic distribution of the cheetah is very wide. It ranged from Palestine and the Arabian Peninsula to Tajikistan and central India, as well as throughout the continent of Africa. Cheetahs appear to show relatively low habitat selectivity compared with other carnivores (Durant et al., 2010a). However, female cheetahs of differing reproductive status vary the habitat that they select (Pettorelli et al., 2009). In Africa, cheetahs are found in a wide range of habitats and ecoregions, ranging from dry forest and thick scrub through to grassland and hyperarid deserts, such as the Sahara (IUCN SSC, 2007a, b, 2012; Durant et al., 2014) with cheetahs found at altitudes up to 4,000 metres (Mount Kenya) (Young and Evansm, 1993). However, cheetahs are absent from tropical and montane forest. In Iran, cheetahs inhabit deserts, where most of the area has an annual precipitation of less than 100 millimetres. The terrain ranges from plains and saltpans to eroded foothills, and rugged desert ranges that rise to an elevation of up to

	2,000-3,000 metres (Hunter et al., 2007c). This landscape is not dissimilar to the mountains of the Algerian Sahara (Belbachir et al., 2015). Cheetahs are carnivorous. A large portion of their diet includes small to medium-sized ungulates and other small animals such as hares and birds (especially when larger prey are hard to obtain). Cheetahs will also hunt juvenile large ungulates and will rarely scavenge for food, unlike many other African predators. Unlike other cats, cheetahs do not ambush or stalk prey. Instead, they charge at the prey from a distance between 70 to 100 metres. The cheetah is one of the fastest terrestrial mammals, but their velocity can only be maintained for a few hundred metres. Therefore, most cheetah hunts will end in failure. Cheetahs, unlike many other African predators, rarely scavenge. Cheetahs have a social organisation that is unique among felids (Durant et al., 2007; Durant et al., 2010b). Females are solitary or accompanied by dependent young, and males are either solitary or live in stable coalitions of two or three (Caro, 1994; Broomhall et al., 2003; Marnewick et al., 2006). Most coalitions consist of brothers, but unrelated males may also be members of the group (Caro and Collins, 1987). Unlike the coalitions formed by male lions, where a single male from the coalition will guard and mate with a female throughout oestrus, female cheetahs appear to mate with as many males as possible, and show no mate fidelity (Gottelli et al., 2007). In areas where prey is migratory (such as the Serengeti Plains), female cheetahs follow the herds, while male coalitions establish small territories (average 30 km^2) which are centred on areas attractive to females (Durant et al., 1988; Caro, 1994). However, in areas where prey is non-migratory, male and females may have overlapping ranges that can be more similar in size (Broomhall et al., 2003). **Longevity:** Average longevity following maturity 7.5 to 8 years in the wild, though may live up to 12 years. Up to 17 years in captivity with 19 years on record. **Conservation status:** **IUCN:** Vulnerable **CITES:** Appendix I
DATE OF ORIGINAL ASSESSMENT: 22 April 2013 **DATE OF CURRENT ASSESSMENT:** Jan 2021 (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 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.

EIC ENDORSEMENT: 17/11/21 **Risk assessment model used for the assessment:** Bomford 2008, Mammals and Birds	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.*	2	*Animal that sometimes attacks when unprovoked and/or is capable of causing serious injury (requiring hospitalisation) or fatality.* Whilst uncommon, cheetahs sometime attack unprovoked and can cause serious harm.
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*	0	*Nil or low risk (highly unlikely or not possible).*

(excluding the safety of anyone entering the animals' cage/enclosure or otherwise coming within reach of the captive animals)		
STAGE A PUBLIC SAFETY RISK SCORE **SUM A1 - A2 (0-4)**	2	**Highly 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, CMS = sum of classes 6 – 10, see Table 1.*	5	*Very High climate match to Australia*. Value X = 15,080 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.* There are no records found of cheetahs being introduced outside its natural range.
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 square kilometres.* Overseas range size is estimated to be 8,292,517 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.* The cheetah is a strict carnivore and will feed on many species.
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.
B7. Migratory score (0–1) *Always migratory = 0; non-migratory = 1*	1	*Non-migratory.*
B. ESTABLISHMENT RISK SCORE SUM OF B1- B7 (1–16)	10	**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 kilometre*	0	*Overseas geographic range less than 10 million square kilometres.* Overseas range size = ~8,292,517 km^2
C3. Diet and feeding (0–3)	3	*Mammal that is a strict carnivore (eats only animal matter) and arboreal (limited tree climbing ability but does climb).*
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.* There are no occurrences where the cheetah has established outside natural range.

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 (DAWE Protected Matters Search Tool) include: *Parantechinus apicalis* (Dibbler) – Endangered *Lathamus discolor* (Swift Parrot) – 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.* The cheetah is considered a moderate pest to primary production and is a recorded as a pest to farmers in Namibia (Marker et al., 2007) and Botswana (Kent, 2011).
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*	4	Total Commodity Damage Score = 123.8 (see Table 2) The cheetah impacts livestock particularly sheep.
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.* The cheetah is unlikely to harm 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*	3	*Annoyance moderate or severe but few people exposed: Moderate risk.*

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).		The possibility of injuries or harm to humans (possibly fatal) from a wild population is moderate (overt aggression is uncommon in this species and they are more likely to flee from people).
C. PEST RISK SCORE **SUM C 1 TO C 11 (1–37)**	21	**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*	2	Highly 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*	7	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)** *≤ 6 = low establishment risk; 7-11 = moderate establishment risk; 12-13 = serious establishment risk; ≥14 = extreme establishment risk*	10	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*	21	Extreme pest risk

ENVIRONMENT AND INVASIVES COMMITTEE THREAT CATEGORY	**EXTREME**

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

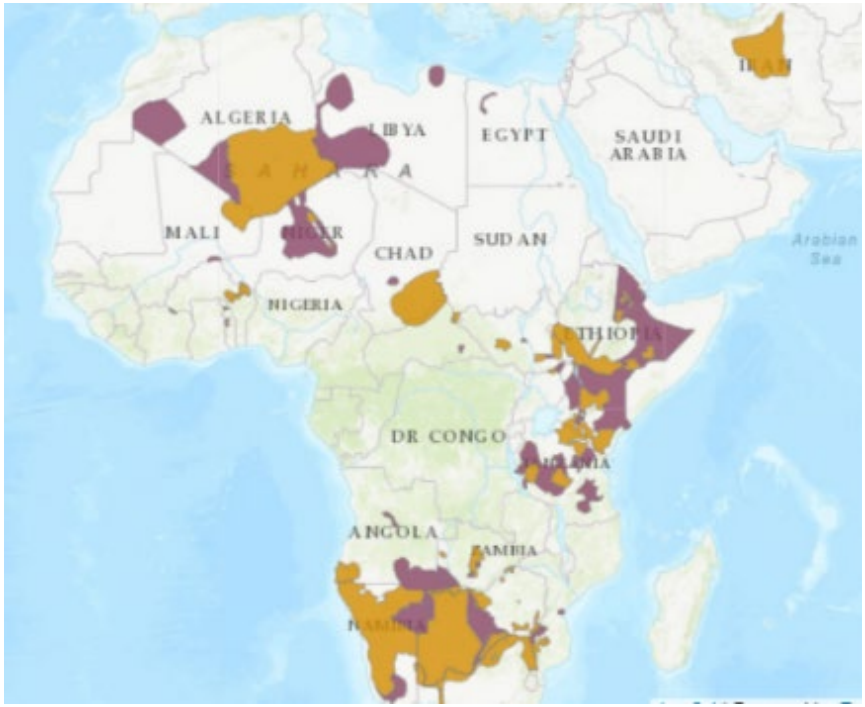


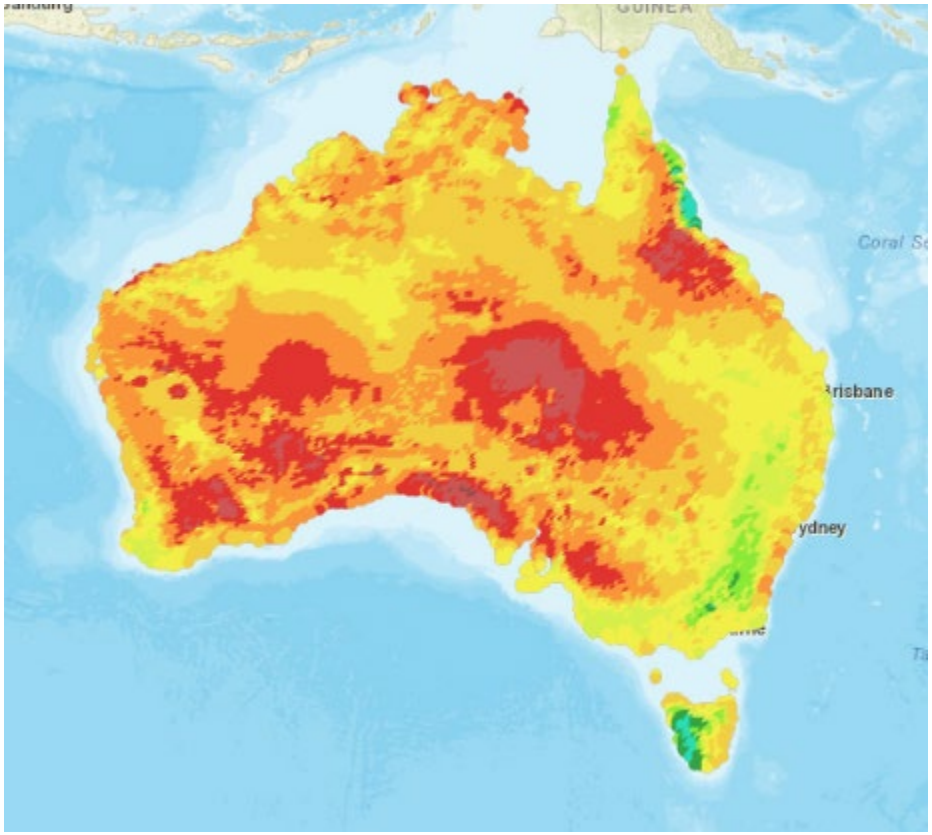
Figure 1 - World Distribution Map - IUCN Red List

Figure 2 - World Distribution Map - Climatch

Climate match between world distribution of species and Australia:

Areas of Australia where the climate appears suitable for *Acinonyx jubatus*

CMS = 15,080



Score	Color	Count
0		0
1		41
2		51
3		217
4		681
5		3166
6		6497
7		5367
8		2559
9		648
10		9

Species: Acinonyx jubatus (Cheetah)
Algorithm: Closest Standard Score
649 source features selected
19236 target features selected
Approximate selected area: 8,292,517 km^2

Table 1: ABARES recalibration thresholds

Climate Match Score (CMS)	Current Bomford 2008 model classes (50 km)	Recalibrated classes to Climatch v2.0 (20 km)
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 2005 – 2006 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)**
Cattle (includes dairy and beef)	*11*	1	4	44
Timber (includes native and plantation forests)	*10*			
Cereal grain (includes wheat, barley sorghum etc)	*8*			
Sheep (includes wool and sheep meat)	*5*	3	4	60
Fruit (includes wine grapes)	*4*			
Vegetables	*3*			
Poultry and eggs	*2*	2	3	12
Aquaculture(includes coastal mariculture)	*2*			
Oilseeds (includes canola, sunflower etc)	*1*			
Grain legumes (includes soybeans)	*1*			
Sugarcane	*1*			
Cotton	*1*			
Other crops and horticulture (includes nuts tobacco and flowers etc)	*1*			
Pigs	*1*	2	3	6
Other livestock (includes goats, deer, camels, rabbits)	*0.5*	3	2	1.8
Bees (included honey, beeswax and pollination)	*0.3*			
Total Commodity Damage Score (TCDS)				123.8

NB The Commodity Value Index scores in this table are derived from Australian Bureau of Statistics 2005–2006 data and will need to be updated if these values change significantly.

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:	Tasmanian Government Risk Assessment for Cheetah, April 2013	**By:** Jodi Buchecker	**Date:** Jan 2021

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National Risk Assessment: EXTREME

RISK ASSESSMENT FOR AUSTRALIA: # Chukar Partridge (*Alectoris chukar*)

Class - Aves**, Order -** Galliformes**, Family -** Phasianidae**, Genus -** *Alectoris*.

SPECIES: *Alectoris chukar* (Gray, 1830) **Synonyms:** *Alectoris chukar fallax* (Sushkin, 1927) **Subspecies:** *Alectoris chukar chukar* (Gray, 1830) *Alectoris chukar cypriotes* (Hartert, 1917) *Alectoris chukar dzungarica* (Sushkin, 1927) *Alectoris chukar falki* (Hartert, 1917) *Alectoris chukar kleini* (Hartert, 1925) *Alectoris chukar koroviakovi* (Zarudny, 1914) *Alectoris chukar kurdestanica* (Meinertzhagen, 1923) *Alectoris chukar pallescens* (Hume, 1873) *Alectoris chukar pallida* (Hume, 1873) *Alectoris chukar potanini* (Sushkin, 1927) *Alectoris chukar pubescens* (Swinhoe, 1871) *Alectoris chukar sinaica* (Bonaparte, 1858)	**Species description:** The chukar partridge is a plump, upright, medium-sized partridge approximately 38 centimetres high with a strongly patterned head and throat, plain upper parts, strongly barred flanks and rufous outer tail feathers. A dark black line across the forehead, eyes, and down the neck contrasts the white throat from the grey head and breast. There is no seasonal variation and plumage pattern is similar for both sexes. Males are slightly larger than females in length and mass; males weigh between 510-800 grams and females between 450-680 grams (Marchant and Higgins, 1993). The bill, margins of eyelids, legs and feet are coral pink to deep red or crimson. Both sexes can have a small tarsal spur, but usually this is characteristic of males. The chukar partridge is a fast runner and strong flier but it only flies short distances, usually downhill (BBI, 2009). Juveniles are like the adults but smaller, the patterns of the head, throat and flanks are duller and less clear, and there is no black band on the head (Marchant and Higgins, 1993). In its native habitat, colouring can vary geographically; birds in more arid areas tend to be greyer and paler (Christensen, 1996; del Hoyo, 1994; National Geographic Society, 1999). **General information:** The chukar partridge is native to the mountainous regions of Asia, Western Europe and the Middle East (Robinson, 2007; BirdLife International, 2019). The chukar partridge natural range includes Turkey, the Mediterranean Islands, Iran and east through Russia and China and south into Pakistan and Nepal (Cowell, 2008). It is also native and widespread in the western Himalayas of India where it is found up to an altitude of 5,000 metres (BBI, 2009). The species occupies approximately 14,055,247 square kilometres. Chukar partridges have been introduced widely for game hunters and have become established in the United States of America (Hawaii), Canada, England and New Zealand (Robinson, 2007; BirdLife International, 2019). Introduced populations of chukar partridge are threatening native populations of red-legged partridge (*Alectoris rufa*) and rock partridge (*Alectoris graeca*) through hybridisation. Genetic data indicates that hybridisation with chukar partridges is widespread across the entire natural and introduced distribution range of the red-legged partridge and the rock partridge (Barliani, 2007).

Alectoris chukar subpallida (Zarudny, 1914) *Alectoris chukar werae* (Zarudny & Loudon, 1904) There are fourteen geographical subspecies that range from Turkey and Mediterranean islands in the west to India and central Nepal in the east. **Common Names:** Chukar Partridge Chuckar Partridge Rock Partridge Red-legged Partridge Indian Hill Partridge	The basic habitat of the chukar partridge is found in arid or semi-arid regions the amount of precipitation that is received during key periods of the year appears to be the primary factor in determining reproductive success. The effective precipitation in any given range largely determines the composition, abundance and condition of essential food plants that in turn play a major role in influencing the yearly chukar partridge production. The chukar partridge prefers rocky terrains but it has been recorded in a variety of open woodlands and grasslands (Cowell, 2008). In the Himalayas, it inhabits open, rocky, dry mountain slopes, hillsides or canyon walls but is also found on open and flat deserts with sparse grasses and on barren plateaus (BBI, 2009). In Israel, the chukar partridge occurs along a steep eco-geographical gradient extending from Mediterranean zones in the north to desert regions in the south (Kark et al., 1999). It is mainly found at an altitude of 2,000 to 4,000 metres except in Pakistan, where it occurs at 600 metres. They are not found in areas of high humidity or rainfall (Baker, 1922). The chukar partridge can be found in North America throughout the west in steep, mountainous, rocky locations in mixed habitat types. The Great Basin area of desert shrub is representative of their preferred habitat; climate is arid to semiarid, water is generally available from scattered sources, and temperature varies. The grazed and disturbed public lands provide plentiful grasses and seeds with scattered shrubs while the rocky terrain provides cover. Unsuccessful attempts to introduce the chukar partridge into other areas of North America suggest that they are already established in the most suitable habitat types (Encyclopaedia of life, 2011). The summer distribution of the birds seems to depend a great deal upon the distribution and availability of water present in their habitat. Chukar partridges take advantage of all water, from rivers to small creeks and springs to nearly stagnant seeps that barely moisten the ground (Christensen, 1970). Chukar partridges exhibit altitudinal migration, moving from higher elevations to lower terrain during heavy snows. They may also move on to south-facing slopes to escape inclement weather. Nesting habitat is similar to foraging habitat: dry, rocky slopes with open, brushy cover (Sullivan, 1994). Chukar partridges are diurnal and forage on the ground throughout the morning and afternoon. They feed on a wide variety of seeds and some insects (Christensen, 2020). The bulk of their diet in the Himalayas is composed of grass seeds, grass blades, basal shoots, bulbs, stems, leaves, plant buds and cereals (BBI, 2009). The diet of young partridges includes a high proportion of insects (termites, caterpillars, crickets, ants and insect eggs) whereas the adult diet contains not more than 15% of insects by volume (BBI, 2009). When chukar partridges are in the vicinity of agriculture, investigations have found that they utilize the grains of barley (*Hordeum vulgare*), oats (*Avena sativa*), wheat (*Triticum* species) and corn (*Zea mays*), seeds of sweet clover (*Melilotus* species) and bluegrass (*Poa pratensis*), and green shoots of alfalfa (*Medicago sativa*)

	(Sandfort, 1954; Johnson, 1957; Ferkovich, 1965). There are occasional instances where chukar partridges have been known to cause damage to specific agricultural crops (apples (*Malus* species) and potatoes (*Solanum tuberosum*) in Nevada, and potatoes in Washington and California). However, these incidents are considered rare (Christensen, 1970). Chukar partridges usually breed once a year depending on environmental conditions, although 2 broods of young may be raised when nesting conditions are favourable (WA Dept Ag and Food, 2011). Breeding occurs from April to July in North America and in New Zealand chukar partridges begin nesting in September (Olliver, 2005). Nests are simple scrapes, sometimes lined with grass or feathers, in rocky or brushy areas. They are difficult to find and are not well studied. Clutch size varies between 7 and 21 and is determined by site and environmental condition. Broods average around 10.5 chicks, and clutch size is greatly reduced in drought years; in extreme drought breeding may not occur at all. Incubation lasts approximately 24 days and is usually a female activity. In North America, hatching can occur from May until August, depending on the success of the first clutch. Nesting chukar partridges and chukar broods are normally found within 2 kilometres of water (WA Dept Ag and Food, 2011). **Longevity:** It is thought that chukar partridges have a short life span that is demographically offset by high reproductive rates (Christensen, 1996 cited in Robinson, 2007). **Conservation status:** **IUCN:** Least Concern. The chukar partridge is not globally threatened. In most areas, populations are stable or increasing, though habitat loss and intensive hunting may affect some local populations in their native distribution. The species has an extremely large range, the population trend appears to be stable, and the population size is extremely large. **CITES:** Not listed.
DATE OF ORIGINAL ASSESSMENT: March 2011 **DATE OF CURRENT ASSESSMENT:** Jan 2021 (Jodi Buchecker) **EIC ENDORSEMENT:** 17/11/21	**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.

Risk assessment model used for the assessment: Bomford 2008, Mammals and Birds	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 (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).*
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*	0	*Nil or low risk (highly unlikely or not possible).*

(excluding the safety of anyone entering 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, CMS = sum of classes 6 – 10, see Table 1.*	5	*Very high climate match in Australia.* Value X = 12,349 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.*	4	*Exotic population established on a larger island (> 50,000 km^2) or anywhere on a continent (including elsewhere on the land mass where the natural distribution of the animal is, if this population is due to human introduction and is geographically separate from the natural range of the species).* Introduced chukar partridge populations have been established in United States of America, Saint Helena Island (south Atlantic), Canada, New Zealand, England and Hawaii (BirdLife International, 2019; Robinson, 2007).
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.* Range = 14,055,247 km^2
B4. Taxonomic Class (0–1) *Bird = 0; mammal = 1*	0	Bird
B. ESTABLISHMENT RISK SCORE **SUM OF B1- B4 (1–13)**	10	**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 chukar partridge is not a specialist. The chukar partridge eats roots, grain and grain shoots, berries and insects.
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 chukar partridge can live in disturbed habitats.
B7. Migratory score (0–1) *Always migratory = 0; non-migratory = 1*	1	*Non-migratory.*
B. ESTABLISHMENT RISK SCORE SUM OF B1- B7 (1–16)	13	**Serious establishment risk**
STAGE C: PROBABILITY AN ESTABLISHED SPECIES WILL BECOME A PEST		
C1. Taxonomic group (0–4)	0	*Other group.* The chukar partridge is in the family Phasianidae but no native species of the same genus are found in Australia.
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 kilometre*	1	*Overseas geographic range 10–30 million square kilometres.* Range = 14,055,247 km^2
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.* Chukar partridge nests are simple scrapes lined with grass or feathers.

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?*	2	*Moderate environmental pest in any country or region.* The hybridisation of the chukar partridge is widespread across the entire range of the red-legged partridge.
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 691 grid squares within the highest four climate match classes, that overlap the distribution of any susceptible native species or ecological communities = 5* Examples of susceptible native species or ecological communities (DAWE Protected Matters Search Tool) include: *Turnix melanogaster* (Black-breasted Button-quail) – Vulnerable *Turnix olivii* (Buff-breasted Button-quail) – 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?*	1	*Minor pest of primary production in any country or region.* The chukar partridge is known to feed on grains of barley (*Hordeum vulgare*), oats (*Avena sativa*), wheat (*Triticum* species) and corn (*Zea mays*), seeds of sweet clover (*Melilotus* species) and bluegrass (*Poa pratensis*), and green shoots of alfalfa (*Medicago sativa*). There are occasional instances where chukar partridges have been known to cause damage to specific agricultural crops (apples (*Malus* species) and potatoes (*Solanum tuberosum*) in Nevada, and potatoes in Washington and California). However, these incidents are considered rare (Christensen, 1970).
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*	4	Total Commodity Damage Score = 112 (see Table 2) More than 50% of the range of susceptible commodities overlaps with grid squares with climate match scores of 6-8.
C9. Spread disease (1–2)	2	*All birds likely or unknown effect on native species and on livestock and other domestic animals).*

Assess the risk that the species could play a role in the spread of disease or parasites to other 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.*	1	*$0.* Low 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).*	0	*Nil risk.*
C. PEST RISK SCORE **SUM C 1 TO C 11 (1–37)**	16	**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*	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*	10	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*	13	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*	16	Serious pest risk

ENVIRONMENT AND INVASIVES COMMITTEE THREAT CATEGORY	**EXTREME**

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

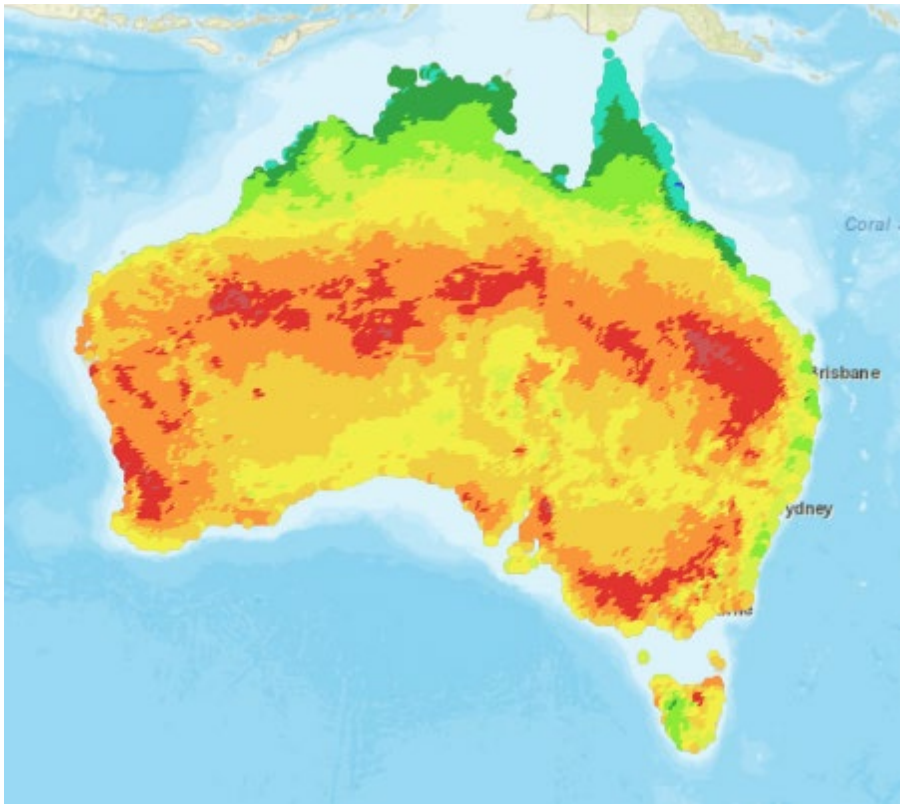
Figure 1 - World Distribution Map - IUCN Red List

Figure 2 - World Distribution Map - Climatch

Climate match between world distribution of species and Australia:

Areas of Australia where the climate appears suitable for *Alectoris chukar*

CMS = 12,349



Score	Color	Count
0		1
1		213
2		757
3		1237
4		1280
5		3399
6		5433
7		5047
8		1756
9		113
10		0

Species: Alectoris chukar (Chukar Partridge)
Algorithm: Closest Standard Score
1424 source features selected
19236 target features selected
Approximate selected area: 13,165,361 km^2

Table 1: ABARES recalibration thresholds

Climate Match Score (CMS)	Current Bomford 2008 model classes (50 km)	Recalibrated classes to Climatch v2.0 (20 km)
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 2005 – 2006 data. The values will require updating if significant change has occurred in the value of the commodity (Bomford 2008). Table 9

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)**
Cattle (includes dairy and beef)	*11*			
Timber (includes native and plantation forests)	*10*			
Cereal grain (includes wheat, barley sorghum etc)	*8*	2	4	64
Sheep (includes wool and sheep meat)	*5*			
Fruit (includes wine grapes)	*4*	1	4	16
Vegetables	*3*	1	4	12
Poultry and eggs	*2*			
Aquaculture (includes coastal mariculture)	*2*			
Oilseeds (includes canola, sunflower etc)	*1*	2	4	8
Grain legumes (includes soybeans)	*1*	2	4	8
Sugarcane	*1*			
Cotton	*1*			
Other crops and horticulture (includes nuts tobacco and flowers etc)	*1*	1	4	4
Pigs	*1*			
Other livestock (includes goats, deer, camels, rabbits)	*0.5*			
Bees (included honey, beeswax and pollination)	*0.5*			
Total Commodity Damage Score (TCDS)				112

NB The Commodity Value Index scores in this table are derived from Australian Bureau of Statistics 2005–2006 data and will need to be updated if these values change significantly.

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:	Latitude 42 (2011) Pest Risk Assessment: Chukar partridge (*Alectoris chukar*). Latitude 42 Environmental Consultants Pty Ltd. Hobart, Tasmania.	**By:** Jodi Buchecker	**Date:** Jan 2021

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National Risk Assessment: SERIOUS

RISK ASSESSMENT FOR AUSTRALIA: # Blue-fronted Amazon (*Amazona aestiva*)

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

SPECIES: *Amazona aestiva* (Linnaeus, 1758) **Synonyms:** *Psittacus aestivus* (Linnaeus, 1758) **Subspecies:** *Amazona aestiva aestiva* (Linnaeus, 1758) *Amazona aestiva xanthopteryx* (Berlepsch, 1896) **Common Names:** Blue-fronted Amazon Turquoise-fronted Amazon Turquoise-fronted Parrot Blue-fronted Parrot Yellow-winged Amazon	**Species description:** The blue-fronted amazon is one of the world's most popular captive parrots and is heavily traded, due in part to its colour patterning, hardiness and its ability to imitate the human voice. Blue-fronted amazons are typically 37 centimetres in length with a mean weight of 400 grams. There can be a substantial variation in colour of the blue-fronted amazon. Although the fore-crown is generally blue, the mid-crown, face, chin and throat can vary in colour being yellow, blue or green. The posterior ear-coverts, sides of the neck, the nape and the mantle are green with heavy black edging that produces a scaled effect. This effect is less pronounced on the wings and underside. The shoulder and speculum are red, the primary feathers are tipped dark blue, the tail is green with a yellowish tip and the lateral feathers are basally barred with red. The blue and yellow of the head is reduced in immature members of the species. There is no clear difference in the appearance of males and females, and researchers use blood tests (Seixas & Mourao, 2002; Berkunsky & Reboreda, 2009) or a laparoscope (Thompson, 1995) to genetically determine gender. The blue-fronted amazon can have similar features as the yellow-crowned Amazon (*Amazona ochrocephala*), and the yellow-shouldered Amazon (*Amazona barbadensis*) (Ribas et al., 2007; Urantowka et al., 2014). No seasonal variations in appearance have been noted, and the species is unlikely to be confused with any Australian species. **General information:** The blue-fronted amazon is a South American parrot found in north-eastern Brazil, eastern Bolivia, northern Argentina, and southern Paraguay. A small, introduced population of blue-fronted amazons and yellow-headed amazons (*Amazona oratrix*) have established in Stuttgart, Germany where they have hybridised. The population was introduced in 1984, with 46 individuals reported in 2012. In Germany, they have been recorded consuming common ivy (*Hedera helix*), birch (*Betula* species), oak (*Quercus* species), walnut (*Juglans* species), pine (*Pinus* species), maple (*Acer* species) and horse chestnut trees (*Aesculus hippocastanum*), to name a few. Another introduced population of blue-fronted amazons has been recorded in southern Florida, United States of America. The population was first detected in 1982 with 103 birds counted in 2002.

	Menchetti & Mori (2014) state that: "Small- to medium-sized, widely distributed species (e.g., *Agapornis* species, *Amazona* species, *Aratinga* species, *Myiopsitta monachus*, *Psittacula* species) are the most adept at establishing non-native populations, because they are (i) more traded than others, (ii) commonly sold at relatively low prices, (iii) highly synanthropic and (iv) adapted to live in a variety of environmental conditions, i.e. latitude and habitat types." In its native range, the blue-fronted amazon lives in sub-tropical forests and savannahs of central South America (Berkunsky & Reboreda, 2009). Its habitat includes Cerrado and Chaco scrub, savannah, flood plains, grasslands, palm groves, gallery forest, subtropical woodland, areas of old growth with large trees, and areas of man-made pasture (del Hoyo et al., 1994; Seixas & Mourao, 2000; Seixas & Mourao, 2003). The site of a restocking program for the species in the Pantanal of Brazil had an average temperature range of 18 to 30 degrees Centigrade (Seixas & Mourao, 2000). The upper elevation limit of the blue-fronted Amazon is 1,600 metres (BirdLife International, 2012; Forshaw, 1989 and Ribas et al., 2007 cited in Berkunsky & Reboreda, 2009). Individual blue-fronted amazons may have a home range between 1-1,600 hectares (Seixas & Mourao, 2000). Blue-fronted amazons are herbivorous generalists that feed on the fruit, flowers and seeds of a range of plants, including fruits of *Melia, Aspidosperma, Prosopis, Schinopsis and Ziziphus,* and seeds of *Citrus, Anadenanthera, Bulnesia* and *Cercidium*. Fruits of cactus (*Cactacea*e species) and palm seeds (*Arecaceae* species) may be eaten, along with flowers of *Erythrina* and *Morus* (del Hoyo et al., 1994). All amazon parrots are secondary cavity nesters (Forshaw, 1989 and Ribas et al., 2007 cited in Berkunsky & Reboreda, 2009). Blue-fronted amazons take advantage of natural or abandoned nest cavities in mature trees, both living and dead, with nests generally found 9 metres above the ground (del Hoyo et al., 1994). They do not make a nest in cliff faces or arboreal termitarium (del Hoyo et al., 1994). Blue-fronted amazons are monogamous and reach sexual maturity at 3 or 4 years old (Blue-fronted Amazon Project, 2021). Breeding occurs in spring and early summer. In general, parrots tend to have relatively small eggs, long incubation periods (in captivity the blue-fronted amazon has an incubation period between 23 to 25 days) and asynchronous clutches. Hatchlings are featherless with closed eyes and cannot support their heads. The juveniles grow slowly and fledge after a considerable time in the nest (Bucher, 1983 cited in Seixas & Mourao, 2003). The species is not noted for storing sperm. They are known to hybridise with the yellow-headed amazon (Martens et al., 2013) and are suspected of hybridising with other *Amazona* species. The blue-fronted Amazon is considered an agricultural pest in some parts of its South American range. The blue-fronted amazon has an impact on agriculture crops, including maize (*Zea mays*) and sunflower (*Helianthus annuus*) and causes damage to fruit crops during winter. The pest status of the blue-fronted amazon is thought

	to have contributed to the Government's high export quotas, however, research into actual impacts on *Citrus* trees found that damage was very minor and not economically important (Navarro et al., 1991). **Longevity:** Can live up to 70 years in captivity. **Conservation status:** **IUCN:** Near Threatened **CITES:** Appendix II
DATE OF ORIGINAL ASSESSMENT: 22 March 2016 **DATE OF CURRENT ASSESSMENT:** Feb 2021 (Jodi Buchecker) **EIC ENDORSEMENT:** 17/11/21 **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 (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).*
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, CMS = sum of classes 6 – 10, see Table 1.*	3	Moderate climate match in Australia. Value X = 5,703 Climate Match Score = 3

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 (including elsewhere on the land mass where the natural distribution of the animal is, if this population is due to human introduction and is geographically separate from the natural range of the species).* Blue-fronted Amazon have established populations in Germany and southern Florida, United States of America. A small, introduced population of blue-fronted amazons and yellow-headed amazons established in Stuttgart, Germany where they have hybridised. The population was introduced in 1984, and 46 individuals were reported in 2012. The population established in Florida was first detected in 1982 with 103 birds counted in 2002. Modelling based on the species' native range suggests that northern and north-east Australia has areas of similar climate which may strongly support introduced populations of blue-fronted amazons.
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.* Estimated overseas range is estimated to be 6.3 million km^2.
B4. Taxonomic Class (0–1) *Bird = 0; mammal = 1*	0	*Bird.*
B. ESTABLISHMENT RISK SCORE **SUM OF B1- B4 (1–13)**	8	**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.* The blue-fronted amazon feeds on a wide variety of fruit (*Melia, Aspidosperma, Prosopis*) and seeds (*Citrus, Anadenanthera, Bulnesia*), as well as cactus fruits, palm seeds and flowers of *Erythrina* and *Morus* (del Hoyo *et al.,* 1997). Fruits, berries, seeds, nuts, blossom and leaf buds are harvested from treetops (Forshaw, 1989).

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 blue-fronted amazon can live in human-disturbed habitats as well as savannahs, woods and forest, Cerrado, Catinga and palm groves in Brazil. The blue-fronted amazon requires old-growth forest for trees with suitable nesting hollows. The species has benefited from agriculture (De la Pena and Rumboll, 1998; Souza, 2003) and tolerates considerable habitat disturbance provided large, secluded nests and roosting trees are available (Forshaw, 1989).
B7. Migratory score (0–1) *Always migratory = 0; non-migratory = 1*	1	*Non-migratory.* The blue-fronted amazon is an altitudinal migrant however, it is non-migratory in its native range. In Argentina, the Chaco province populations move from the west to the eastern foothills of the Andes from mid-March to mid-September. In Paraguay, some blue-fronted amazons wander east to east during May to July (del Hoyo *et al.,* 1997).
B. ESTABLISHMENT RISK SCORE SUM OF B1- B7 (1–16)	11	**Moderate 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 (Psittaciformes) = 2* *Bird in one of the families likely to hybridise with native species (Psittacidae), and if there are relatives in the same genus among Australian native birds = 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 kilometre*	0	*Overseas geographic range less than 10 million square kilometres.* It is estimated that the overseas range for the blue-fronted amazon is 6.3 million km^2.

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.* All Amazon parrots are secondary cavity nesters (Forshaw, 1989; Ribas et al, 2007 cited in Berkunsky & Reboreda, 2009). Blue-fronted amazons take advantage of natural or abandoned nest cavities in mature trees, both living and dead, and are rarely seen in cliff faces or arboreal termitarium (del Hoyo *et al*., 1994).
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.* There are no reports found that this species is 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 and/or has more than 691 grid squares within the highest four climate match classes, that overlap the distribution of any susceptible native species or ecological communities = 5* Examples of susceptible native species or ecological communities (DAWE Protected Matters Search Tool) include: *Neophema chrysogaster* (Orange-bellied Parrot) – Critically Endangered *Lathamus discolor* (Swift Parrot) – 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.* The blue-fronted amazon is considered an agricultural pest in some parts of its South American range. The blue-fronted amazon impacts agriculture crops, including maize and sunflower and causes damage to fruit crops during winter.
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,*	4	Total commodity damage score = 124 (see Table 2)

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 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.*
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.*
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*	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*	8	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)** *≤ 6 = low establishment risk; 7-11 = moderate establishment risk; 12-13 = serious establishment risk; ≥14 = extreme establishment risk*	11	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*	18	Serious pest risk

ENVIRONMENT AND INVASIVES COMMITTEE THREAT CATEGORY	**SERIOUS**

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

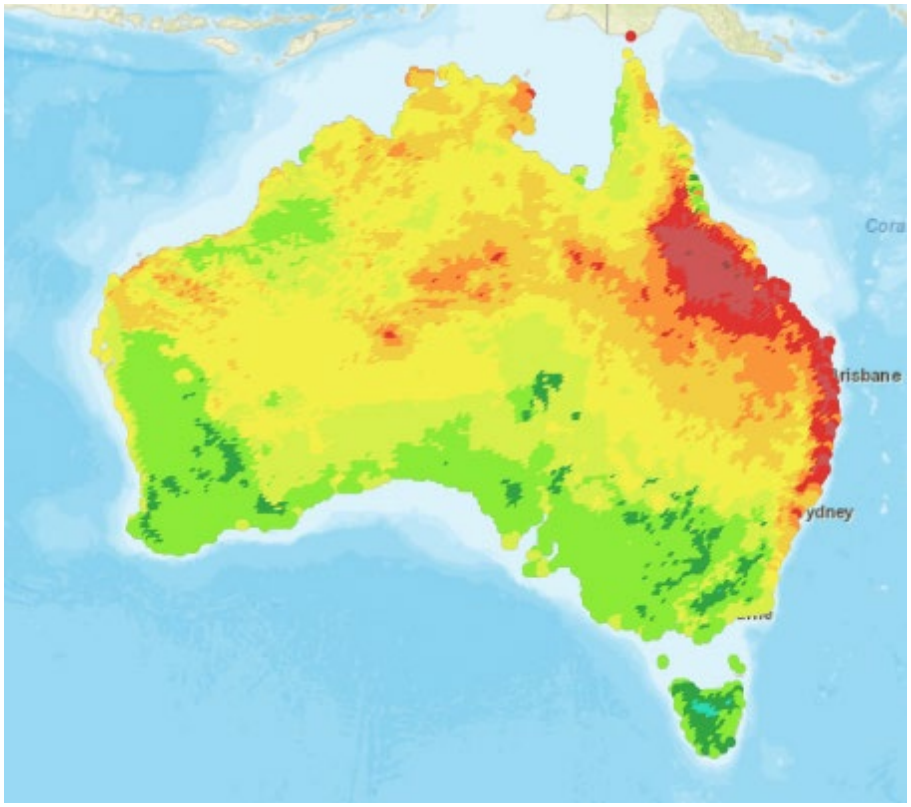
Figure 1 - World Distribution Map - IUCN Red List

Figure 2 - World Distribution Map - Climatch

Climate match between world distribution of species and Australia:

Areas of Australia where the climate appears suitable for *Amazona aestiva*

CMS = 5,703



Score	Color	Count
0		0
1		14
2		526
3		3450
4		3359
5		6184
6		3283
7		1352
8		601
9		462
10		5

Species: Amazona aestiva (Blue-fronted Amazon)
Algorithm: Closest Standard Score
622 source features selected
19236 target features selected
Approximate selected area: 6,273,541 km^2

Table 1: ABARES recalibration thresholds

Climate Match Score (CMS)	Current Bomford 2008 model classes (50 km)	Recalibrated classes to Climatch v2.0 (20 km)
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 2005 – 2006 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)**
Cattle (includes dairy and beef)	*11*			
Timber (includes native and plantation forests)	*10*	2	2	40
Cereal grain (includes wheat, barley sorghum etc)	*8*	2	2	32
Sheep (includes wool and sheep meat)	*5*			
Fruit (includes wine grapes)	*4*	2	3	24
Vegetables	*3*	2	2	12
Poultry and eggs	*2*			
Aquaculture(includes coastal mariculture)	*2*			
Oilseeds (includes canola, sunflower etc)	*1*	2	3	6
Grain legumes (includes soybeans)	*1*	2	2	4
Sugarcane	*1*			
Cotton	*1*			
Other crops and horticulture (includes nuts tobacco and flowers etc)	*1*	2	3	6
Pigs	*1*			
Other livestock (includes goats, deer, camels, rabbits)	*0.5*			
Bees (included honey, beeswax and pollination)	*0.5*			
Total Commodity Damage Score (TCDS)				124

NB The Commodity Value Index scores in this table are derived from Australian Bureau of Statistics 2005–2006 data and will need to be updated if these values change significantly.

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:	DPIPWE (2016) Species Profile: Blue-fronted Amazon (*Amazona aestiva*). Department of Primary Industries, Parks, Water and Environment. Hobart, Tasmania. Tasmanian Government Risk Assessment for Blue-fronted Amazon, March 2016	**By:** Jodi Buchecker	**Date:** Feb 2021

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National Risk Assessment: EXTREME

RISK ASSESSMENT FOR AUSTRALIA: Caracal (*Caracal caracal*)

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

SPECIES: *Caracal caracal* (Schreber, 1776) **Synonyms:** *Felis caracal* (Schreber, 1776) **Subspecies:** *Caracal caracal caracal* (Schreber, 1776) *Caracal caracal nubicus* (Fischer, 1829) *Caracal caracal schmitzi* (Matschie, 1912) **Common Names:** Caracal African Caracal Asian Caracal Desert Lynx	**Species description:** Caracals have red to brown coats with colour varying among individuals. The caracal's undersides are white with many small spots. The face has black markings on the whisker pads, around the eyes, above the eyes and faintly down the centre of the head and nose. A distinguishing feature of caracals is their elongated and black-tufted ears. The legs are relatively long, and the hind legs are disproportionately tall and well-muscled. The tail is short and ranges in length from 18 to 34 centimetres. Although the tail is short, it still makes up a significant proportion of the body length. Eye colour varies from gold or copper to green or grey. Melanistic individuals have been reported but are extremely rare. Juveniles differ in their shorter ear tufts and blue-tinted eyes. Head to body length ranges from 62 to 91 centimetres. Males are typically larger and heavier than females. Males can weigh up to 20 kilograms whereas the females are at or below 13 kilograms. However, it is possible for a large female to weigh more than a small male. Even the smallest adult is larger than most domestic cats. **General information:** The taxonomy of this species is currently under review by the IUCN SSC Cat Specialist Group (2014). The caracal has been classified variously with *Lynx* and *Felis* in the past, but molecular evidence supports a monophyletic genus. The caracal is closely allied with the African Golden Cat (*Caracal aurata*) and Serval (*Leptailurus serval*) (Johnson et al., 2006). The caracal is widely distributed across Africa, Central Asia, and south-west Asia into India. The caracal occupies a wide variety of habitats from semi-desert to relatively open savanna, scrubland to moist woodland and thicket or evergreen/montane forest (as in the Western Cape of South Africa). However, the caracal favours drier woodland and savanna regions with lower rainfall (Stuart and Stuart, 2013; TAWIRI, 2009). While drier open country is preferred, they are absent from true desert and usually require some form of vegetative cover (Sunquist and Sunquist, 2002). On the Arabian Peninsula they mainly occur in desert wadis, foothills, mountains and basalt fields (Mallon and Budd, 2011). In the Ethiopian Highlands, they range up to 2,500 metres and exceptionally 3,300 metres (Ray et al., 2005).

	Caracal prey mainly on small to medium-sized mammals, from small murids to antelope up to ~50 kilograms. However, they will also take birds, reptiles (such as lizards and snakes), invertebrates, fish, and some plant matter (Stuart and Stuart, 2007, 2013; Hunter, 2004; Ghoddousi et al., 2009; Mallon and Budd, 2011). Sexual maturity is reached at 7 to 10 months with a gestation period between 68 to 81 days. Caracals breed once a year and give birth to 1 to 6 kittens (on average 3). Parental investment (and the combined lack of post-partum oestrus) restricts females to 1 litter per year. Mothers care for the kittens for 9 to 10 months. A tree cavity, cave, or abandoned burrow is often chosen for parturition and the first 4 weeks of postnatal development. Caracals are solitary, except for the duration of mating and rearing of kittens. Both sexes are territorial and maintain an active home range. Although primarily nocturnal, caracals can be seen during the day, especially in undisturbed regions. In the Datça Peninsula, Turkey, caracals were active during day and night except for late morning or around midnight (Ilemin and Gürkan, 2010). In the Hawf area, Yemen, caracals were more active during the day (Khorozyan et al., 2014). However, a study in India, showed that caracals displayed mainly nocturnal behaviour (Singh et al., 2014). Though they are terrestrial, they are also skilled climbers with tenacious attitudes. A single caracal has been known to chase off predators up to twice its size. **Longevity:** ~20 years in captivity, 12 years in the wild (Livingston, 2009). **Conservation status:** **IUCN**: Least Concern. Due to its large geographical distribution covering a wide range of environments, caracals are subject to different pressures and threats that vary in extent and severity resulting in very different local population trends. While the species is considered as Least Concerned in the Arabian Peninsula (Mallon and Budd, 2011), it is listed as Endangered in Jordan (GCEP, 2000) and Critically Endangered in Pakistan (Sheikh and Molur, 2004) and Morocco (Cuzin, 2003). It has already dissipated in Kuwait (Cowan, 2013), parts of Turkmenistan (Lukarevsky, 2001) and is believed to be on the verge of extinction in many parts of North Africa (Cuzin, 2003; F. Belbachir, pers. comm., 2014). However, while it shows such signs of population declines and range loss in parts of Asia and Northern Africa, caracals are very common and stable in central and southern Africa (Thorn et al., 2011) which covers a large fraction of its global range. As the declines are highly local and none cause a significant range loss in relation to its global population, the species is considered as Least Concern. **CITES:** Populations in Asian range states are included in CITES Appendix I while the populations in African range states are included on Appendix II. Hunting of the species is prohibited in Afghanistan, Algeria, Egypt, India, Iran, Israel, Jordan, Kazakhstan, Lebanon, Morocco, Pakistan, Syria, Tajikistan, Tunisia, Turkey, Turkmenistan, and Uzbekistan (updated from Nowell and

	Jackson, 1996). In sub-Saharan Africa, the caracal is protected from hunting in about half of its range states (Nowell and Jackson, 1996). In Namibia and South Africa, the caracal is classified as a "problem animal", which permits landowners to kill the species without restriction. Nonetheless, caracals have persisted and remain widespread.
DATE OF ORIGINAL ASSESSMENT: 21 July 2019 **DATE OF CURRENT ASSESSMENT:** Feb 2021 (Jodi Buchecker) **EIC ENDORSEMENT:** 17/11/21 **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.*	2	*Animal that sometimes attacks when unprovoked and/or is capable of causing serious injury (requiring hospitalisation) or fatality.* Caracals have been known to attack humans and can cause serious injury (requiring hospitalisation) if cornered or handled (Nattrass, 2020).
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)**	2	**Highly 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, CMS = sum of classes 6 – 10, see Table 1.*	5	*Very high climate match to Australia.* Value X = 18,336 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.* There are no records found of exotic populations having been 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.* Range size approximately 7.7 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.* The caracal is a generalist carnivore that eats small-medium mammals, birds and rodents. Lizards, snakes, and insects are infrequently eaten. Grasses and grapes are taken occasionally to clear the caracal's immune system and stomach of any parasites.
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 caracal can live in disturbed habitats (Nattrass, 2020).
B7. Migratory score (0–1) *Always migratory = 0; non-migratory = 1*	1	*Non-migratory.*
B. ESTABLISHMENT RISK SCORE	10	**Moderate establishment risk**

SUM OF B1- B7 (1–16)		
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 less than 10 million square kilometres.* Range size estimated to be 7.7 million km^2.
C3. Diet and feeding (0–3)	3	*Mammal that is a strict carnivore (eats only animal matter) and arboreal (climbs trees for any reason).*
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 20 grid squares within the highest two climate match classes and/or has more than 100 grid squares within the highest four climate match classes, that overlap the distribution of any susceptible native species or ecological communities = 5* Examples of susceptible native species or ecological communities (DAWE Protected Matters Search Tool) include: *Leipoa ocellata* (Malleefowl) – Vulnerable *Lathamus discolor* (Swift Parrot) – 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?*	3	*Major pest of primary productions in any country or region.*

		The caracal is recorded as killing livestock in many countries across its range. In a study conducted by Strauss (2009) at the Glen Agricultural Institute near Bloemfontein in the Free State (South Africa), the extent of predation by black-backed jackals (*Lupulella mesomelas*) and caracal on Merino and Dorper sheep (*Ovis aries*) flocks caused the flocks to become unsustainable. The estimated direct cost of predation by black-backed jackals and caracals was more than ZAR 1.4 billion per year (Bergman, 2013).
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*	4	Total Commodity Damage Score = 104 (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.*
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	*Annoyance moderate or severe but few people exposed: Moderate risk.*
C. PEST RISK SCORE	23	**Extreme 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*	2	Highly 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*	7	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)** *≤ 6 = low establishment risk; 7-11 = moderate establishment risk; 12-13 = serious establishment risk; ≥14 = extreme establishment risk*	10	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*	23	Extreme pest risk

ENVIRONMENT AND INVASIVES COMMITTEE THREAT CATEGORY	**EXTREME**

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

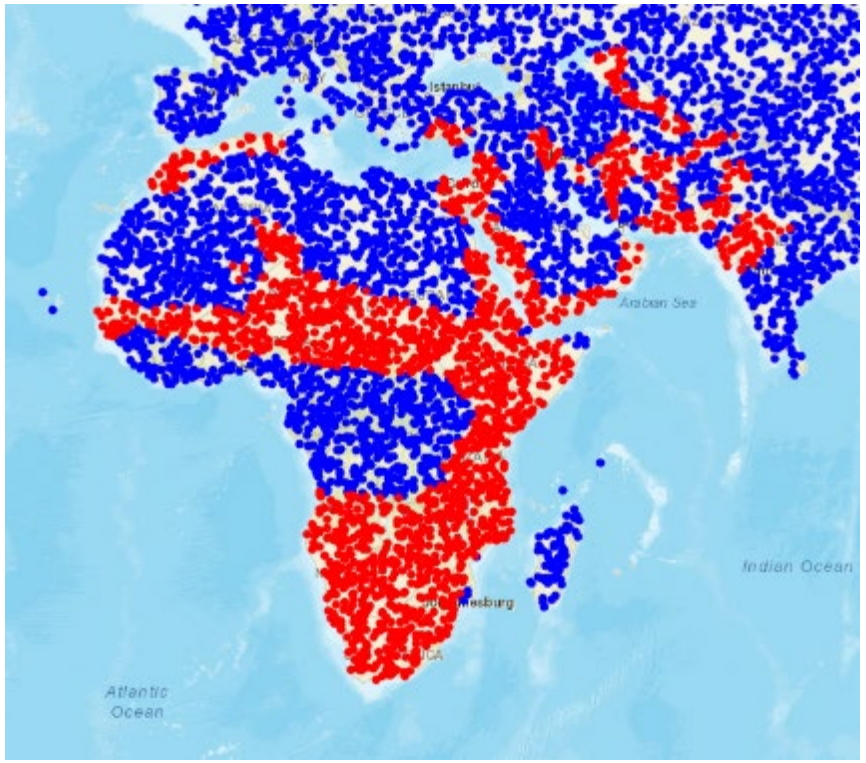
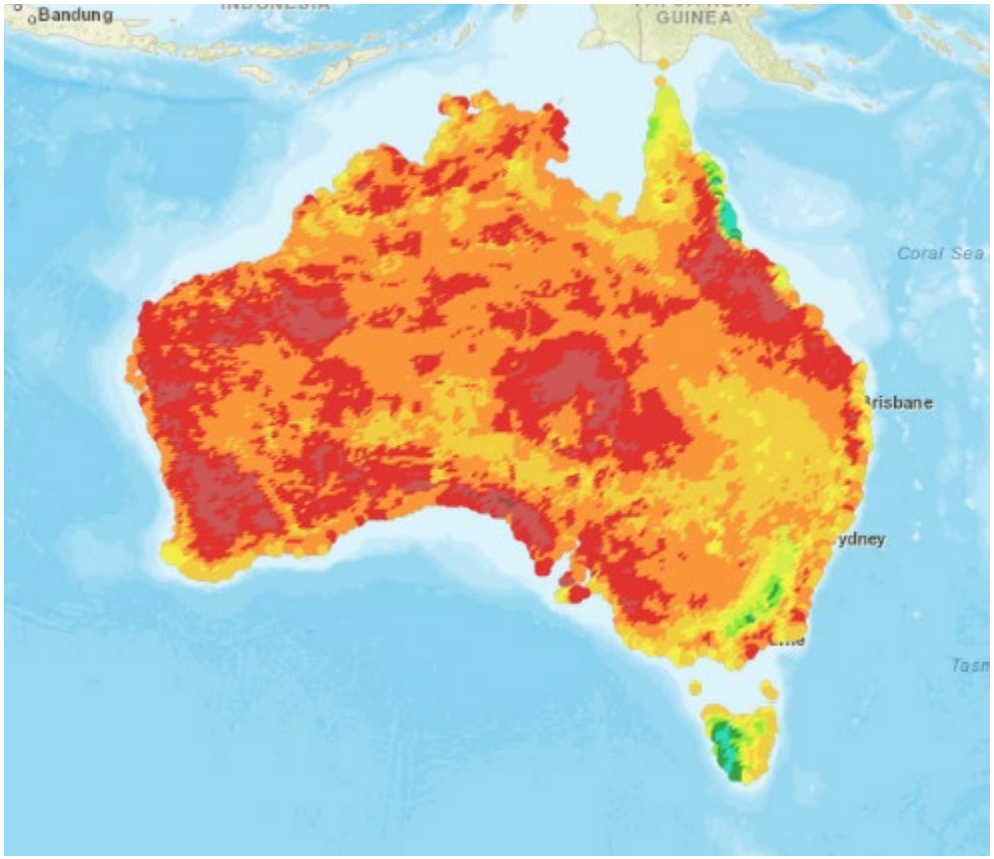


Figure 2 - World Distribution Map - Climatch

Climate match between world distribution of species and Australia:

Areas of Australia where the climate appears suitable for *Caracal caracal*

CMS = 18,336



Score	Color	Count
0		0
1		41
2		48
3		96
4		182
5		533
6		3328
7		8318
8		5373
9		1307
10		10

Species: Caracal caracal (Caracal)
Algorithm: Closest Standard Score
1945 source features selected
19236 target features selected
Approximate selected area: 21,525,827 km^2

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 2005 – 2006 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)**
Cattle (includes dairy and beef)	*11*			
Timber (includes native and plantation forests)	*10*			
Cereal grain (includes wheat, barley sorghum etc)	*8*			
Sheep (includes wool and sheep meat)	*5*	3	4	60
Fruit (includes wine grapes)	*4*			
Vegetables	*3*			
Poultry and eggs	*1.5*	3	4	18
Aquaculture (includes coastal mariculture)	*2*	1	4	8
Oilseeds (includes canola, sunflower etc)	*1*			
Grain legumes (includes soybeans)	*1*			
Sugarcane	*1*			
Cotton	*1*			
Other crops and horticulture (includes nuts tobacco and flowers etc)	*1*			
Pigs	*1*	3	4	12
Other livestock (includes goats, deer, camels, rabbits)	*0.5*	3	4	6
Bees (included honey, beeswax and pollination)	*0.5*			
Total Commodity Damage Score (TCDS)				104

NB The Commodity Value Index scores in this table are derived from Australian Bureau of Statistics 2005–2006 data and will need to be updated if these values change significantly.

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:	Tasmanian Government Risk Assessment for Caracal, July 2019	**By:** Jodi Buchecker	**Date:** Feb 2021

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National Risk Assessment: SERIOUS

RISK ASSESSMENT FOR AUSTRALIA: # Red-fronted Parakeet (*Cyanoramphus novaezelandiae*)

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

SPECIES: *Cyanoramphus novaezelandiae* (Sparrman, 1787) **Synonyms:** *Psittacus novaezelandiae* – (Sparrman, 1787) *Cyanoramphus novaezelandiae erythrotis* (Wagler, 1832) – Extinct **Subspecies:** *Cyanoramphus novaezelandiae novaezelandiae (*Sparrman, *1787)* – New Zealand Red-crowned Parakeet *Cyanoramphus novaezelandiae chathamensis* (Oliver, 1930) – Chatham Island Red-crowned Parakeet *Cyanoramphus novaezelandiae cyanurus* (Salvadori, 1891) – Kermadec Red-crowned Parakeet **Common Names:** Red-fronted Kakariki	**Species description:** The red-fronted parakeet is a medium sized parrot (length 25-27 centimetres, wingspan 32-38 centimetres, weight: males 80 grams and females 70 grams), with a long tail and predominately green plumage (Higgins, 1999). It is recognisable by its distinctive, bright green plumage, dark-blue outer upper wings and diagnostic crimson forecap, eyestripe and rump side patches. The bill is white to pale blue grey and the legs and feet are grey to dark grey or pale brown. The sexes are alike in plumage, but the female is slightly smaller, with a smaller narrower bill. There is no seasonal variation in the plumage (Higgins, 1999). This bird has a unique and unusual voice, which is sometimes likened to the bleating of a goat (Encyclopedia of Life, 2011). Juveniles are very similar to adults with a slightly smaller crimson forecap. The crimson patch on the sides of the upper rump is much smaller, and the pale underwing bar is very prominent and slightly longer. Young juveniles are best distinguished by the colour of the bare parts; the bill is wholly pink or pink at the base grading to grey at the tip and the legs and feet are a paler pink grey (Higgins, 1999). There are several colour variations in the plumage of the red-fronted parakeet, most being the replacement of green plumage with some other colour. Yellow colour morphs are rare in the wild but common in captivity, in which the green plumage is replaced by pale yellow but the red and blue markings are unchanged (Higgins, 1999). All subspecies and ages possess a diagnostic crimson forecap and eyestripe extending behind. The subspecies *C. n. cyanurus* has bluer flight feathers with a greenish tail and *C. n. chathamensis* has a bright emerald face. Of the other *Cyanoramphus* species, *C. cookii* (Norfolk Island Parakeet) and *C. hochstetteri* (Reischek's Parakeet) are both very similar to *C. novaezelandiae* but both are larger. *C. hochstetteri* is also more yellowish in colouration compared to *C. novaezelandiae. C. saisseti* (New Caledonian Parakeet) is also more yellowish in colouration and the red is lighter and brighter (del Hoyo et al., 1997). **General information:** The historical distribution of the red-fronted parakeet was centred on New Zealand and extends north to New Caledonia, south to Macquarie Island, west to Lord Howe Island and east to Kermadec and Chatham Islands. In New Zealand it was formerly widespread, but the range is now much reduced. It is now extinct on the mainland

Red-fronted Parakeet Red-crowned Parakeet New Zealand Parakeet Kermadec Red-crowned Parakeet Chatham Island Red-crowned Parakeet New Zealand Red-crowned Parakeet Red-fronted New Zealand Parakeet Green Parrot (Norfolk Island) Maori names include: Kakariki, Porete, Kaka-wariki, Powhaitere and Kawariki.	(recent records are now believed to be caged escapees/releases or vagrants from offshore island populations) but recorded on many nearshore and offshore islands (Higgins, 1999). Past population estimates suggest the total population was more than 20,000 individuals, but historically the island populations were part of an effectively panmictic population. When the mainland linking populations became extinct, the island populations became isolated, and their effective population sizes are now much reduced. Declines are likely to be taking place on Stewart Island, by inference from measured declines of other species owing to rat and cat predation (Birdlife International, 2008). Populations currently exist on the Kermadec islands, Three Kings, some Hauraki Gulf islands, Kapiti Island, Stewart Island and surrounding islands, Chatham Islands, Snares, Antipodes Islands and Auckland Islands (Birdlife International, 2008). This species was formerly abundant but is now extinct on Macquarie Island and Lord Howe Island (Higgins, 1999). Red-fronted parakeets are found in a wide variety of habitats ranging from the Tropics to Subantarctic, including dense temperate rainforests, coastal forest, scrubland, forest edges and open areas. They may also occur in some habitats much modified by clearance or browsers. On Meyer Island (Herald Group, Kermadec Island) this species is abundant in coastal shrub, stunted forest and steep rocky slopes vegetated by low shrubs, herbs, sedges and a variety of salt tolerant species. On Macauley Island, it is abundant in dense highly modified vegetation of sedges and scattered trees. On Norfolk Island, it occurs in tall dense remnant rainforest and other native vegetation and is also recorded in *Eucalyptus* plantations, orchards and gardens. On the Chatham Islands, they mostly inhabit grassland in winter and move to forest during summer. On Subantarctic islands (Auckland Islands and Antipodes Islands), the red-fronted parakeet is most common in low open vegetation such as sedges and tussocks (Higgins, 1999). Red-fronted parakeets occur throughout the year in most habitats. Adults exhibit little movement before or after breeding. Birds regularly move between islets in island groups and can cross wide expanses of sea. There is possibly some altitudinal movement, most likely as a response to availability of food. On Little Barrier Island, they move from *Leptospermum* and *Agathis-Nothofagus* forests to low coastal vegetation in April. On Mangere Island, they shift from open grass habitats in winter to taller forests in summer. On Norfolk Island, they visit gardens when trees are fruiting (Higgins, 1999). The red-fronted parakeet is omnivorous, feeding mainly on plant material but also on invertebrates and marine molluscs, and will occasionally scavenge animal carrion, including birds. It prefers to feed in the canopy, but in open habitats feeds on the ground (Greene, 1998) The birds forage singly, in pairs or in loose flocks of up to 30 birds, feeding at all levels from the ground to the outermost canopy, depending on the structure of the habitat. They mostly feed in the morning and afternoon, although feeding on limpets on Macauley Island (Kermadec

	Group) is determined by tides. They move quickly over the substrate with frequent short pauses to feed and may use their feet to scratch at the surface to expose seeds or invertebrates. They will often hold food in one foot when feeding and mainly feed by biting the food item and then chewing, crushing, peeling or husking. They are a destructive feeder and seed predator and often create large amounts of debris. Their presence is often betrayed by the continual clicking of mandibles, the steady stream of discarded fragments and occasional calls. Red-fronted parakeets need water and regularly drink throughout the day (Higgins, 1999). Red-fronted parakeets live in permanent pairs. These pair will frequently join with other pairs and their young and have been observed to form small flocks in the autumn and winter (Encyclopedia of Life, 2011). Breeding appears to be related to climate, conditions and seasonal availability of food, and has been recorded in all months of the year, with main periods of laying varying throughout the range. On islands around New Zealand, they generally breed in October to February. On Norfolk Island, laying is recorded in all months; on Kermadec Island, they lay mainly in October and November; on Chatham Island, most eggs are laid October to December; and in the Antipodes nests are found from November to March (Higgins, 1999). Roosting sites must have dense cover. Red-fronted parakeets' nest in a tree hollows or cavities in limbs, trunks and stumps of living or dead trees. In areas lacking suitable tree hollows, they will nest in holes in cliffs, banks, root-mass of fallen trees, in rock crevices and in burrows of petrels and prions (Higgins, 1999). The red-fronted parakeet will also use tunnels in the dense crowns of ferns and matted vegetation such as epiphytes, tussocks or sedges as a nesting site. They loaf in trees or on the ground in areas sheltered from wind, either in direct sunlight or available shade. The red-fronted parakeet usually only breeds in native vegetation, preferring larger trees, particularly *Metrosideros*, *Vitex*, *Nothofagus*, *Olearia* and *Plagianthus* (Higgins, 1999). The age at first pairing and breeding in the wild is unknown. However, 1 juvenile female, only 1 week after reaching independence, was seen repeatedly with an adult male and behaving as a mated pair. In captivity, the red-fronted parakeet is said to first breed less than 1 year old (Higgins, 1999). Eggs are broadly elliptical, smooth, lustreless and white. The average clutch size is 7 and incubation is done by only the female for a period of 18-21 days. The fledging period varies throughout the range from 5-7 weeks and both parents care for the young. After fledging the young remain near the nest for the first 2 weeks and then begin to feed themselves and form family groups. There is usually only 1 successful breeding attempt in a season (Higgins, 1999). **Longevity:** The maximum recorded longevity for this species is 12.4 years in captivity (AnAge, 2011). **Conservation status:**

	IUCN: Least Concern **CITES:** Appendix I
DATE OF ORIGINAL ASSESSMENT: April 2011 **DATE OF CURRENT ASSESSMENT:** Feb 2021 (Jodi Buchecker) **EIC ENDORSEMENT:** 17/11/21 **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).*	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, 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.		
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, CMS = sum of classes 6 – 10, see Table 1.*	1	*Very low climate match in Australia.* Value X = 491 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 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.* There is no record found of an exotic population of red-fronted parakeet established overseas.
B3. Overseas range size score (0–2) < 1 = 0; 1– 70 = 1; >70 = 2	0	*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*		Range = ~269,260 km^2
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.* The red-fronted parakeet is omnivorous, feeding mainly on plant material but also on invertebrates and marine molluscs. The red-fronted parakeet will occasionally scavenge animal carrion, including birds.
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.* They may also occur in some habitats that have been modified by clearance or browsers.
B7. Migratory score (0–1) *Always migratory = 0; non-migratory = 1*	1	*Non-migratory*
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 (Psittaciformes) = 2* *Bird in one of the families likely to hybridise with native species (Psittacidae), and if there are relatives in the same genus among Australian native birds, family = 1.*

		No native species of the same genus, however parrots are commonly known to hybridise so +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 geographic range less than 10 million square kilometres.* Range = ~250,000 km^2
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.* The red-fronted parakeet will nest in tree holes, cliff banks, natural fissures in rocks, burrows in the ground or natural vegetation.
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 record found of species being 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	*One or more susceptible native species or ecological communities that are listed as vulnerable or endangered under the Australian Government Environment Protection and Biodiversity Conservation Act 1999 has a restricted geographic range that lies within the mapped area of the highest six climate match classes (ie in classes 10, 9, 8, 7, 6, and 5) for the exotic species being assessed = 5* Examples of susceptible native species or ecological communities (DAWE Protected Matters Search Tool) include: *Neophema chrysogaster* (Orange-bellied Parrot) – Critically Endangered *Lathamus discolor* (Swift Parrot) – Critically Endangered
C7. Overseas primary production pest status (0–3)	2	*Moderate pest of 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?		The red-fronted parakeet was formerly persecuted because birds damage crops and gardens. They were shot and trapped on Lord Howe Island. In New Zealand, Norfolk and Macquarie Island, red-fronted parakeets were shot as pests of crops by early settlers. Norfolk Island convicts were said to drive birds away from ripening corn (Birdlife International).
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*	4	Total Commodity Damage Score = 108 (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* Low 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).*	0	*Nil risk.*
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

0 = Not dangerous; 1 = Moderately dangerous; ≥ 2 = Highly 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*	18	Serious pest risk

ENVIRONMENT AND INVASIVES COMMITTEE THREAT CATEGORY	**SERIOUS**

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

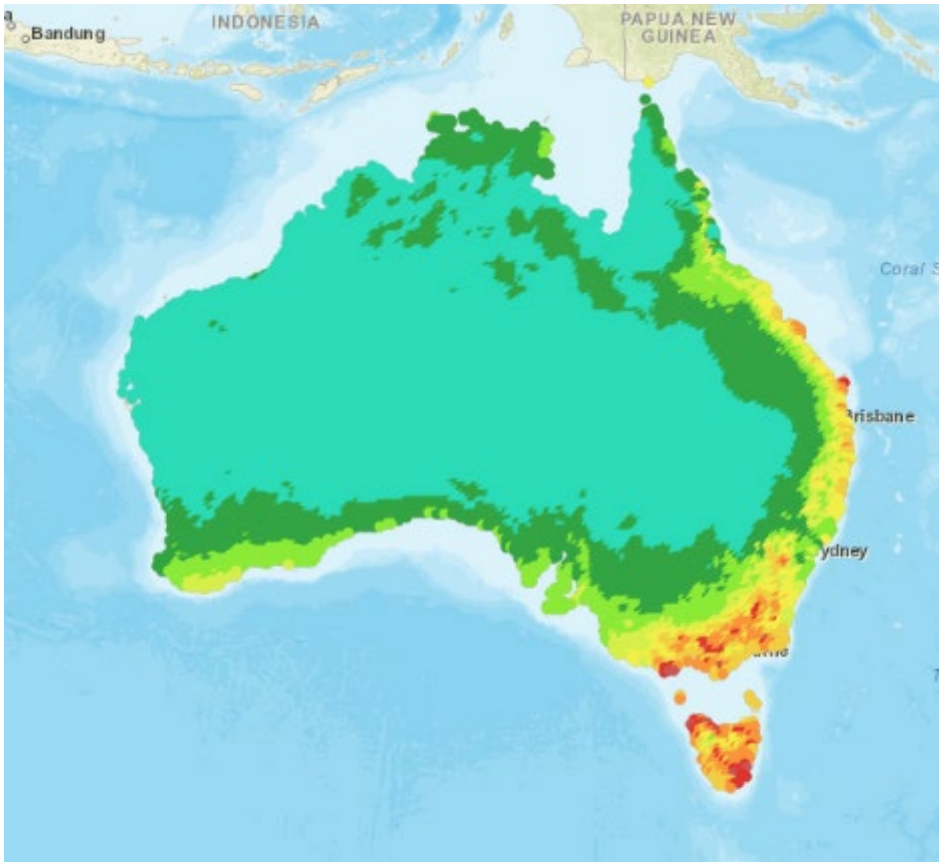
Figure 1 - World Distribution Map - IUCN Red List

Figure 2 - World Distribution Map - Climatch

Climate match between world distribution of species and Australia:

Areas of Australia where the climate appears suitable for *Cyanoramphus novaezelandiae*

CMS = 491



Score	Color	Count
0		0
1		13177
2		3816
3		1017
4		409
5		326
6		238
7		185
8		56
9		12
10		0

Species: Cyanoramphus novaezelandiae (Red-fronted Parakeet)
Algorithm: Closest Standard Score
46 source features selected
19236 target features selected
Approximate selected area: 244.495 km^2

Table 1: ABARES recalibration thresholds

Climate Match Score (CMS)	Current Bomford 2008 model classes (50 km)	Recalibrated classes to Climatch v2.0 (20 km)
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 2005 – 2006 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)**
Cattle (includes dairy and beef)	*11*			
Timber (includes native and plantation forests)	*10*			
Cereal grain (includes wheat, barley sorghum etc)	*8*	2	3	48
Sheep (includes wool and sheep meat)	*5*			
Fruit (includes wine grapes)	*4*	2	3	24
Vegetables	*3*	2	3	18
Poultry and eggs	*2*			
Aquaculture (includes coastal mariculture)	*2*			
Oilseeds (includes canola, sunflower etc)	*1*	2	3	6
Grain legumes (includes soybeans)	*1*	2	3	6
Sugarcane	*1*			
Cotton	*1*			
Other crops and horticulture (includes nuts tobacco and flowers etc)	*1*	2	3	6
Pigs	*1*			
Other livestock (includes goats, deer, camels, rabbits)	*0.5*			
Bees (included honey, beeswax and pollination)	*0.5*			
Total Commodity Damage Score (TCDS)				108

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:	Tasmanian Government Risk Assessment for Red-fronted Parakeet (*Cyanoramphus novaezelandiae*), 2011	**By:** Jodi Buchecker	**Date:** Feb 2021

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National Risk Assessment: MODERATE

RISK ASSESSMENT FOR AUSTRALIA: Red Lory (*Eos bornea*)

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

SPECIES: *Eos bornea* (Linnaeus, 1758) **Synonyms:** *Eos rubra* (Linnaeus, 1758) *Psittacus borneus* (Linnaeus, 1758) *Trichoglossus borneus* (Linnaeus, 1758) *Trichoglossus borneus cyanonothus* (Vieillot, 1818) **Subspecies:** *Eos bornea cyanonotha* (Vieillot, 1818) *Eos bornea bornea* (Linnaeus, 1758) **Common Names:** Red Lory	**Species description:** Adult red lories grow to 31 centimetres in length, have a wingspan of 16-17 centimetres, weigh around 180 grams and have a bill length of 2.2‑2.5 centimetres. Male and females have identical external appearances, while juveniles are duller and have brown irises and a brownish beak. Lory breeders depend on DNA or endoscopic sexing to determine sex. Adult red lories are redder than any other member of the *Eos* genus. The red lory is almost entirely all red. All the plumage of the upper body is red. However, in contrast, the primary feathers are black and the secondaries are tipped with black. Although the wings are red, there is blue on the coverts. The tail is reddish black with the underside dull red. The eye ring is bluish black, with a red iris and the beak is orange. There is no bare skin at the base of the lower mandible. Their bills are narrow and less powerful than other types of parrots. Apart from their almost entirely red colour a defining characteristic of a lory is their brush tongues with papillae at the tips to help them feed on pollen and nectar. The legs are grey but the cere and feet are dark blue-black. Little seasonal variations in appearance have been recorded for the red lory. The red lory is dissimilar to Australian parrots in appearance simply because of its dominant red colouration. Most Australian parrot species have green and blue colourings. Red can be present, but it is not a dominant colouring. **General information:** The Red Lory is endemic to the Malucu Islands and surrounding islands in Indonesia and has a natural range of approximately 57,900 km^2. The habitat of the red lory in the Maluku Islands is a tropical wet climate with no dry or cold season. The average annual temperature is 27.1 degrees Celsius with average lows of 21 and highs of 31. Average annual precipitation is 3,459 millimetres (ClimaTemps.com). Red lories nest in tree hollows of old tress, generally high up in the canopy and forage on nectar of *Eugenia* and *Erythrina* species. Red lories generally occupy the coastal regions, lowland forest, mangroves, secondary forest and coconut plantations in areas with fruit or flower carrying trees and bushes. They generally inhabit the lower altitudes but have been observed up to 1,200 meters above sea level.

	In the wild, red lories eat nectar, flowers and insects, especially those found in *Eugenia* and *Erythrina* trees. They will also eat the green seeds found in the fresh fruit. In captivity, red lories will eat fruits and vegetables. Red lories are conspicuous and often occur in large flocks of up to 50 especially to feed. When travelling between islands in their home range they occur in smaller flocks and have been observed flying fast and high. In captivity, they can be territorial and will defend chicks even attacking cats and dogs. Red lories become sexually mature around 8 months and can produce up to 3 clutches per year, each with 2 eggs. Incubation takes approximately 25 days and the young fledge between 7-9 weeks. The fledglings can be independent in a further 3-4 weeks. No information was found regarding age at which breeding ceases, or if females can store sperm, although some lories have been known to lay fertile eggs at age of 20. The red lory is not recorded in the Global Invasive Species Database, managed by the Invasive Species Specialist Group (ISSG) of the IUCN Species Survival Commission. No records of the species being a pest and causing damage to the environment or agriculture were found. No records were found of the species spreading rapidly following release in new environments. **Longevity:** Red Lories generally live to between 15 and 28 years of age. **Conservation status:** **IUCN**: Least Concern **CITES:** Appendix II
DATE OF ORIGINAL ASSESSMENT: 22 March 2016 **DATE OF CURRENT ASSESSMENT:** Feb 2021 (Jodi Buchecker) **EIC ENDORSEMENT:** 17/11/21 **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 (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).* Red lories, being a medium-sized Psittacine species, are not equipped to cause any serious harm to members of the public. A lack of claws or talons, or a ripping beak and its small size prevents injury from being likely.
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, CMS = sum of classes 6 – 10, see Table 1.*	1	*Very low climate match in Australia.* Value X = 12 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 intentionally fed or sheltered, even though they may be living in a highly disturbed environment with access to non-natural food supplies or shelter.*	2	*Exotic populations only established on small islands (< 50 000 km2; Tasmania is 67 800 km^2).* While many thousands of birds are believed to have been taken from the wild for illegal trade, little is recorded about introduced populations, and no records were found that mentioned feral establishments or hybridisation with wild populations. References to the red lory being introduced to Taiwan (Republic of China) are vague in literature however it appears this occurred during 1980-1990's (Taiwan Biodiversity Information Facility).
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 between 1 to 70 million square kilometres.* Natural range is approximately 65,000 km^2.
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.* The red lory has a generalist diet.

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 red lory would be able to survive and breed in disturbed habitats
B7. Migratory score (0–1) *Always migratory = 0; non-migratory = 1*	1	*Non-migratory.*
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)	3	*Bird in one of the taxa that are particularly prone to cause agricultural damage (Psittaciformes) = 2* *Bird in one of the families likely to hybridise with native species (Psittacidae), and if there are relatives in the same genus among Australian native birds' family = 1.* No native species of the same genus, however parrots are commonly known to hybridise so +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 geographic range less than 10 million square kilometres.* Natural range is approximately 65,000 km^2.
C3. Diet and feeding (0–3)	0	*Not a mammal*
C4. Competition with native fauna for tree hollows (0–2)	2	*Uses 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.* There are no records of the red lory being considered as a pest. There is no reference in literature of the red lory causing damage to the environment or agricultural production.
C6. Climate match to areas with susceptible native species or communities (0–5)	2	*The species has no grid squares within the highest two climate match classes (ie in classes 9 and 10) that overlap the distribution of any susceptible native species or*

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.		*ecological communities, and has 1-62 grid squares within the highest four climate match classes, that overlap the distribution of any susceptible native species or ecological communities = 2* Examples of susceptible native species or ecological communities include (DAWE Protected Matters Search Tool): *Anthochaera phrygia* (Regent Honeyeater) – Critically Endangered *Lathamus discolor* (Swift Parrot) – 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?*	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*	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 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*
C11. Harm to people (0–5)	2	*Injuries, harm or annoyance likely to be minor and few people exposed: Low risk.*

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).		
C. PEST RISK SCORE SUM C 1 TO C 11 (1–37)	11	**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*	11	Moderate pest risk

ENVIRONMENT AND INVASIVES COMMITTEE THREAT CATEGORY	**MODERATE**

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

Figure 1- World Distribution Map - IUCN RedList

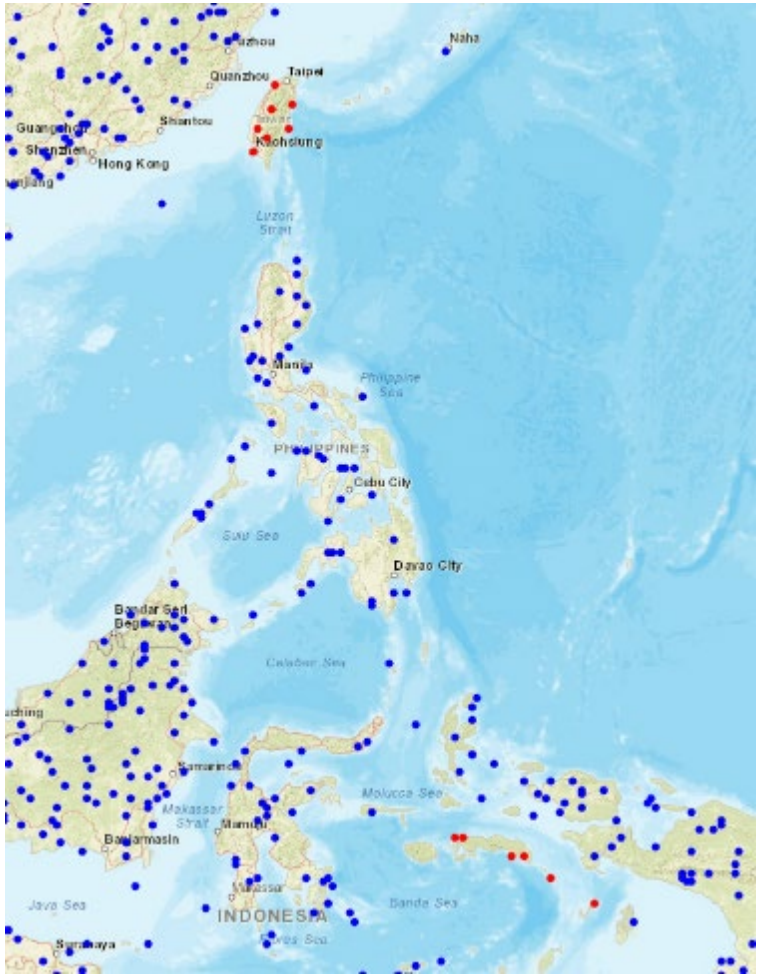
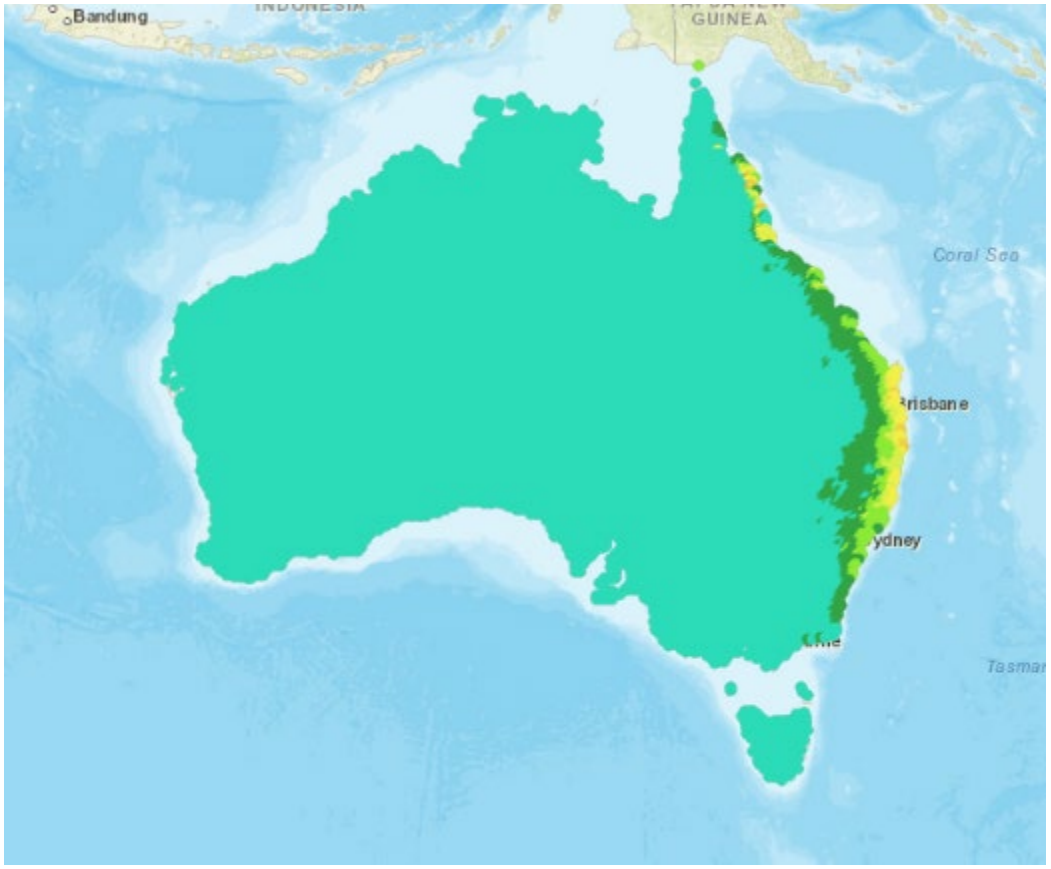


Figure 2 - World Distribution Map - Climatch

Climate match between world distribution of species and Australia:

Areas of Australia where the climate appears suitable for *Eos bornea*

CMS = 12



Score	Color	Count
0		0
1		18355
2		586
3		174
4		61
5		48
6		10
7		2
8		0
9		0
10		0

Species: Eos bornea (Red Lory)
Algorithm: Closest Standard Score
14 source features selected
19236 target features selected
Approximate selected area: 65,333 km^2

Table 1: ABARES recalibration thresholds

Climate Match Score (CMS)	Current Bomford 2008 model classes (50 km)	Recalibrated classes to Climatch v2.0 (20 km)
1 (Very low)	< 100	< 691
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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 2005 – 2006 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)**
Cattle (includes dairy and beef)	*11*			
Timber (includes native and plantation forests)	*10*			
Cereal grain (includes wheat, barley sorghum etc)	*8*	1	0	0
Sheep (includes wool and sheep meat)	*5*			
Fruit (includes wine grapes)	*4*	1	0	0
Vegetables	*3*	1	0	0
Poultry and eggs	*2*			
Aquaculture (includes coastal mariculture)	*2*			
Oilseeds (includes canola, sunflower etc)	*1*	1	0	0
Grain legumes (includes soybeans)	*1*	1	0	0
Sugarcane	*1*			
Cotton	*1*			
Other crops and horticulture (includes nuts tobacco and flowers etc)	*1*	1	0	0
Pigs	*1*			
Other livestock (includes goats, deer, camels, rabbits)	*0.5*			
Bees (included honey, beeswax and pollination)	*0.5*			
Total Commodity Damage Score (TCDS)				0

NB The Commodity Value Index scores in this table are derived from Australian Bureau of Statistics 2005–2006 data and will need to be updated if these values change significantly.

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:	DPIPWE (2016) Species Profile: (*Eos bornea*). Department of Primary Industries, Parks, Water and Environment, Hobart, Tasmania.	**By:** Jodi Buchecker	**Date:** Feb 2021

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National Risk Assessment: SERIOUS

RISK ASSESSMENT FOR AUSTRALIA: Peach-fronted Conure (*Eupsittula aurea*)

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

SPECIES: *Eupsittula aurea* (Gmelin, 1788) **Synonyms:** *Aratinga aurea* (Gmelin, 1788) *Psittacus aureus* (Gmelin,1788) **Subspecies:** Monotypic **Common Names:** Peach-fronted Parakeet Peach-fronted Conure Golden-crowned Conure	**Species description:** The peach-fronted conure has a peach cap, yellow round the eye and green plumage. Adults grow to an approximate length between 250-270 millimetres and have an average weight of 75 grams. Peach-fronted conures are sexually monomorphic. Juvenile peach-fronted conures resemble adults, with a much smaller peach crown and no yellow eye ring. **General information:** The peach-fronted conure is native to eastern Brazil, Bolivia, Paraguay, far northern Argentina and southern Suriname. It has an extremely large range, and the population appears to be stable. Occurs in open woodland areas including deciduous forest, gallery woodland, Mauritia palm swamp and savanna as well as cultivated areas. Around the Amazon basin, the peach-fronted conure occurs in low scrubby vegetation on sandy soil. In interior Eastern Brazil, the peach-fronted conure occupies Caatinga and Cerrado areas with grassland below 600 metres. The peach-fronted conure feeds in trees and on the ground, often eating seeds, flowers and insects including termites and larvae of beetles, flies and moths in the company of other parrot species. Peach-fronted conures reach sexual maturity between 12 to 24 months and will usually have 1 or 2 clutches per year 1 or 2. The breeding season is from June-July in Peru and in January in Mato Grosso. Eggs per nest 3-4. Incubation 24-25 days. Fledge at ~7-8 weeks. Independent ~2-3 weeks post-fledge. The peach-fronted conure is typically found in pairs during the breeding season. Outside of this season, the peach-fronted conure is found in groups of 10-30 birds and will roost communally. **Longevity:** Approximately 20 years or more **Conservation status:** **IUCN:** Least concern **CITES:** Appendix II

DATE OF ORIGINAL ASSESSMENT: May 2012 **DATE OF CURRENT ASSESSMENT:** Feb 2021 (Jodi Buchecker) **EIC ENDORSEMENT:** 17/11/21 **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*	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).* Unlikely to cause injury requiring hospitalisation.

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.		
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, CMS = sum of classes 6 – 10, see Table 1.*	2	*Low climate match in Australia.* Value X = 2,073 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.* Literature search did not show any exotic populations of this species establishing outside natural range.
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.* The range of the peach-fronted conure is approximately 6.4 million km^2.

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.* Generalist diet of seeds, flowers, leaves and insects, often feeding on the ground.
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.* Peach-fronted conures live in diverse habitats and have adapted to the encroachment of people into their areas (BirdLife International, 2020).
B7. Migratory score (0–1) *Always migratory = 0; non-migratory = 1*	1	*Non-migratory.*
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)	3	*Bird in one of the taxa that are particularly prone to cause agricultural damage (Psittaciformes) = 2.* *Bird in one of the families likely to hybridise with native species (Psittacidae), and if there are relatives in the same genus among Australian native birds = 1.* The family is likely to cause agricultural damage and could hybridise with native species.
C2. Overseas range size including current and past 1000 years, natural and introduced range (0–2)	0	*Overseas geographic range less than 10 million square kilometres.*

Estimate the species overseas range size (including current and past 1000 years, natural and introduced range) in millions of square kilometres		The range of the peach-fronted conure is approximately 6.4 million km^2.
C3. Diet and feeding (0–3)	0	*Not a mammal.* Bird species.
C4. Competition with native fauna for tree hollows (0–2)	2	*Can nest or shelter in tree hollows.* Utilises tree hollows for nesting sites.
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.* Not found in the wild outside of its natural range.
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 and/or has more than 691 grid squares within the highest four 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): *Anthochaera phrygia* (Regent Honeyeater) – Critically Endangered *Lathamus discolor* (Swift Parrot) – 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?*	1	*Minor pest of primary production in any country or region.* Although the peach-fronted conure is recorded as a pest of soybeans, rice and corn in Brazil, a questionnaire to producers about pest damage to agriculture in south-eastern Brazil did not list the peach-fronted conure (de Carvalho, 2019).

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 = 40 (see Table 2) Has the potential to impact cereal crops.
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.* The peach-fronted conure is unlikely to harm 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).*	2	*Injuries, harm or annoyance likely to be minor and few people exposed: Low risk.* When grouped together, peach-fronted conures may be considered a nuisance due to their vocalisations.
C. PEST RISK SCORE **SUM C 1 TO C 11 (1–37)**	17	**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*	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)**	3	Low 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*	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*	17	Serious pest risk

ENVIRONMENT AND INVASIVES COMMITTEE THREAT CATEGORY	**SERIOUS**

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

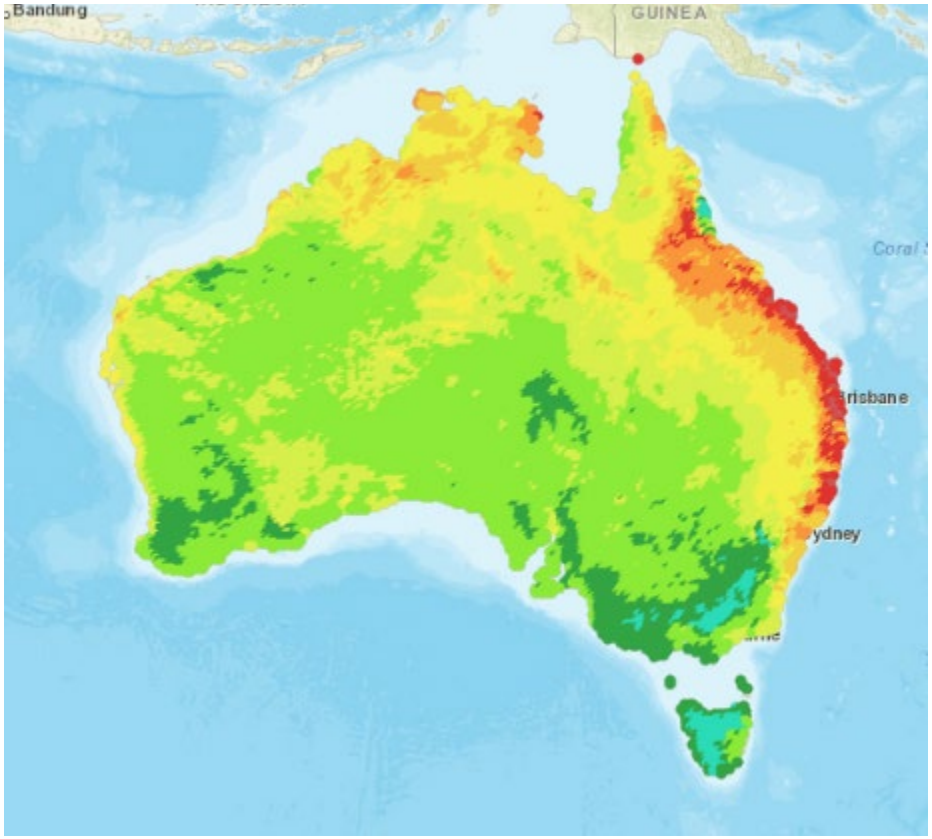
Figure 1 - World Distribution Map - IUCN RedList

Figure 2 - World Distribution Map - Climatch

Climate match between world distribution of species and Australia:

Areas of Australia where the climate appears suitable for *Eupsittula aurea*

CMS = 2073



Score	Color	Count
0		0
1		208
2		1278
3		8269
4		4245
5		3163
6		1204
7		606
8		229
9		34
10		0

Species: Eupsittula aurea (Peach-fronted Conure)
Algorithm: Closest Standard Score
586 source features selected
19236 target features selected
Approximate selected area: 6,376,651 km^2

Table 1: ABARES recalibration thresholds

Climate Match Score (CMS)	Current Bomford 2008 model classes (50 km)	Recalibrated classes to Climatch v2.0 (20 km)
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 2005 – 2006 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)**
Cattle (includes dairy and beef)	*11*			
Timber (includes native and plantation forests)	*10*			
Cereal grain (includes wheat, barley sorghum etc)	*8*	2	2	32
Sheep (includes wool and sheep meat)	*5*			
Fruit (includes wine grapes)	*4*			
Vegetables	*3*			
Poultry and eggs	*2*			
Aquaculture (includes coastal mariculture)	*2*			
Oilseeds (includes canola, sunflower etc)	*1*			
Grain legumes (includes soybeans)	*1*	2	4	8
Sugarcane	*1*			
Cotton	*1*			
Other crops and horticulture (includes nuts tobacco and flowers etc)	*1*			
Pigs	*1*			
Other livestock (includes goats, deer, camels, rabbits)	*0.5*			
Bees (included honey, beeswax and pollination)	*0.5*			
Total Commodity Damage Score (TCDS)				40

NB The Commodity Value Index scores in this table are derived from Australian Bureau of Statistics 2005–2006 data and will need to be updated if these values change significantly.

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:	Tasmanian Government risk assessment for Peach-fronted Conure, May 2012	**By:** Jodi Buchecker	**Date:** Feb 2021

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National Risk Assessment: EXTREME

RISK ASSESSMENT FOR AUSTRALIA: Crab-eating Macaque (*Macaca fascicularis*)

Class - Mammalia**, Order -** Primates**, Family -** Cercopithecidae**, Genus -** *Macaca*.

SPECIES:
Macaca fascicularis (Raffles, 1821)

Subspecies:

1. *M. f. atricepts* (Kloss, 1919)
2. *M. f. aurea* (Saint-Hilaire, 1831)
3. *M. f. condorensis* (Kloss, 1926)
4. *M. f. fascicularis* (Raffles, 1821)
5. *M. f. fuscua* (Miller, 1903)
6. *M. f. karimondjawae* (Sody, 1949)
7. *M. f. lasiae* (Lyon, 1916)
8. *M. f. tua* (Kellogg, 1944)
9. *M. f. umbrosus* (Miller, 1902)

Synonyms:

***1. M. f. atricepts* (Kloss, 1919)**

***2. M. f. aurea* (Saint-Hilaire, 1831)**

Macaca fascicularis aureus (Saint-Hilaire, 1831)
Macacaus aureus (Saint-Hilaire, 1831)
Pithecus vitiis (Elliot, 1910)

***3. M. f. condorensis* (Kloss, 1926)**

***4. M. f. fascicularis* (Raffles, 1821)**

Pithecus mindorus (Hollister, 1913)
Macacus fur (Slack, 1867)
Cynamolgus mindanensis (Mearns, 1905)
Macacus palpebrosus (Saint-Hilaire, 1851)
Simia aygula (Linnaeus, 1758)

Species description:
The fur of the crab-eating macaque is basically uniformly coloured, varying slightly from light brown or greyish yellow to dark brown or grey, while the fur on the underside surface is lighter (Fa, 1989; Rowe, 1996, cited in WPRC, 2010). The face is pinkish brown and thinly haired, with sharp white colourations on the eyelids (Fooden, 2005). Fur on the head sweeps back over the forehead and often creates a rest of hair at the top of the head (WPRC, 2010).
The tail is exceptionally long in this species (measuring between 40–65 centimetres) and is usually longer than the length from head to rump (Fa, 1989 cited in WPRC, 2010). Tail length can be used to distinguish crab-eating macaques from similar species such as Rhesus monkeys (*Macaca mulatta*) and Japanese macaques (*Macaca fuscata*).
Crab-eating macaques are sexually dimorphic. Males are larger than females, weighing between 4.7-8.3 kilograms, and measuring 41.2-64.8 centimetres. Comparatively, females weigh between 2.5-5.7 kilograms and measure 38.5-50.3 centimetres (Fa, 1989 cited in WPRC, 2010). Both sexes have cheek whiskers however, males have moustaches whereas females just have beards (Fooden, 2005; WPRC, 2010). Males also have larger canine teeth in comparison to females. Fur in adult males tends to be longer and sleeker than fur of juveniles and females (Fooden, 2005; WPRC, 2010).
Infants are born with a black natal coat, which they start losing at 2-3 months. Juveniles begin to resemble adults in appearance after one year (Fooden, 2005).
Hybrids of crab-eating macaques and Rhesus monkeys showed transitional characteristics of tail length and coat colours of the two species, particularly where species' ranges overlap in the Indo-Chinese Peninsula (Fooden, 2005).

General information:
Crab-eating macaques are native to much of Southeast Asia and have been noted as one of the most geographically wide-spread and abundant non-human primate species in the world. They have been deliberately introduced to a variety of small tropical islands, commonly for biomedical research.

Simia cynomolgus (Schreber, 1775) *Macacus carbonarius* (Cuvier, 1825) *Macaca irus* (Saint-Hilaire, 1826) *Semnopithecus kra* (Lesson, 1830) *Semnopithecus buku* (Martin, 1838) *Cynamolgus cynocephalus* (Reichenbach, 1862) *Macacus pumilus* (Miller, 1900) Macacus phaeura (Miller, 1903) *Macaca mordax* (Thomas and Wroughton, 1909) *Macaca resima* (Thomas and Wroughton, 1909) *Pithecus validus* (Elliot, 1909) *Pithecus alacer* (Elliot, 1909) *Pithecus karimoni* (Elliot, 1909) *Pithecus agnatus* (Elliot, 1910) *Pithecus dollmani* (Elliot, 1909) *Pithecus bintangensis* (Elliot, 1909) *Pithecus lapsus* (Elliot, 1910) *Pithecus lingungensis* (Elliot, 1910) *Pithecus lautensis* (Elliot, 1910) *Pithecus sihassensis* (Elliot, 1910) *Pithecus carimatae* (Elliot, 1910) *Pithecus mandibularis* (Elliot, 1910) *Pithecus baweanus* (Elliot, 1910) *Pithecus cupidus* (Elliot, 1910) *Pithecus impudens* (Elliot, 1910) *Pithecus capitalis* (Elliot, 1910) *Pithecus lingae* (Elliot, 1910) *Pithecus laetus* (Elliot, 1909) *Cynamolgus cagayanus* (Mearns, 1905) *Cynamolgus suluensis* (Mearns, 1905) *Cynomolgus mindanensis apoensis* (Mearns, 1905) *Macaca irus argentimembris* (Kloss, 1911) *Macacus cynomolgus cumingii* (Gray, 1870)	Crab-eating macaques are a pest in many introduced areas and the species is included on the Global Invasive Species Database list of 100 of the "World's Worst" invaders. In Mauritius, the introduced population has contributed to the extinction of the broad-billed parrot (*Lophopsittacus mauritianus*) and scops owl (*Scops commersoni*) as well as contributed to the decline of many endangered bird species including pigeons, parrots, birds of paradise and frogmouths. Small reptiles and large mammals have also been affected. The species has a significant impact on agriculture and consumes a wide variety of crops. Crab-eating macaques are frequently killed as agricultural pests, and some farmers have stopped planting crops due to damage caused. Crab-eating macaques are also noted for being a nuisance to humans. They may grab or take human possessions, threaten people by lunging, biting, following or chasing, and raid houses, bins and cars. Mobbing behaviour is observed occasionally. Crab-eating macaques are highly adaptable and can persist in a variety of habitats. Their distribution is limited to tropical, humid climates with high rainfall (WPRC, 2010), including mangroves, swamp forests, evergreen forests, agricultural areas and degraded habitat (Ong & Richardson, 2008). Suitable habitat is commonly found at sea level, but crab-eating macaques can be found up to elevations of 2,000 metres (Fooden, 2005). Crab-eating macaques are primarily arboreal but may range on the ground along riverbanks and seashore and in open areas (Sussman & Tattersal, 1981). They regularly enter bodies of water and can swim up to 100 metres (Furuya, 1965 cited in Fooden, 1995). At night, crab-eating macaques usually sleep in trees or dense protective vegetation near rivers (Fooden, 1995). Trees are also used during the day in providing protective cover from predators and food resources (Sussman & Tattersal, 1981). The species is not noted for using tree hollows. Crab-eating macaques are eclectic, primarily frugivorous feeders which may show short-term selectivity for specific plant species (Sussman & Tattersall, 1981; Yeager, 1996). Fruit composes approximately 66% of their diet, with leaves making up 17.2% and flowers 8.9% (Yeager, 1996). Insects make up 4.1% (Yeager, 1996), and considerable time is spent foraging for these. The diet may be supplemented with a variety of different species including snails, frogs, crustaceans, octopus, lizards and small birds (including bird eggs and chicks) (Fooden, 2005; Sussman & Tattersal, 1981; WPRC, 2010). Feeding is the most common daytime activity. When foraging, the group subdivides into smaller groups, which feed in different locations. They will travel in circuitous routes and modify their route depending on protective vegetation cover, feeding locations, resting sites and water sources (Sussman & Tattersal, 1981). Crab-eating macaques may travel up over 2 kilometres from the sleeping site to obtain food (Sussman & Tattersal, 1981).

Pithecus fascicularis limitis (Schwarz, 1913) *Macaca irus mansalaris* (Lyon, 1916) *Macaca irus sublimitus* (Sody, 1932) *Macaca irus submordax* (Sody, 1949) *Macaca irus sumbae* (Sody, 1933) **5. *M. f. fusca* (Miller, 1903)** *Macaca fascicularsis fuscus* (Miller, 1903) *Macacus fuscus* (Miller, 1903) **6. *M. f. karimondjawae* (Sody, 1949)** Not Applicable **7. *M. f. lasiae* (Lyon, 1916)** Not Applicable **8. *M. f. tua* (Kellogg, 1944)** Not Applicable **9. *M. f. umbrosus* (Miller, 1902)** *Macaca fascicularis umbrosus* (Miller, 1902) *Macacus umbrosus* (Miller, 1902) *M. f. philippensis* (Saint-Hilaire, 1843) *M. f. philippinensis* (Saint-Hilaire, 1843) **Common Names:** **1. *M. f. atricepts* (Kloss, 1919)** Dark-crowned Long-tailed Macaque **2. *M. f. aurea* (Saint-Hilaire, 1831)** Myanmar Long-tailed Macaque Burmese Long-taield Macaque **3. *M. f. condorensis* (Kloss, 1926)** Con Son Long-tailed Macaque **4. *M. f. fascicularis* (Raffles, 1821)** Common Long-tailed Macaque **5. *M. f. fusca* (Miller, 1903)**	Crab-eating macaques generally live in groups of 35 to 50 individuals, although some larger groups may have 100 individuals (Sussman & Tattersal, 1981). Groups exist in varying densities from 11 individuals per kilometre squared (Crockett & Wilson, 1980, cited in Fooden 2005) to 1,111 individuals per kilometre squared (Wheatley, 1999 cited in Sha et al., 2005a). Several males may exist in one group, but most of the group is female (Sussman & Tattersal, 1981). Reproductive events (mating, pregnancy and birth) can occur at any time throughout the year in natural populations, although long-term studies indicate that these events may peak seasonally (Fooden, 2005). Reproductive peaks vary geographically and by year and are thought to be influenced by the quality of the fruiting season between April and June, as peak births are delayed in years of low fruit production (Fooden, 2005). Females in natural populations may become reproductively active when they are about 3.5 years old, whereas captive females may breed earlier at 2.5 years (Chance et al. 1977, cited in Fooden et al. 2005). In the wild, males are usually reproductively active at 5-6 years once they have left their natal groups as sub-adults, whereas males in captive populations may breed earlier at around 3.5 years (Honjo et al. 1984, cited in Fooden, 2005). Dominant males participate in most breeding events and father the most offspring (Fooden, 2005). Females may opportunistically mate with multiple males, and engage in sneak copulations with subdominant males, however dominant males increase their paternity by engaging in mate guarding strategies (Engelhardt et al., 2006). Sperm storage has not been noted in this species. After a gestation of approximately 163 days (in a captive population recorded by Honjo et al., 1984, cited in Fooden, 2005), females have a single offspring which is raised on milk until they are about 2-3 months old when they can obtain some of their food independently (Fooden, 2005). Infants are carried by females during foraging trips (Sussman & Tattersal, 1981). Infanticide is committed by adult males and is a primary cause of infant deaths in this species (Thompson, 1967, cited in Fooden, 2005). Effective fertility in females is estimated to cease at around 20 years, and an average female could be expected to produce around 8 to 9 offspring in her reproductive life (Fooden, 2005). The genus *Macaca* is phylogenetically close to mangabeys and baboons, and contains 21 species (Hamada & Yamamoto, 2010; Myers et al. 2008). *M. fascicularis* is known to hybridise with Rhesus monkeys, Japanese macaques, pigtail macaques (*Macaca nemestrina*) moor macaques (*Macaca maura*) and bonnet macaques (*Macaca radiata*) (Fooden, 1964; Fa, 1989; Fooden & Aimi, 2005; Groves, 2001 cited in Ong & Richardson, 2008).

Simeulue Long-tailed Macaque **6. *M. f. karimondjawae* (Sody, 1949)** Karimunjawa Long-tailed Macaque **7. *M. f. lasiae* (Lyon, 1916)** Lasia Long-tailed Macaque **8. *M. f. tua* (Kellogg, 1944)** Maratua Long-tailed Macaque **9. *M. f. umbrosus* (Miller, 1902)** Nicobar Crab-eating Macaque Long-tailed Macaque Crab-eating Macaque Cynomolgus Monkey Java Macaque Kra Macaque	**Longevity:** The maximum known lifespan of a captive crab-eating macaque is 37 years 1 month (Jones, 1982 cited in Fooden, 2005). **Conservation status:** **IUCN:** Currently listed as a species of 'least concern' under the IUCN Red List. Major threats to the species include hunting and habitat loss. The species is subject to a high level of hunting for local consumption and sport. The species is also used for research purposes. In mainland Southeast Asia, females are taken to breeding facilities and males exported internationally for use in laboratory research (Ong & Richardson, 2008). **CITES:** Appendix II of CITES.
DATE OF ORIGINAL ASSESSMENT: March 2011 **DATE OF CURRENT ASSESSMENT:** Feb 2021 (Jodi Buchecker) **EIC ENDORSEMENT:** 17/11/21 **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.*	2	*Animal that sometimes attacks when unprovoked and/or is capable of causing serious injury (requiring hospitalisation) or fatality.*
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)**	2	**Highly 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 in Australia.* Value X = 1,513

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, CMS = 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.*	4	*Exotic population established on a larger island (>50,000km^2).* Crab-eating macaques have established in New Guinea (area: 786,000km^2) and other smaller islands. Non-naturally occurring populations are found on Kabaena Island and Tinjil Island in Indonesia, Ngeuar Island in the Republic of Palau, the Jayapura area of West Papua, Hong Kong, Mauritius and New Guinea (Groves, 2001, cited in Ong & Richardson, 2008).
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 size range score 1-70 million km^2.* The estimated overseas range (natural and introduced) is approximately 3 million km^2.
B4. Taxonomic Class (0–1) *Bird = 0; mammal = 1*	1	*Mammal*
B. Establishment Risk Score **Sum of B1- B4 (1–13)**	8	**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.* The crab-eating macaque is omnivorous and can predate on some species (WPRC, 2010; Fooden, 2005; Sussman & Tattersal, 1981).
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.* Adaptive, prefers human modified environments (Ong & Richardson, 2008).
B7. Migratory score (0–1) *Always migratory = 0; non-migratory = 1*	1	*Non-migratory*

B. ESTABLISHMENT RISK SCORE **SUM OF B1- B7 (1–16)**	11	**Moderate establishment risk**
STAGE C: PROBABILITY AN ESTABLISHED SPECIES WILL BECOME A PEST		
C1. Taxonomic group (0–4)	0	*Other group.* No taxonomic matches.
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 kilometre*	0	*Overseas geographic range less than 10 million square kilometres.* <10 million km^2
C3. Diet and feeding (0–3)	3	*Mammal that is primarily a grazer or a browser.* Crab-eating macaques are eclectic, primarily frugivorous feeders (Fooden, 2005; Sussman & Tattersal, 1981; WPRC, 2010).
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?*	3	*Major environmental pest in any country or region.* In Mauritius, the introduced population has contributed to the extinction of the broad-billed parrot (*Lophopsittacus mauritianus*) and scops owl (*Scops commersoni*) and the decline of multiple endangered bird species. This species is noted for consuming and dispersing the seeds of exotic plant species and changing the composition of native forests (Global Invasive Species Database).
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 more than 69-138 grid squares within the highest two climate match classes and/or 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):

		Zyzomys pedunculatus (Central Rock-rat) – Critically Endangered *Lathamus discolor* (Swift Parrot) – 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?*	3	*Major pest of primary production in any country or region.* Crab-eating macaques are a pest in many introduced areas. The species has a significant impact on agriculture and consumes a wide variety of crops. Millions of dollars damage to agriculture is estimated per year (Global Invasive Species Database, 2011).
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 = 57 (see Table 2) Reported as a significant pest to sugarcane and crops overseas.
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.*	1	*$1-$10 million*
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).*	4	*Injuries or harm severe or fatal but few people at risk.* Crab-eating macaques may cause moderate injury by biting and scratching and transmit diseases such as herpes B and hepatitis E. Herpes B can be fatal to humans, although the prevalence of human infection is low (Huff & Barry, 2003; Williams & Barker, 2001).

C. PEST RISK SCORE **SUM C 1 TO C 11 (1–37)**	23	**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*	2	Highly 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*	8	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)** *≤ 6 = low establishment risk; 7-11 = moderate establishment risk; 12-13 = serious establishment risk; ≥14 = extreme establishment risk*	11	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*	23	Extreme pest risk

ENVIRONMENT AND INVASIVES COMMITTEE THREAT CATEGORY	**EXTREME**

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

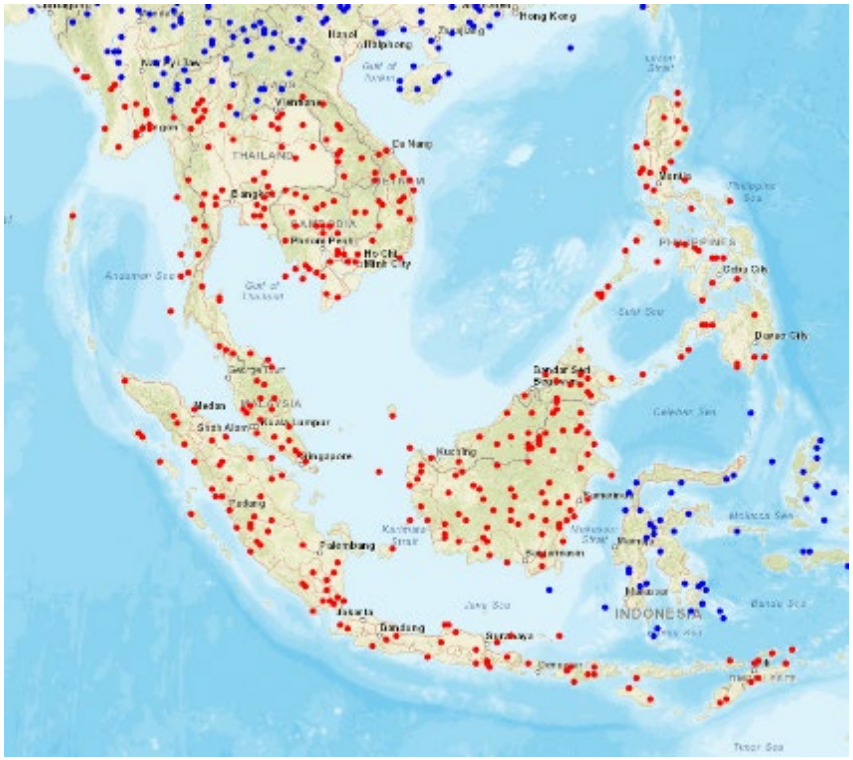
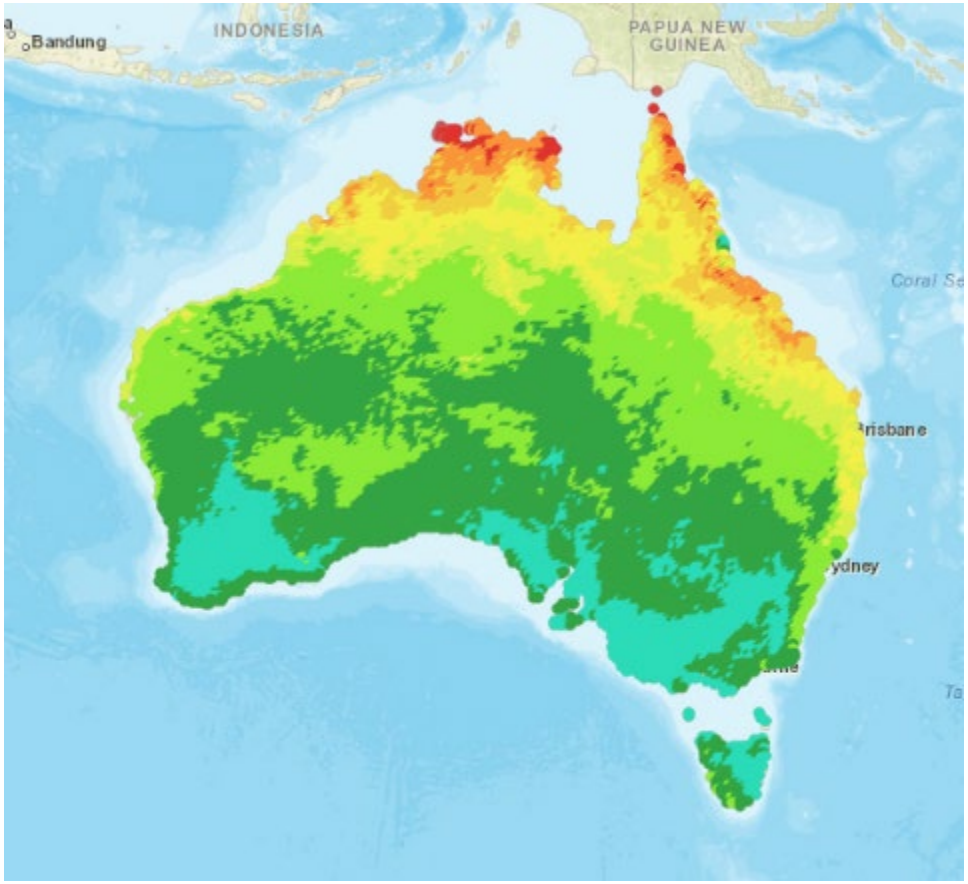


Figure 2 - World Distribution Map - Climatch

Climate match between world distribution of species and Australia:

Areas of Australia where the climate appears suitable for *Macaca fascicularis*

CMS = 1513



Score	Color	Count
0		0
1		1982
2		6886
3		5491
4		1644
5		1720
6		906
7		499
8		99
9		9
10		0

Species: Macaca fascicularis (Crab-eating Macaque)
Algorithm: Closest Standard Score
382 source features selected
19236 target features selected
Approximate selected area: 3,006,697 km^2

Table 1: ABARES recalibration thresholds

Climate Match Score (CMS)	Current Bomford 2008 model classes (50 km)	Recalibrated classes to Climatch v2.0 (20 km)
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 2005 – 2006 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)**
Cattle (includes dairy and beef)	*11*			
Timber (includes native and plantation forests)	*10*			
Cereal grain (includes wheat, barley sorghum etc)	*8*			
Sheep (includes wool and sheep meat)	*5*			
Fruit (includes wine grapes)	*4*	3	3	36
Vegetables	*3*	3	1	9
Poultry and eggs	*2*			
Aquaculture(includes coastal mariculture)	*2*			
Oilseeds (includes canola, sunflower etc)	*1*			
Grain legumes (includes soybeans)	*1*			
Sugarcane	*1*	2	4	8
Cotton	*1*			
Other crops and horticulture (includes nuts tobacco and flowers etc)	*1*	2	2	4
Pigs	*1*			
Other livestock (includes goats, deer, camels, rabbits)	*0.5*			
Bees (included honey, beeswax and pollination)	*0.5*			
Total Commodity Damage Score (TCDS)				57

NB The Commodity Value Index scores in this table are derived from Australian Bureau of Statistics 2005–2006 data and will need to be updated if these values change significantly.

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:	DPIPWE (2011) Pest Risk Assessment: Long-tailed macaque (Macaca fascicularis). Department of Primary Industries, Parks, Water and Environment. Hobart, Tasmania.	By: Jodi Buchecker	Date: Feb 2021

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National Risk Assessment: MODERATE

RISK ASSESSMENT FOR AUSTRALIA: Cotton-top Tamarin (*Oedipomidas oedipus*)

Class - Mammalia**, Order -** Primates**, Family -** Callitrichidae**, Genus –** *Saguinus.*

SPECIES: *Oedipomidas oedipus* (Linnaeus, 1758) **Synonyms:** *Simia oedipus* (Linnaeus, 1758) *Saguinus oedipus* (Linnaeus, 1758) **Subspecies:** Monotypic **Common Names:** Cotton-top Tamarin Cotton-headed Tamarin White-plumed Bare-face Tamarin	**Species description:** The cotton-top tamarin is a New World monkey and member of the Callitrichidae family (marmosets and tamarins). Callitrichidae can be distinguished from other New World monkeys by their small size, the presence of sharp, claw like nails on all digits except the big toe, having two, rather than three, molar teeth on each side of the jaw, and by the incidence of twin births (Rodríguez et al., 2020). The cotton-top tamarin has a head-body length of 20.8–25.9 centimetres and a total length including non-prehensile tail of around 33-41 centimetres (Hershkovitz, 1977). Males and females of this species are of a similar size and weight, showing no sexual dimorphism (Rowe, 1996). The fur of the cotton-top tamarin is mottled grey brown on the shoulders, back, and rump, and white on the stomach and limbs. The fur on the back of their thighs and base of their tail is reddish-brown, but on the rest of the tail it is grey-brown-black (Rowe, 1996; Groves, 2001). Density of the fur varies throughout the body. The cotton-top tamarin has a long sagittal crest, with a fan of long, white hairs extending from forehead to nape and flowing over the shoulders (Cawthon Lang, 2005). Tamarins are generally classified as hairy-faced, mottled-faced or bare-faced. The cotton-top tamarin has white hair covering the black skin of its face, but the hair is so fine that this species is considered a bare-faced tamarin (Garber, 1993). The cotton-top also has whiskers on its forehead and around its mouth (Hershkovitz, 1977). Members of the Callitrichidae family (including this species) have sharp nails (tegulae) on all digits except the big toes, which have the flat nails (ungulae) (Cawthon Lang, 2005; Rodríguez et al., 2020). The tegulae resemble a squirrel's claws and assist the cotton-top tamarin to move through trees (Kinzey, 1997). Like other Callitrichids, the cotton-top tamarin has two molar teeth on each side of the jaw. The lower canine teeth are longer than the incisors (Garber, 1993). Cotton-top tamarins move by quadrupedal running, bounding, or galloping along medium to small branches, and clinging and leaping between trees on thin or small branches (Kinzey, 1997; Rowe, 1996). **General information:** The cotton-top tamarin is an Amazonian species which occurs in a small area of northwestern Colombia. Their range is bound by the Cauca and Magdalena Rivers and the Atlantic coast (Groves, 2001; Snowdon & Soini, 1988).

	This species occurs in humid forest in the south of their range, through to dry deciduous forest in the north. They have been observed at altitudes of up to 400 metres but could occur in higher elevations (to 1,500 metres) in the upper valley of the Sinu River (Defler, 2004). Tamarins live in extended family groups of up to 15 individuals, but usually groups consist of 2-8 animals (Rodríguez et al., 2020). Cotton-top tamarins have been observed in groups as small as 1 individual and as large as 13 (Gonzalez, 2014; Neyman 1977, 1979; Savage et al. 1996a, 1996b). Generally, only one female per group breeds each breeding season (Rodríguez et al. 2020). Cotton-top tamarins primarily feed on insects, fruit, plant exudates (gum, sap, resin, and latex) and nectar, but they have also been known to eat reptiles and amphibians (Cawthon Lang, 2005). Insect-hunting techniques employed by cotton-top tamarins include stealth, turning over leaves, exploring crevices, pouncing, and moving rapidly to the ground to seize prey (Garber, 1993). It is important for tamarins to have a high-quality, high-energy diet because of their small-body size, limited gut volume, and rapid rate of food passage (Garber, 1993). Plant exudates are an important source of minerals, water, and other nutrients in the diet of Callitrichids, though tamarins do not have the same specialised adaptations to feeding on exudates as do marmosets (*Callithrix* species) and are therefore more dependent on insects and fruits (Kinzey, 1997; Snowdon & Soini, 1988). When they do eat gum, cotton-top tamarins rely on indirect means to obtain this food source, such as natural weathering of bark, the holes left by wood-boring insects or rodents, and re-gouging of hardened gum holes to stimulate flow (Kinzey, 1997; Snowdon & Soini, 1988). **Longevity:** ~23 years in captivity. Lifespan in the wild averages 13 years (Rowe, 1996). **Conservation status:** **IUCN:** Critically Endangered **CITES:** Appendix I
DATE OF ORIGINAL ASSESSMENT: 10 April 2014 **DATE OF CURRENT ASSESSMENT:** Jul 2021 (Jodi Buchecker) **EIC ENDORSEMENT:** 17/11/21	**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

Risk assessment model used for the assessment: Bomford 2008, Mammals and Birds	**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 can make unprovoked attacks causing moderate injury (requiring medical attention) or severe discomfort but is highly unlikely to cause serious injury (requiring hospitalisation).* Any bite or scratch from a primate should be referred for medical treatment (Riesland & Wilde, 2015).
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, CMS = sum of classes 6 – 10, see Table 1.*	1	*Very low climate match in Australia.* Value X = 0 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 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.* Two populations established outside current range however, it was likely within the historic range for the species (Rodríguez et al., 2020).
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.* The overseas range for the cotton-top tamarin < 10 million km^2.
B4. Taxonomic Class (0–1) *Bird = 0; mammal = 1*	1	*Mammal*
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.*

		Generalist. Eats fruits, flowers, nectar, plant exudates (gums, saps, latex) and animal prey (including frogs, snails, lizards, spiders and insects) (Cawthon Lang, 2005).
B6. Habitat score (0–1) *Undisturbed or disturbed habitat*	0	*Requires access to undisturbed (natural) habitats to survive and breed.* This species is listed as Critically Endangered, and habitat destruction is one of the main contributing factors (Rodríguez et al., 2020)
B7. Migratory score (0–1) *Always migratory = 0; non-migratory = 1*	1	*Non-migratory* (Rodríguez et al., 2020)
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 kilometre*	0	*Overseas geographic range less than 10 million square kilometres.* Range (Rodríguez et al., 2020) < 10 million Km^2
C3. Diet and feeding (0–3)	1	*Mammal that is a non-strict carnivore (mixed animal-plant matter in diet).* (Cawthon Lang, 2005)
C4. Competition with native fauna for tree hollows (0–2)	2	*Can nest or shelter in tree hollows.* Literature search did not confirm or rule out tree hollow use.
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	*Not 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.*	1	*The species has no grid squares within the highest four climate match classes (ie in classes 10, 9, 8 and 7) that overlap the distribution of any susceptible native species or ecological communities, and has 1-346 grid squares within the highest six climate match classes that overlap the distribution of any susceptible native species or ecological communities = 1* Examples of susceptible native species or ecological communities include (DAWE Protected Matters Search Tool): *Anthochaera phrygia* (Regent Honeyeater) – Critically Endangered *Lathamus discolor* (Swift Parrot) – 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?*	0	*No reports of damage to crops or other primary production in any country or region.* No established populations nor pest issues within its range. No reports of damage.
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.* No refence found that they cause 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).*	2	*Injuries, harm or annoyance likely to be minor and few people exposed: Low risk = 2.* Low risk of harm to people due to its size. Any bite or scratch from a primate should be referred for medical treatment (Riesland & Wilde, 2015).
C. PEST RISK SCORE **SUM C 1 TO C 11 (1–37)**	8	**Low 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*	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*	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*	8	Low pest risk

ENVIRONMENT AND INVASIVES COMMITTEE THREAT CATEGORY	**MODERATE**

World distribution map indicating where meteorological data was sourced for the climate analysis (see B1).

Figure 1 - World Distribution Map - IUCN Red List

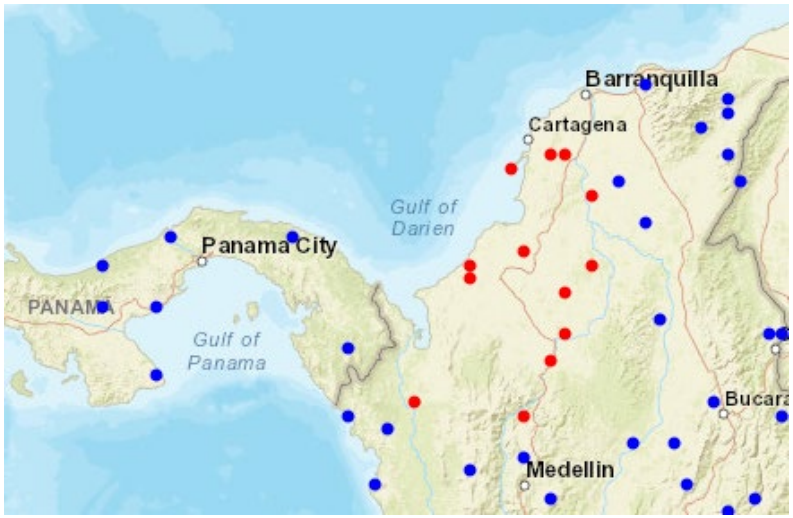
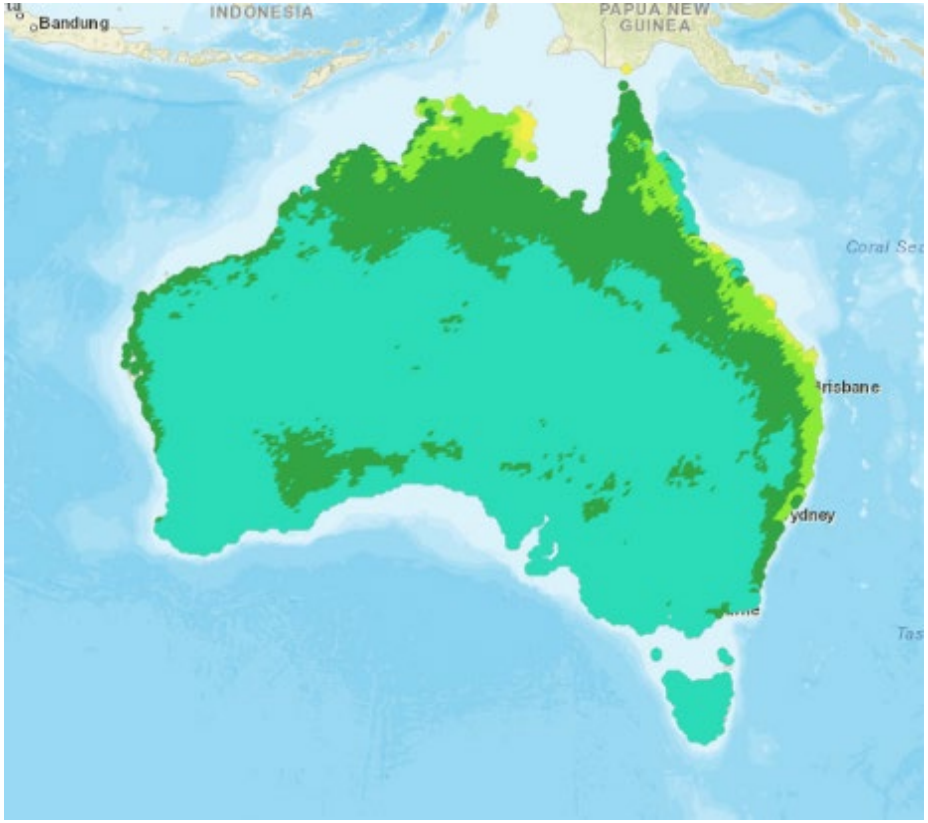


Figure 2 - World Distribution Map – Climatch

Climate match between world distribution of species and Australia:

Areas of Australia where the climate appears suitable for *Oedipomidas oedipus*

CMS = 0



Score	Color	Count
0		0
1		13214
2		5034
3		899
4		69
5		20
6		0
7		0
8		0
9		0
10		0

Species: Saguinus oedipus (Cotton-top Tamarin)
Algorithm: Closest Standard Score
13 source features selected
19236 target features selected
Approximate selected area: 173,897 km^2

Table 1: ABARES recalibration thresholds

Climate Match Score (CMS)	Current Bomford 2008 model classes (50 km)	Recalibrated classes to Climatch v2.0 (20 km)
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 2005 – 2006 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)**
Cattle (includes dairy and beef)	*11*	0		
Timber (includes native and plantation forests)	*10*	1	0	0
Cereal grain (includes wheat, barley sorghum etc)	*8*	0		
Sheep (includes wool and sheep meat)	*5*	0		
Fruit (includes wine grapes)	*4*	1	0	0
Vegetables	*3*	0		
Poultry and eggs	*2*	0		
Aquaculture (includes coastal mariculture)	*2*	0		
Oilseeds (includes canola, sunflower etc)	*1*	0		
Grain legumes (includes soybeans)	*1*	0		
Sugarcane	*1*	0		
Cotton	*1*	0		
Other crops and horticulture (includes nuts tobacco and flowers etc)	*1*	1	0	0
Pigs	*1*	0		
Other livestock (includes goats, deer, camels, rabbits)	*0.5*	0		
Bees (included honey, beeswax and pollination)	*0.5*	0		
Total Commodity Damage Score (TCDS)				0

NB The Commodity Value Index scores in this table are derived from Australian Bureau of Statistics 2005–2006 data and will need to be updated if these values change significantly.

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:	Tasmanian Government Risk Assessment for Cotton Top Tamarin, April 2014	**By:** Jodi Buchecker	**Date:** July 2021

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