

Stoat

Mustela erminea



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Front cover: Stoat *Mustela erminea*

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Summary

This study assessed the potential for stoats (*Mustela erminea*) to become an invasive pest in Queensland. It used an “evidence-based” approach to pest risk assessment where published information on a species’ biology, ecology and history as a pest elsewhere was used to make reasonable predictions of potential impact and probability of naturalisation in Queensland.

This study presents evidence that stoats could naturalise in cooler upland areas of southern Queensland, where climate is marginally suitable. They are not predicted to survive in other areas of the state, since such areas are too hot.

Potential impacts may be comparable to impacts experienced in New Zealand where stoats are a major predator of native birds.

The risk of introduction into the state is low.

Worldwide, there are few examples of successful eradication of introduced mammals (other than on small islands). Once established, the impacts of invasive species are generally irreversible. As such, preventing the entry, sale and possession of stoats in Queensland is wise.

Identity and taxonomy

Species identity: *Mustela erminea* (Linnaeus, 1758)

Common names: stoat, ermine, short-tailed weasel and ermelin.

Family: Mustelidae

Similar species:

M. erminea is very similar in appearance to *Mustela frenata* (long-tailed weasel). They can be distinguished by the lack of a black tip on the weasel's tail (Wikipedia 2009).

There are a number of subspecies: *M. e. aestiva*, *M. e. alascensis*, *M. e. algericus*, *M. e. anguinae*, *M. e. angustidens*, *M. e. artica*, *M. e. audax*, *M. e. bangsi*, *M. e. celenda*, *M. e. cicognanni*, *M. e. cocognanii*, *M. e. erminea*, *M. e. fallenda*, *M. e. ferghanae*, *M. e. gulosa*, *M. e. haidarum*, *M. e. herminea*, *M. e. hibernica*, *M. e. imperii*, *M. e. initis*, *M. e. invicta*, *M. e. kadiacensis*, *M. e. kanei*, *M. e. labiata*, *M. e. leptus*, *M. e. lymani*, *M. e. microtis*, *M. e. minima*, *M. e. mortigena*, *M. e. muricus*, *M. e. nippon*, *M. e. olympica*, *M. e. orientalis*, *M. e. polaris*, *M. e. pusilla*, *M. e. richardsonii*, *M. e. rixosa*, *M. e. salva*, *M. e. seclusa*, *M. e. semplei*, *M. e. streatori*, *M. e. transbaikalica*, *M. e. vulgaris*, *M. e. whiteheadi* (Wikipedia 2009; ZipcodeZoo 2009).

Description

Stoats have a long, thin body with short legs and a smooth, pointed head. Body size varies markedly over their geographical range, perhaps depending on the size, frequency and distribution of available prey (Erlinge 1987).

Stoats exhibit sexual dimorphism. Males are usually twice the size of females, weighing 67–116 g and females 25–80 g (Animal Diversity Web 1999; Hellstedt & Henttonen 2006). Adult body length (from head to rump) can vary from 170–330 mm. The tail is 42–120 mm long, about 35% of the total body length (Animal Diversity Web 1999).

Their claws are sharp and non-retractile; ears are short, rounded, and set almost flat into the fur; eyes are round, black and slightly protruding; whiskers are very long; and the muzzle is black and dog-like. The body fur is short, normally a rich chestnut-brown on the head and back, and white or cream (sometimes shading to yellow or even to apricot) on the underside. The tail has a black tip, which may be bristled out into a ‘bottlebrush’ when the animal is excited. The black tip is used as a decoy to predators (ISSG 2006; Wikipedia 2009).

During winter, the coat becomes thicker and the colour changes to clean white. An individual may be referred to as an ‘ermine’ when the fur is white and a ‘stoat’ when the fur is brown (Wikipedia 2009).

Stoats are very active for short periods of time. They “move rapidly, investigating every hole and crevice, and often stop to survey the surroundings by raising the head or standing upright on the hind legs. They may glide along with the body extended almost straight, taking many rapid steps with the short legs, or if alarmed, they gallop with great leaps, with the back arched” (King 1983).

Biology and ecology

Life history

Gestation period: 43 days

Young per birth: 6-7

Birth interval: 12 months

Weaning: 45 days

Sexual maturity: 95 days females, 365 days males

Sexual activity: unknown

Life span: up to 12.5 years in captivity, 2–3 years in the wild

(AnAge Database undated; ISSG 2006)

Stoats are solitary animals and females generally only accept males when they are in oestrus. A female may mate with more than one male and litters can be fathered by at least three different males. After mating, the female becomes aggressive towards the male and the male has no part in rearing the young (King *et al.* 2007).

Nests are made in hollow trees, rock piles or burrows (King 1983). Young stoats grow rapidly and can hunt with their mother by eight weeks of age (Nowak *et al.* 2005).

Stoats breed once a year, during September and November in New Zealand. The reproductive cycle is strictly controlled by the ratio of light-to-dark hours and is not dependent on prey availability. Research in New Zealand found that simulating the onset of summer by increasing day length significantly advanced seasonal reproduction in both male and female stoats (King *et al.* 2007; O'Connor *et al.* 2006).

Stoats have a unique aspect to their reproductive cycle; a period of embryonic diapause. Two weeks after fertilisation the developing embryo stops growing for around eight to nine months, before continuing its development (O'Connor *et al.* 2006). When prey is abundant, females have higher reproductive success, whereas prey shortages cause an increase in embryo and nestling mortality (King *et al.* 2003).

The mating system is promiscuous. Female stoats exhibit extreme juvenile precocity, with female cubs mated in the nest before their eyes open. Up to 90% or more of females may be pregnant at any one time. In England, practically all female stoats are pregnant by the end of June (Hellstedt & Henttonen 2006; King *et al.* 2003; Wikipedia 2009).

Male cubs mature later than females, at 10–11 months. The average life span is less than 12 months in both sexes, due to high juvenile mortality of 55–92%. Therefore, both sexes must survive to one year old to produce or father any young, and those that survive their first year have a good chance of living two to three years (ISSG 2006; King *et al.* 2003). Females tend to live longer than males, and generally experience two breeding seasons, whereas males only survive one (CentralPets.com undated).

For further information on reproduction in stoats, see King *et al.* (2007).

Social organisation

Stoats are solitary animals and males and females only associate in the mating season. They are territorial with defined home ranges. Home range size is dependent on the area, season and prey density. Male home ranges are usually twice the size of females, and territory boundaries are marked with scent. Dominant animals scent mark more frequently than subordinates and scent marking can resolve conflicts between individuals (Erlinge *et al.* 1982). Home range size for males can vary from 4–200 hectares and are usually 10–40 hectares (Reid & Helgen 2008). When prey is abundant, home ranges are smaller and travelling distance reduced. Stoats regularly visit all parts of their range, scent-marking and hunting. They can travel one to eight kilometres in a single hunt (King 1983).

During spring and summer, young and adult males become more active, establishing or extending home ranges, or dispersing in search of breeding territories. They have been recorded travelling as far as 35 km (King 1983). Stoats are also capable of long distance dispersal on land and can cover up to 60 km in a few weeks (ISSG 2006).

In the Northern Hemisphere, stoats are usually diurnal in summer, their behaviour changes in autumn, and by winter they are nocturnal (Hellstedt & Henttonen 2006).

The density and structure of stoat populations are unstable, due to their short life span and high reproductive capacity. Population size fluctuates markedly and depends on prey abundance. Stoats compete intraspecifically for resources and interspecifically with weasels (*Mustela nivalis*). In areas without weasels, stoats are smaller; about 70 g (Hellstedt & Henttonen 2006; Reid & Helgen 2008).

Diet

Stoats are specialist predators of small, warm-blooded vertebrates, generally mammals the size of rabbits or water voles and smaller. They evolved to hunt unstable populations of small rodents in the boreal regions of the northern hemisphere (King *et al.* 2003). Despite this specialisation, they have a broad, opportunistic diet, tending to eat whatever is seasonally available.

In New Zealand, stoats have been recorded to consume birds, feral house mice, rabbits, rats, possums, insects, lizards, fish, crayfish, carrion and rubbish (ISSG 2006), with a preference for birds and rabbits (Murphy & Dowding 1994). In their native range they usually eat small mammals such as mice, rabbits, pikes, rats and squirrels, as well as porcupines, frogs, eggs, insects and fish (CentralPets.com, undated). In Great Britain, their diet consists of lagomorphs (65%), small rodents (16%) and birds and bird eggs (17%) including domestic poultry and game birds (McDonald *et al.* 2000).

Stoats can utilise alternative food resources when their usual prey is absent. A study in the alpine regions of Italy found that fruit such as juniper berries and bilberries were more common, or made up the majority of the stoat's diet, when rodent prey was scarce (Martinoli *et al.* 2001). In very cold climates, stoats can hunt under snow for small rodents and lemmings (Animal Diversity Web 1999).

Stoats can kill animals much larger than themselves. When they have identified potential prey, they approach as close as possible before quickly grasping the back of the head and neck. The stoat wraps its body and feet around the prey, and kills it by repeated bites to the base of the skull (Animal Diversity Web 1999).

Stoats often 'surplus kill', meaning they will kill a higher number of prey items than they can eat at one time, storing the extra food for later. Due to their high energy expenditure, they require a daily quantity of food equivalent to 19–32% of their body weight (SUNY-ESF 2009).



Figure 1. Stoat standing upright on rear legs Photo: Steve Hillebrand, USFWS. Image from Wikimedia Commons in the Public Domain.

Preferred habitat

Stoats are habitat generalists found wherever suitable prey is available. Habitats include successional or forest-edge habitats, scrub, alpine meadows, riparian woodlands, hedgerows, riverbanks, tundra, agricultural areas, coastland, wetlands, grasslands, disturbed areas, and human settlements such as villages and suburban gardens. Only deserts and dense forests are avoided (ISSG 2006; Reid & Helgen 2008).

Stoats can readily colonise offshore islands as they can swim up to 1.5 km across sea (Wikipedia 2009). In open habitats, they use vegetation and other cover to avoid predation, and in alpine areas spend much of their time in runs and burrows under the snow (ISSG 2006). They are skilful tree climbers and can descend trunks head-first (Wikipedia 2009).

Stoats are found from sea level to elevations of 3000 m (King 1983). In New Zealand they inhabit high altitude alpine grasslands, despite the lack of diverse small mammal communities that they would normally rely on in their native range (Smith *et al.* 2007).

Predators and disease

Stoats are preyed upon by almost any carnivore that is large enough to eat them. For example, wolves, foxes, wolverines, coyotes, domestic cats, badgers, and some birds of prey (Wikipedia 2009).

A nematode (*Skrjabinylus nasicola*) is a major cause of death. This parasite causes skull deformity by eroding bones of the nasal sinuses, which is thought to lead to pressure on the brain. Infection rates may be as high as 100% in certain parts of the stoat's native range. Stoats are also susceptible to fleas, ticks, lice and mites (McDonald & Larivière 2001).

Diseases include canine distemper virus, rabies, Aujeszky's disease, Lyme disease, plague, and leptospirosis.

Stoats act as a reservoir for *Mycobacterium bovis*, the bacteria that causes bovine tuberculosis (McDonald & Larivière 2001).

Origin and distribution

Stoats are found almost throughout northern temperate, subarctic, and Arctic regions of Europe, Asia and North America, from Greenland and the Canadian and Siberian Arctic islands south to about 35° N (Reid & Helgen 2008; Wikipedia 2009). They are considered native to Afghanistan; Albania; Andorra; Austria; Azerbaijan; Belarus; Belgium; Bosnia and Herzegovina; Bulgaria; Canada; China; Croatia; Czech Republic; Denmark; Estonia; Finland; France; Georgia; Germany; Greece; Hungary; India; Ireland; Italy; Japan; Kazakhstan; Kyrgyzstan; Latvia; Liechtenstein; Lithuania; Luxembourg; Macedonia, the former Republic of Yugoslav; Moldova; Mongolia; Montenegro; Netherlands; Norway; Pakistan; Poland; Portugal; Romania; Russian Federation; Serbia; Slovakia; Slovenia; Spain; Sweden; Switzerland; Tajikistan; Turkey; Ukraine; United Kingdom; United States; and Uzbekistan.

They have naturalised in New Zealand (Reid & Helgen 2008).

Stoats are widespread and abundant with the total adult population size exceeding 100,000. Population size and range fluctuates and in some areas is declining or considered rare (Reid & Helgen 2008).

Stoats are listed on the IUCN Red List as Least Concern as it has a wide circumpolar distribution, and it is an abundant species with no significant major threat (Reid & Helgen 2008).

M. erminea ssp. ferghanae is listed on a CITES appendix III (UNEP-WCMC 2009).

Status in Australia and Queensland

Stoats are not present in Australia. They are reported to have been introduced at an unknown early date, but failed to become established (Long 2003).

History as a pest elsewhere

Stoats are among 100 of the ‘World’s Worst’ invaders and have naturalised on Terschelling Island (Netherlands) and in New Zealand (ISSG 2006).

On Terschelling Island six to nine specimens were first released in 1931 to control water voles. By 1934 there were at least 180 (Lever 1985). Currently, they appear to have died out following the extinction of the water vole (Thissen & Hollander 1996).

Stoats are major pests in New Zealand, where their introduction is commonly regarded as one of the “worst mistakes ever made by European colonists to New Zealand” (Department of Conservation undated). They were first introduced, along with ferrets and weasels, around 1884 as part of rabbit control programs. Numerous introductions occurred in subsequent years and by the late 1940s stoats were widespread and abundant throughout New Zealand (Lever 1985). Stoats are currently the most widespread introduced predator in New Zealand’s beech forests and the most abundant introduced mustelid. Their most significant impact has been a decline in ground-dwelling native bird species. More than NZ\$6.6 million was spent on control and research over a five year period (Department of Conservation undated).

Stoats are major predators of eggs, nestlings and adult ground-nesting and tree-nesting birds. Consequently they are a primary factor in the continuing decline of many endemic and endangered New Zealand bird species. These include the kaka (*Nestor meridionalis*), yellow-crowned parakeet (*Cyanoramphus auriceps*), kiwi (*Apteryx australis*, *Apteryx haastii*, *Apteryx mantelli*), New Zealand dotterel (*Charadrius obscurus*), mohua (*Mohoua ochrocephala*), Fiordland crested penguin (*Eudyptes pachyrhynchus*), titi (*Puffinus griseus*), weka (*Gallirallus australis*), karearea (*Falcon novaeseelandiae*), South Island Wren (*Xenicus gilviventris*), blue duck (*Hymenolaimus malacorhynchus*) and kakariki (*Cyanoramphus auriceps*) (ISSG 2006; Long 2003).

Stoats are responsible for catastrophic losses of kiwi chicks in most years, preying on kiwi chicks that are under 100 g. In some areas, stoats kill up to 94% of kiwi chicks. Predation on kaka, particularly females incubating eggs, has caused highly skewed sex ratios and declines in kaka populations and local extinctions (ISSG 2006).

Mohua have suffered a 75% range contraction since stoats were introduced to the South Island in the late 1800s (O’Donnell 1993). Up to 50–100% of adult females in any given population may be killed by stoats (ISSG 2006). Stoats also threaten a giant carnivorous snail (*Powelliphanta* sp.) (ISSG 2006).

Eradication has been carried out on some offshore islands. However, since stoats can swim considerable distances some of islands have been recolonised several times. For example, Maud Island is 900 m offshore and stoats have recolonised this island three times (ISSG 2006).

Stoats are a reservoir for bovine tuberculosis (*Mycobacterium bovis*) (de Lisle *et al.* 2008).

Risk of introduction

In western and central Europe, the stoat was frequently hunted for its white winter fur up until at least the 1930s, with approximately 30,000 pelts sold in Finland alone during that decade. This white fur is a symbol of royalty in Europe. In some parts of its range, stoats are still hunted for fur (Reid & Helgen 2008; Wikipedia 2009).

The import of stoats into Australia is restricted by the *Environment Protection and Biodiversity Conservation Act 1999*.

Pest potential in Queensland

Climate is a primary factor that determines a species' distribution. Climate-modelling software (PC CLIMATE) was used to predict the area of Australia where climate is suitable for stoats (Figure 2).

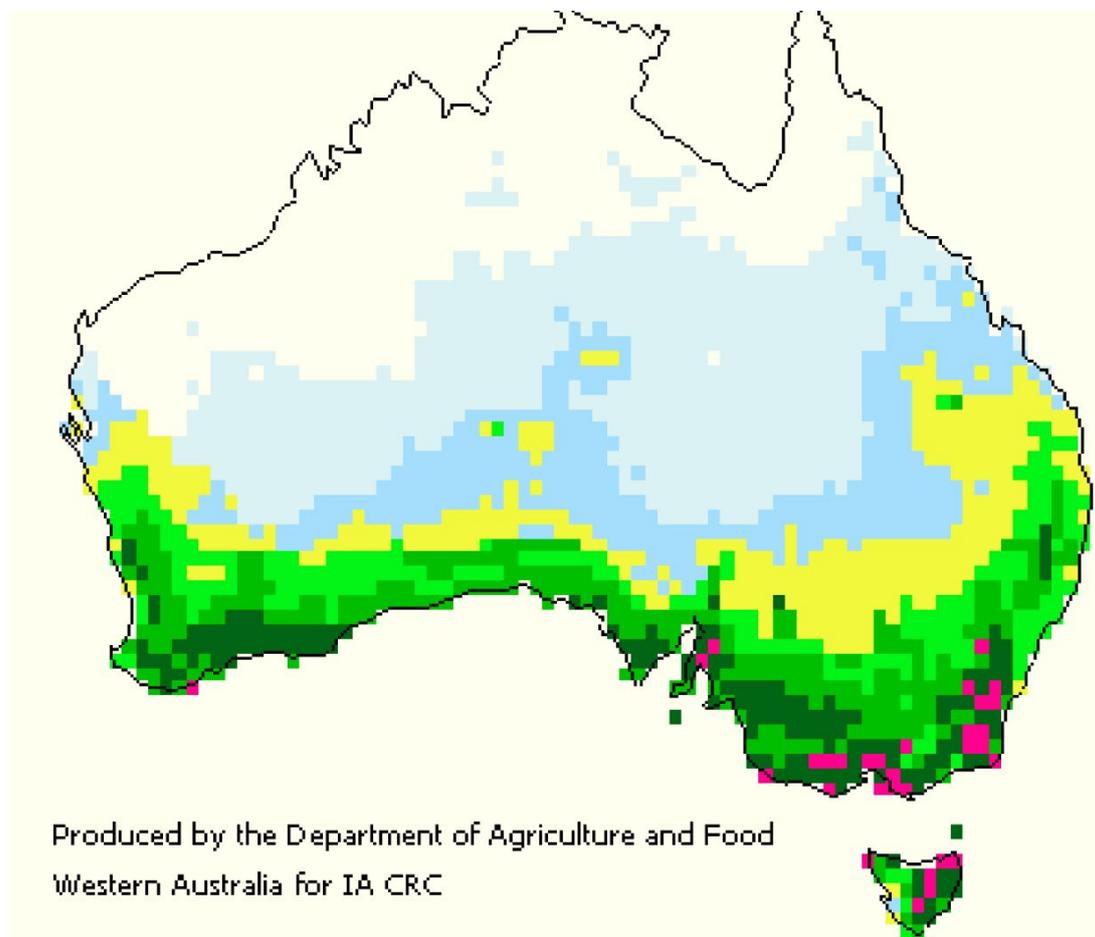


Figure 2. Potential distribution of stoats in Australia (pink and dark green areas indicate where climate is most suitable for the species; mid-green, light green, and yellow indicate areas where climate is moderately suitable; blue and light blue indicate low suitability; and white is unsuitable). Map courtesy of Department of Agriculture and Food, Western Australia.

Based purely on an assessment of climate, stoats are most likely to survive in cooler, upland areas of south eastern Queensland, where climate can be described as warm temperate. Subtropical and tropical areas appear to be unsuitable. Within their preferred climatic envelope, stoats are most likely to survive where there is suitable prey including open grasslands, pastures, forest edges, eucalypt woodland and agricultural and peri-urban areas. They are not expected to survive in dense forests or rainforest.

If stoats ever naturalise in Queensland, their primary impact is likely as a new predator of small to mid-sized native animals such as possums, bandicoots, birds, bird eggs, lizards, frogs, fish and invertebrates, much like other mustelids (eg. Ferrets). As has occurred in New Zealand, ground-dwelling or ground-nesting birds are particularly at risk.

Bomford (2008) suggests three attributes are most often associated with invasive mammals:

- a history of invasion success elsewhere
- “climate match” (i.e. climate in an introduced range is similar to the species’ native range)
- a relatively broad natural geographic range.

Stoats have these three attributes and while Queensland may be marginally suitable, southern areas of Australia are almost certainly at risk.

Eradication

If detected at a very early stage of population development, when the population is small and confined to a manageable area, eradication may be viable. However, once widespread, a wild population could become highly resilient.

The ‘Bomford numerical risk assessment’

A numerical risk assessment system developed by Bomford (2008) is widely applied in Australia to assess the level of risk posed by particular vertebrate species. This approach enables numerical ranking and prioritisation of large numbers of species. First, a species’ potential distribution is predicted using climate-modelling computer programs. The remaining steps involve allocation of scores for a number of attributes relevant to a species’ pest status including biology, costs to the economy, the environment and society, and management efficacy.

Using the Bomford system, stoats in Queensland were assessed as an ‘extreme’ threat species (refer to attachment).

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Attachment

Using the Bomford (2008) system, stoats in Queensland were ranked as an ‘extreme’ threat.

Species		<i>Mustela erminea</i> (stoat)
Date of assessment	16/07/2009	
Literature search type and date	see references	
Factor	Score	
A1. Risk to people from individual escapees (0–2)	0	Stoats pose a low risk of harm to people.
A2. Risk to public safety from individual captive animals (0–2)	0	Stoats pose no risk to public safety.
Stage A. Public Safety Risk Rank = Sum of A 1 to 2. (0–4)	0	Not dangerous
B1. Climate Match (1–6)	3	Moderate climate match in Australia. CMS = 659. From climate map produced by Department of Agriculture and Food, Western Australia, using PC Climate software.
B2. Exotic population Established Overseas (0–4)	4	Stoats have established in New Zealand, and Terschelling Island, Netherlands.
B3. Overseas Range Size (0–2)	1	Overseas range size of 145 million square kilometres (Source: feral.org.au, undated).
B4. Taxonomic Class (0–1)	1	Mammal
B5. Diet (0–1)	1	Generalist diet of small rodents, lagomorphs, birds, possums, squirrels, porcupines, frogs, eggs, insects, lizards, fish, crayfish, fruit, carrion, and rubbish.
B6. Habitat (0–1)	1	Stoats can survive and breed in human-disturbed habitats, and manmade environments.
B7. Migratory (0–1)	1	Non-migratory.
B. Probability escaped or released individuals will establish a free-living population = Sum of B 1 to 7. (1–16)	12	Serious Establishment Risk
C1. Taxonomic group (0–4)	4	Order Carnivora, Family Mustelidae
C2. Overseas range size including current and past 1000 years, natural and introduced range (0–2)	1	Approximately 145 million square kilometres (Source: feral.org.au, undated).
C3. Diet and feeding (0–3)	1	Stoats are non-strict carnivores, known to eat fruit.

C4. Competition with native fauna for tree hollows (0–2)	2	Stoats use tree hollows as dens.
C5. Overseas environmental pest status (0–3)	3	Stoats are a major environmental pest in New Zealand.
C6. Climate match to areas with susceptible native species or communities (0–5)	5	The species has more than 20 grid squares within the highest two climate match classes, and has more than 100 grid squares within the four highest climate match classes, that overlap the distribution of any susceptible native species or communities.
C7. Overseas primary production pest status (0–3)	1	Stoats are known to eat domestic poultry and game birds.
C8. Climate match to susceptible primary production (0–5)	1	Total commodity damage score = 18 (see Table 1).
C9. Spread disease (1–2)	2	Mammal
C10. Harm to property (0–3)	0	\$0
C11. Harm to people (0–5)	1	Stoats may carry diseases that are harmful to humans.
C. Probability an exotic species would become a pest (for birds, mammals, reptiles and amphibians) = Sum of C 1 to 11. (1–37)	21	Extreme Pest Risk
A. Risk to public safety posed by captive or released individuals		
A = 0 = not dangerous; A = 1 = moderately dangerous; A ≥ 2 = highly dangerous	0	Not dangerous
B. Risk of establishing a wild population		
For birds and mammals: B < 6 = low establishment risk; B = 7–11 = moderate establishment risk; B = 12–13 = serious establishment risk; B > 14 = extreme establishment risk	12	Serious establishment risk
For reptiles and amphibians: B < 3 = low establishment risk; B = 3–4 = moderate establishment risk; B = 5–6 = high establishment risk; B > 6 = extreme establishment risk		
C. Risk of becoming a pest following establishment		
C < 9 = low pest risk; C = 9–14 = moderate pest risk; C = 15–19 = serious pest risk; C > 19 = extreme pest risk	21	Extreme pest risk
VPC Threat Category		Extreme

Table 1.
Calculating Total Commodity Damage Score

Industry	Commodity Value Index¹ (CVI)	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	Not estimated	0
Timber (includes native and plantation forests)	10	0	Not estimated	0
Cereal grain (includes wheat, barley sorghum etc)	8	0	Not estimated	0
Sheep (includes wool and sheep meat)	5	0	Not estimated	0
Fruit (includes wine grapes)	4	0	Not estimated	0
Vegetables	3	0	Not estimated	0
Poultry and eggs	2	2	4	16
Aquaculture (includes coastal mariculture)	2	0	Not estimated	0
Oilseeds (includes canola, sunflower etc)	1	0	Not estimated	0
Grain legumes (includes soybeans)	1	0	Not estimated	0
Sugarcane	1	0	Not estimated	0
Cotton	1	0	Not estimated	0
Other crops and horticulture (includes nuts, tobacco and flowers)	1	0	Not estimated	0
Pigs	1	0	Not estimated	0
Other livestock (includes goats, deer, camels, rabbits)	0.5	1	4	2
Bees (includes honey, beeswax and pollination)	0.5	0	Not estimated	0
Total Commodity Damage Score (TCDS)	—	—	—	18