RISK ASSESSMENT FOR AUSTRALIA – Stoat (*Mustela erminea*) (Linnaeus, 1758)

Class - *Mammalia*, Order – Carnivora, Family - Mustelidae (Fischer, 1817), Genus - *Mustela* (Linnaeus, 1758); (Wilson and Reeder 1993, ITIS Integrated Taxonomic Information System 2007, Catalogue of Life 2008)

GOVERNMENT OF WESTERN AUSTRALIA

Department of Agriculture and Food

Score Sheet

SPECIES: Stoat (*Mustela erminea*) Other common names include: Ermine **Subspecies:** 37 subspecies listed (ITIS Integrated Taxonomic Information System 2007, Catalogue of Life 2008).		**Species Description** – Long and slender body, with pointed head and short legs. Head and body length 170-325 mm, tail length 42-120 mm, weight 42-365 g. Sexual dimorphism is very pronounced with males much larger than females, and European stoats are larger than North American stoats. Summer coat - the back, flanks, and outer sides of the limbs rich chocolate or chestnut brown, the tip of the tail black, and the underparts are white or cream, sometimes shading to yellow. Winter coat - in colder climates it is entirely white except for the tip of the tail, which remains black. In warmer parts of its range, the stoat's coat colour does not change in winter or may only go partly white. The winter pelage is longer and denser than the summer pelage. The eyes are round, black, and slightly protruding. Whiskers are brown or white, and are very long. The ears are short, rounded, and almost flat to the head (Mitchell-Jones et al 1999, Nowak 1999, Long 2003, King 2005) **General information** – The species is swift, agile and strong, and has a keen sense of both smell and hearing (Nowak 1999). It swims well, across streams and in seawater, up to distances of 1-1.5 km (Corbet and Harris 1991, King 2005). Although primarily terrestrial, stoats climb well. Their sharp claws and light weight enable them to climb trees with ease, and run down again head first. They can also climb narrow saplings, and cross between adjacent trees by running along connecting branches. They will search for prey through all possible cover, down every accessible hole, and up every likely tree, in the course of each hunting excursion (Nowak 1999, King 2005). **Longevity –** Maximum recorded longevity 12.5 years (HAGR Human Ageing Genomic Resources 2006). **Status –** 1. Red List Category – Lower Risk Least Concern (LR/lc) Rationale: Listed on the IUCN Red List of Threatened Species as 'Lower Risk Least Concern'. The species does not satisfy the criteria for any of the categories Critically Endangered, Endangered, or Vulnerable (Mustelid Specialist Group 1996). Global abundance is estimated at 100,000-1,000,000 individuals (NatureServe 2008). 2. CITES listed Protection Status – Not listed (CITES 2007).
DATE OF ASSESSMENT: 07/07/2008 **Bird and Mammal Model used (Bomford 2008) using PC CLIMATE (Brown et al 2006, Bureau of Rural Sciences 2006)**		**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 2006, 2008). Developed by Dr Mary Bomford of 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 was originally published in 'Risk Assessment for the Import and Keeping of Exotic Vertebrates in Australia' (Bomford 2003) available online http://www.daff.gov.au/brs/land/feral-animals/management/risk . This model used the Apple Mac application CLIMATE (Pheloung 1996) for

		climate matching. The risk assessment model was revised and recalibrated 'Risk Assessment for the Establishment of Exotic Vertebrates in Australia: Recalibrated and Refinement of Models'(Bomford 2006) and the climate application changed to PC CLIMATE software (Bureau of Rural Sciences 2006), available online at http://affashop.gov.au/product.asp?prodid=13506. The most recent publication (Bomford 2008) includes updated instructions for using the exotic vertebrate risk assessment models and an additional model for freshwater fish. A bird and mammal model for New Zealand has also been included. **Which models are being used for the assessments:** Birds and mammals have been assessed using the Australian Bird and Mammal Model (Bomford 2008), pp 16-28, including both versions of stage B, models 1 (4 factors) and 2 (7 factors). All reptiles and amphibians were assessed using three models; the Australian Bird and Mammal Model (Bomford 2008), including Model A, using 3 factors from stage B (pp 54-55), and Model B, using 7 factors from stage B (pp 20), and the Australian Reptile and Amphibian Model (Bomford 2008), p 51-53. The rational for using additional models for reptiles and amphibians is to compare establishment risk ranks of the three models for a precautionary approach. If the models produce different outcomes for the establishment potential of any reptile or amphibian, the highest ranked outcome should be used (Bomford 2008). **Climate Matching Using PC CLIMATE** Sixteen climate parameters (variables) of temperature and rainfall are used to estimate the extent of similarity between data from meteorological stations located in the species' world distribution and in Australia. Worldwide, data (source; worlddata_all.txt CLIMATE database) from approximately 8000 locations are available for analysis. The number of locations used in an analysis will vary according to the size of the species' distribution. Data from approximately 762 Australian locations is used for analysis. To represent the climate match visually, the map of Australia has been divided into 2875 grid squares, each measured in 0.5 degrees in both longitude and latitude. CLIMATE calculates a match for each Australian grid by comparing it with all of the 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. These levels of climate match are used in the risk assessment for questions B1 (scores are summed to give a cumulative score), C6, and C8. For a grid square on the Australian map to score highly, it must match closely all 16 climatic variables of at least one meteorological station in the species' distribution for each level of climate match. [The score for each grid is based on the minimum Euclidian distance in the 16- dimensional variable space between it and all stations in the species' distribution. Each variable is normalized by dividing it by its worldwide standard deviation.]
LITERATURE SEARCH TYPE AND DATE: NCBI, CAB Direct, MEDLINE, Science Direct, Web of Knowledge (Zoological Records, Biological Abstracts), SCIRUS, Google Search and Google Scholar 10/12/2007		
FACTOR	**SCORE**	
STAGE A: RISKS POSED BY CAPTIVE OR RELEASED INDIVIDUALS		
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	*Low risk* Small mammal less than 400 gram. Low risk of harm to people however, stoats never make good pets and are always bad-tempered and

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. Choose one:		aggressive to people (Polkanov 2000), if handled, stoats will bite and hold on (Bourne 2008). No reports of attacks on humans, small weasel-like animal; sharp, non-retractile claws (King 2005) and sharp teeth suited to a carnivorous diet (Corbet and Harris 1991).
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 TO A2 (0–4)**	**0**	

STAGE B: PROBABILITY ESCAPED OR RELEASED INDIVIDUALS WILL ESTABLISH FREE-LIVING POPULATION		
Model 1: Four-factor model for birds and mammals (BOMFORD 2008)		
B1. Degree of climate match between species overseas range and Australia (1–6)	3	*Climate Match Score = 659 Moderate climate match with Australia* [See above information on climate matching.] Climate data from 2911 locations (see species worldwide distribution map) were used to calculate the CMS. Overseas distribution circumpolar, including northern Europe, Asia, North America and north-eastern Greenland. Introduced populations in New Zealand and on several islands (see B2 and B3 for details).
B2. Exotic population established overseas (0–4)	4	*Exotic population established on an island larger than 50 000 km^2 or anywhere on a continent* ▪ New Zealand **–** Stoats were introduced to New Zealand in 1884, in an attempt to control rabbits. In 1885, 55 stoats were released at Lake Wakatipu and in the Ashburton district. In 1886, 82 stoats were released in the Wilkin River, Makarora, Lake Ohau, and Waitaki areas, and 32 in Marlborough and west Wairarapa. Another 55 were released in 1886 in the Orongorongo Valley. They were first noted established at Tutira in 1902, and by 1904 had reached Poverty Bay some 65 km to the north. By 1950 they were widespread and common in New Zealand, and today are still widespread on both the North and South Islands. Being good swimmers, stoats have also reached some islands, most within 1.5 km of the mainland (islands in Fiordland, Nelson-Marlborough, Hauraki Gulf and Northland). They have colonised Maud Island at least three times and been eradicated each time, and Otata Island where they were eradicated in 1955, and Adele Island in about 1977, where eradication efforts failed in 1980 because of re-invasion (de Vos et al 1956, Taylor and Tilley 1984, Long 2003, King 2005). ▪ Netherlands – In 1931, six to nine stoats, along with 102-104 Weasels, were released on Terschelling Island, for the control of Water Voles (*Avicoal terrestris*). Numbers had increased to at least 180 by 1934, but later decreased as the Water Voles disappeared. By 1937 they had established a fluctuating population and the Water Voles had become extinct. In 1953 it was reported that the stoat had increased to a high population level, but that the Weasel had disappeared. It is thought the Stoat has now died out on Terschelling (de Vos et al 1956, Corbet and Harris 1991, Mitchell-Jones et al 1999, Long 2003). ▪ Denmark – Six male stoats were introduced to Strynoe Kalv Island in 1980 to control Water Voles (Kildemoes 1985, Corbet and Harris 1991, Long 2003).

		▪ <u>United Kingdom</u> – Stoats were introduced to the mainland Shetland Islands in the 17th century or earlier. Some stoats may have been released on Shetland prior to 1680. Some stoats were released on Whalsay in the 19th century to control rabbits and rats, and on Colsay for rat control, but they failed to become established on both islands. Stoats were also released in the Orkneys probably in the 17th century (Long 2003, King 2005). ▪ <u>Australia</u> – Stoats were apparently introduced to Australia for rabbit control at an unknown date, but failed to become established (de Vos et al 1956, Long 2003).
B3. Overseas range size (0–2) < 1 = 0; 1 – 70 = 1; >70 = 2	2	*Overseas range size greater than 70 million km^2, estimated at 133 million km^2. Includes current and past 1000 years, natural and introduced range.* The stoat has a very wide circumpolar distribution: • Throughout Europe, with the exception of the Mediterranean zone and some north Atlantic islands • North-eastern Greenland • Across northern Siberian Asia, south to the Pyrenees, Alps, Caucasus and western Himalayas, northern Mongolia, Manchuria, Xinjiang (China), Sakhalin Island and Japan (Hokkaido and northern Honshu) • Alaska and Canada south throughout most of the northern United States, to New York, Maryland, northern Virginia, Pennsylvania, the Great Lakes region, and northern Iowa, and also to northern New Mexico, northern Arizona, and central California. (Wilson and Reeder 1993, Mitchell-Jones et al 1999, Nowak 1999, Long 2003, NatureServe 2008). The species is found up to 3000 m elevation (Mitchell-Jones et al 1999, King 2005). Introduced populations occur on New Zealand and in several locations in Europe (Long 2003) (see B2 for details).
B4. Taxonomic Class (0–1)	1	*Mammal* (Catalogue of Life 2008).
B. Establishment Risk Score **Sum of B1-4 (1-13)**	**10**	
Model 2: Seven-factor model for birds and mammals (BOMFORD 2008)		
B5. Diet (0–1)	1	*Generalist with a broad diet of many food types* Stoats are active hunters, locating prey by sight and hearing, systematically examining every patch of cover for prey, moving in a zigzag pattern, progressing by a series of leaps. Its slender body allows it to enter and move quickly through the burrows of its prey. Diet consists of small mammals, including rodents, squirrels, chipmunks, rabbits and hares; also birds and eggs, invertebrates and sometimes frogs, lizards and fish. They become more selective as prey becomes more abundant, preferring larger prey such as young rabbits. When food is short, stoats turn to secondary foods, such as earthworms, insects, and fruit. They have also been known to feed on carrion and rubbish. Food may be stored underground for the winter. Prey are often killed by a bite to the back of the neck. The teeth are strongly adapted to an exclusively carnivorous diet (Hewson and Healing 1971, Corbet and Harris 1991, Nowak 1999, Edwards and Forbes 2003, Long 2003, King 2005, Elmeros 2006). Stoats are flexible and opportunistic in their diet, so a change in abundance of their normal prey can be

		expected to cause a rapid shift to alternative resources (King et al 2001). In NZ forests, stoats shift between eating rats and birds, depending upon the abundance of rats (Murphy *et al.* 1998; Murphy *et al.* 2008). A stoat will sometimes attack animals considerably larger than itself, such as adult hares. Larger prey probably dies from shock, rather than a bite to the neck (Hewson and Healing 1971, Nowak 1999, King 2005). Prey size in stoats tends to be related to their body size. One study found that female stoats ate a higher proportion of small rodents than males, while male stoats ate a higher proportion of lagomorphs (McDonald et al 2000). Stoats often remove eggs and chicks from the nests of birds (King 2005). Eggs are a favourite food of stoats, and they have been observed stealing eggs by rolling them along with their noses or carrying them under one limb (King et al 2001). A study of the diet of stoats in Great Britain found that the diet consisted of 65% lagomorphs, 16% small rodents, and 17% birds and birds' eggs (McDonald et al 2000). The most frequently eaten prey of stoats in New Zealand are birds, feral house mice, rabbits, rats and insects. Minor items include lizards, fish, crayfish, carrion and rubbish (King 2005). A stoat will kill all the prey that it can, even if it isn't hungry, and cache the surplus for future use (King and Murphy 2005). In the Italian Alps, fruit consumption is an important part of the stoat diet. Small rodents are the main food item of stoats throughout the year, however when rodent abundance decreases, fruit consumption by stoats increases. When rodent abundance again increases, fruit consumption then decreases, demonstrating that the species can adopt an opportunistic feeding behaviour (Martinoli et al 2001, Remonti et al 2007).
B6. Lives in disturbed habitat (0–1)	1	*Can live in disturbed habitats* The stoat is found in a wide range of habitats, from open tundra to deep forest, but seems to prefer areas with vegetative or rocky cover (Mitchell-Jones et al 1999, Nowak 1999). The stoat is also found at the boundaries of fields and meadows, on farmland, shrubby river banks and lakeshores, and inhabits the summits of fells and mountains (Mitchell-Jones et al 1999, Long 2003). Stoats do not avoid human settlements, and are occasionally seen in rural villages and suburban gardens (King 2005).
B7. Non-migratory behaviour (0–1)	1	*Non-migratory or facultative migrant in its native range* Non-migratory species (NatureServe 2008). Home ranges vary, ranging from 0.4-2 km^2, but more usually 0.1-0.4 km^2, but smaller when prey is abundant. Male stoats generally have a significantly larger home range than females, and juvenile males can wander extensively in the spring to find a breeding territory, reportedly up to 35 km (Alterio 1998, Nowak 1999, Miller et al 2001, Long 2003, King 2005, Hellstedt and Henttonen 2006). The distance travelled in a single hunt averaged 1.3 km, although stoats may travel up to 10-15 km in one night (Nowak 1999, King 2005). One juvenile female travelled a straight-line distance of 65 km within four weeks (Murphy and Dowding 1995).
B. ESTABLISHMENT RISK SCORE **SUM OF B1-7 (1–16)**	**13**	

STAGE C: PROBABILITY AN ESTABLISHED SPECIES WILL BECOME A PEST		
C1. Taxonomic group (0–4)	4	*Mammal in one of the orders that have been demonstrated to have detrimental effects on prey abundance and/or habitat degradation,* Order Carnivora (Catalogue of Life 2008) *AND* *Mammal in one of the families that are particularly prone to cause agricultural damage.* Family Mustelidae (Catalogue of Life 2008).
C2. Overseas range size including current and past 1000 years, natural and introduced range (0–2)	2	*Overseas range greater than 30 million km^2. Estimated at 133 million km^2.* Overseas distribution circumpolar, including northern Europe, Asia, North America and north-eastern Greenland. Introduced populations in New Zealand and on several islands (Long 2003) (see B2 and B3 for details).
C3. Diet and feeding (0–3)	1	*Mammal that is a non-strict carnivore* Diet consists primarily of small mammals and birds, sometimes bird eggs, invertebrates, and occasionally frogs, lizards, fish, and fruit (Nowak 1999) (see B5 for details).
C4. Competition with native fauna for tree hollows (0–2)	2	*Can nest or shelter in tree hollows* It makes its den in a crevice, rock piles, among tree roots, under logs, in a hollow log or tree, in a burrow taken over from a rodent or a nest from a bird. It maintains several dens throughout its home range, which are lined with dry vegetation or the fur and feathers of its prey (Mitchell-Jones et al 1999, Nowak 1999, King et al 2001, Long 2003, King 2005, King and Powell 2007). One stoat den found in northwest Greenland had been built in the wool of a musk ox carcass (King and Powell 2007).
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 Stoat is an environmental pest in New Zealand, where it preys on a number of native species: • The bird life of New Zealand has been severely depleted since human colonisation and currently contains a disproportionately high number of threatened species – of the 23 threatened shorebird species worldwide, 6 are endemic to New Zealand; over 40% of the land bird species present in New Zealand before human occupation are now extinct. Stoats, as well as Ferrets and Cats, appear to be the introduced species posing the greatest threats to the remaining mainland shorebird species (Dowding and Murphy 2001). Hole-nesting forest birds are particularly vulnerable to predation from stoats because they display few predator-avoidance behaviours (O'Donnell 1996). • In New Zealand, predation by the stoat has been shown to be the most important factor in the continuing decline of some hole-nesting (e.g. Kaka, *Nestor meridionalis* and Yellow-crowned Parakeet, *Cyanoramphus auriceps*) and ground-nesting birds (e.g. all four species of the Kiwi, *Apteryx* spp.). They have also contributed to the decline of other birds such as both subspecies of the New Zealand Dotterel (*Charadrius obscurus*) (Long 2003). • Immature Kiwi (*Apteryx* spp.) consistently suffer heavy losses due to stoats, and too few have survived to replace adult deaths in most years. This is the main cause of Kiwi decline in mainland forests in New Zealand. An analysis of the impact of stoats on the Northern Brown Kiwi (*A. mantelli*) found that current survival rates of juveniles (1-5%) were well below the threshold (19%) required to maintain populations. At the present rate, many of the remaining Kiwi populations in the North Island are predicted to disappear during the next 40-50 years (Basse et al 1999). Another study

		estimated that at least 94% of young Kiwi fail to reach adulthood; stoats cause about half of these losses. Young Kiwi have no defences that protect them against introduced predators, and they frequently respond to an approaching predatory by ‘freezing’ rather than fleeing (McLennan et al 1996). • Hutton’s Shearwater (*Puffinus huttoni*), a small endangered burrowing petrel, currently breeds at only two alpine localities on the South Island of New Zealand. The breeding range was formerly more widespread, with historical records to the 1930s indicating at least another eight colonies. The causes of this contraction in breeding range are unknown, however predation by stoats has been suggested as a major factor (Kemp 2001, Cuthbert and Sommer 2002). A study of the diet of stoats in one of the colonies of Hutton’s Shearwaters found that remains of the bird were present in 99.6% of stoat scats examined (Cuthbert et al 2000). It is estimated that stoats kill on average 0.25% of breeding adults and 12% of chicks each season, however natural mortality of breeding Hutton’s shearwaters when they are absent from the colony has a far greater impact on the population than the mortality caused by stoat predation within the colonies (Cuthbert and Davis 2002). • The Kaka (*Nestor meridionalis*) is a forest-dwelling parrot endemic to New Zealand. Its distribution and numbers have decreased dramatically since late last century when they were widespread and abundant. Because of the scarcity of Kaka, major changes in their seasonal conspicuousness, and long-distance movements, it is difficult to be certain whether they are still declining (Beggs and Wilson 1991). Nesting success of Kaka at sites with predator control has been found to be significantly greater (>80%) than at unmanaged sites (<38%). Stoats appear to be the main predator of the species, and it is suggested that control of stoats could potentially reverse the decline of the Kaka on the main islands of New Zealand (Moorhouse 2003). In a study involving large scale stoat control to protect Kaka in the Eglinton Valley, Fiordland, Kakas had successful breeding, and fledgling survival was high. 80% of nests had successfully fledged young. Elsewhere in New Zealand, where Kaka were being monitored and there was no predator control, breeding success was much lower: for example, in beech forests at Nelson Lakes, only 10% of nests produced young (Dilks et al 2003). • The Mohua (*Mohoua ochrocephala*) is a small, endangered bird, endemic to the South Island of New Zealand. The species has all but disappeared from 75% of their former range since the introduction of mammalian predators, and population monitoring has shown that Mohua suffer periodic population declines due to stoat predation. Mohua are particularly vulnerable to stoats because they nest in holes, have long incubation and nestling periods, and breed in late spring, when stoat numbers are highest. Furthermore, the effect of predation is exacerbated by the fact that only females incubate, and therefore most predation is on adult females (O'Donnell et al 1993, Dilks 1999). • Predation by stoats, along with feral Cats (*Felis catus*) and Ferrets (*Mustela furo*), is the principal cause of Yellow-eyed Penguin (*Megadyptes antipodes*) chick mortality on the South Island of New Zealand (Alterio et al 1998, Ratz and Murphy 1999). • Stoat, as well as other mustelid and feral cat predation, is affecting the survival of the Brown Teal (*Anas chlorotis*), a duck endemic to New Zealand. Fewer than 2000 Brown Teal now exist in the wild, and the species is classed as Nationally Endangered (Brown Teal Online 2008). • On the small island of Terschelling, stoats were successfully used for biological control of rodents. Stoats were also introduced to New Zealand for biological control of rabbits, however this has failed (Corbet and Harris 1991, King 2005). Stoats were also successfully used as biological control agents against water voles on Strynoe Kalv island. Ground-nesting bird populations were monitored during this time; effects on the non-target fauna were not considered serious (Kildemoes 1985).

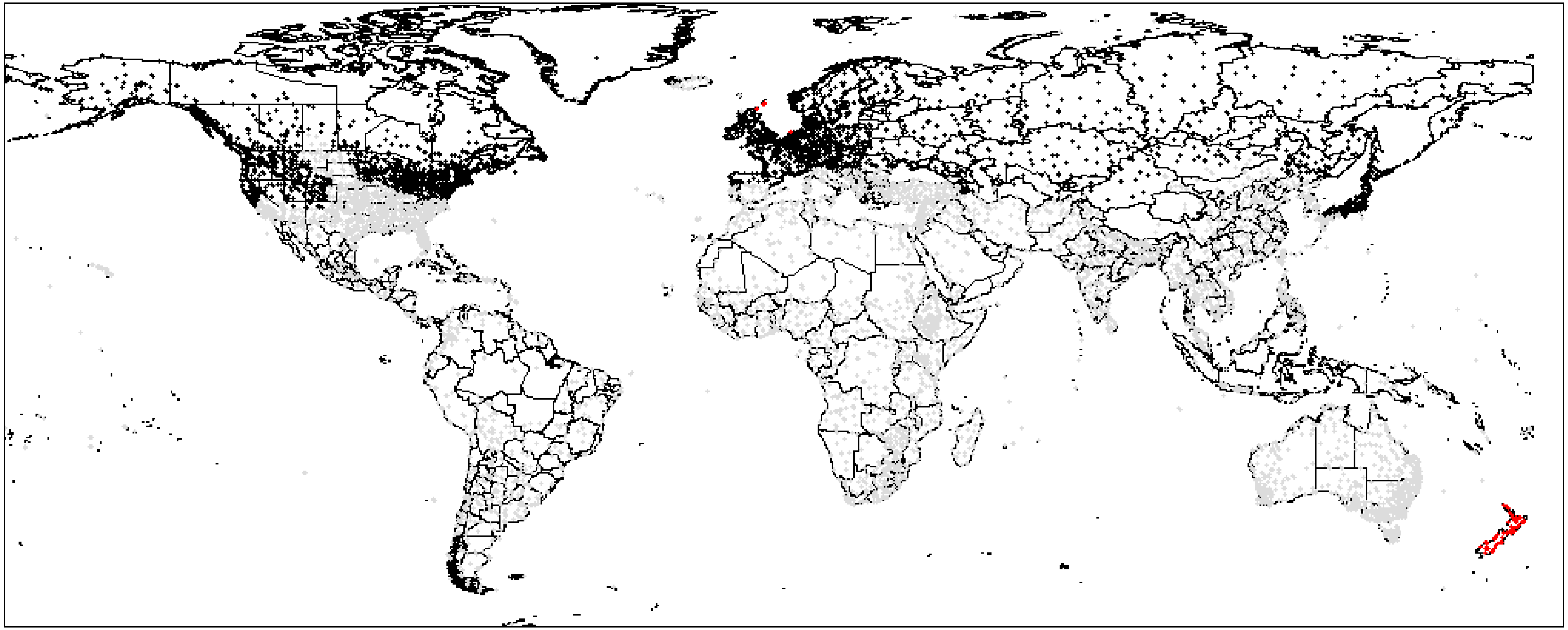
C6. Climate match to areas with susceptible native species or communities (0–5) *Identify any native Australian animal or plant species or communities that could be susceptible to harm by the exotic species if it were to establish a wild population here.*	5	*One or more susceptible native species or ecological communities that are listed as vulnerable or endangered under the Australian Government Environment Protection and Biodiversity Conservation Act 1999 has a restricted geographical range that lies within the mapped area of the highest six climate match classes for the exotic species being assessed.* Reference for all vulnerable or endangered species and communities (status noted in bold) (Dept of the Environment Water Heritage and the Arts 2007, 2008). Reference for all Australian native mammal species (Strahan 1995), and bird species (Barrett et al 2003, Christidis and Boles 2008). Susceptible Australian native species or natural communities that could be threatened include: **Mammals:** **Vulnerable** – Southern Brown Bandicoot *(Isoodon obesulus),* Greater Stick-nest Rat (*Leporillus conditor),* Numbat *(Myrmecobius fasciatus),* Eastern Barred Bandicoot (Tasmania) *(Perameles gunnii),* Dayang (*Pseudomys shortridgei*), Pilliga Mouse (*P. pilligaensis*). **Endangered** – Dibbler (*Parantechinus apicalis),* Eastern Barred Bandicoot *(Perameles gunnii),* Long-footed Potoroo *(Potorous longipes).* **Critically Endangered –** Gilbert's Potoroo *(Potorous gilbertii).* **Birds:** **Vulnerable –** Noisy Scrub-bird *(Atrichornis clamosus),* Cape Barren Goose (*Cereopsis novaehollandiae*), Western Bristlebird (*Dasyornis longirostris).* **Endangered –** Western Ground Parrot (*Pezoporus wallicus),* Gould's Petrel *(Pterodroma leucoptera).* **Communities:** No listed vulnerable or endangered communities likely to be at risk. **AND** *The species 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.* **Mammals:** Short-beaked Echidna (*Tachyglossus aculeatus*) (eggs), Fat-tailed Dunnart (*Sminthopsis crassicaudata*). **Birds:** Stubble Quail (*Coturnix pectoralis*), Brown Quail (*C. ypsilophora*), Australian Wood Duck (*Chenonetta jubata*), Australasian Shoveler (*Anas rhynchotis*), Grey Teal (*A. gracilis*), Pink-eared Duck (*Malacorhynchus membranaceus*), Hardhead (*Aythya australis*), Australasia Grebe (*Tachybaptus novaehollandiae*), Hoary-headed Grebe (*Poliocephalus poliocephalus*), Little Button-quail (*Turnix velox*), Painted Button-quail (*T. varia*), Sharp-tailed Sandpiper (*Calidris acuminata*), Australian Pied Oystercatcher (*Haematopus longirostris*), Sooty Oystercatcher (*H. fuliginosus*), Black-winged Stilt (*Himantopus himantopus*), Red-capped Plover (*Charadrius ruficapillus*), Black-fronted Dotterel (*Elseyornis melanops*), Red-kneed Dotterel (*Erythrogonys cinctus*), Banded Lapwing (*Vanellus tricolor*), Masked Lapwing (*V. miles*), Sacred Kingfisher (*Todiramphus sanctus*), Rainbow Bee-eater (*Merops ornatus*).
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* Stoats are among the traditional vermin regularly killed by gamekeepers and poultry farmers, a single stoat in a pen or enclosure can cause great damage, killing every bird. Research by the Game Conservancy supports the traditional view that stoats can help to substantially reduce the harvestable surplus population of gamebirds in the field, and keepers are advised to control them, even though the effect is only temporary (Corbet and Harris 1991). In Europe the stoat occasionally preys on poultry, however it is valuable to human interests because it also destroys mice and rats around farms (Nowak 1999, Long 2003, King 2005).

		Also in Europe, stoats prey on game birds. Because of this, stoats are culled by gamekeepers, in an attempt to increase game bird populations (McDonald and Harris 2002, Long 2003). Trapping is widely used to remove stoats from game estates in the UK (Global Invasive Species Database 2006). Culling of stoats today does not occur to the extent it did during 1870-1914. After the 1860s, game birds were required in large numbers for shooting parties. Under British law all forms of wildlife were then the legal possession of the landowner, and gamekeepers were supplied with guns, poisons, and the newly developed steel kill traps, to indiscriminately kill all predatory mammals and birds, including stoats. Today, game estates are fewer and smaller, and systematic predator control is practised to only a fraction of its former extent. Old attitudes toward predators are changing to a more informed and discriminating assessment. Fewer than 20% of gamekeepers see stoats and common weasels as major threats now, although both are still included in routine trapping operations (King and Powell 2007).
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.*	1	Score = 18 (Bomford 2003, 2006) See Commodity Scores Table – Species has attributes making it capable of damaging poultry and other livestock (rabbit) commodities.
C9. Spread disease (1–2)	2	*All birds and mammals (likely or unknown effect on native species and on livestock and other domestic animals).*
C10. Harm to property (0–3)	0	*$0* No reports of damage to property.
C11. Harm to people (0–5) *Assess the risk that, if a wild population established, the species could cause harm to or annoy people. Aggressive behaviour, plus the possession of organs capable of inflicting harm, such as sharp teeth, tusks, claws, spines, a sharp bill, horns, antlers or toxin-delivering organs may enable animals to harm people. Any known history of the species attacking, injuring or killing people should also be taken into account (see Stage A, Score A1).*	0	*Low risk* **Zoonoses:** Cases of rabid stoats have been reported, but such cases are insignificant compared to rabies in other species. The role of stoats in rabies transmission remains unclear, but is unlikely to be important (McDonald and Larivière). Rabies is not present in Australia however, it is classified as a notifiable disease by Animal Health Australia (Animal Health Australia 2007).
C. Pest Risk Score **Sum C 1 to 11 (1–37)**	**20**	
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**

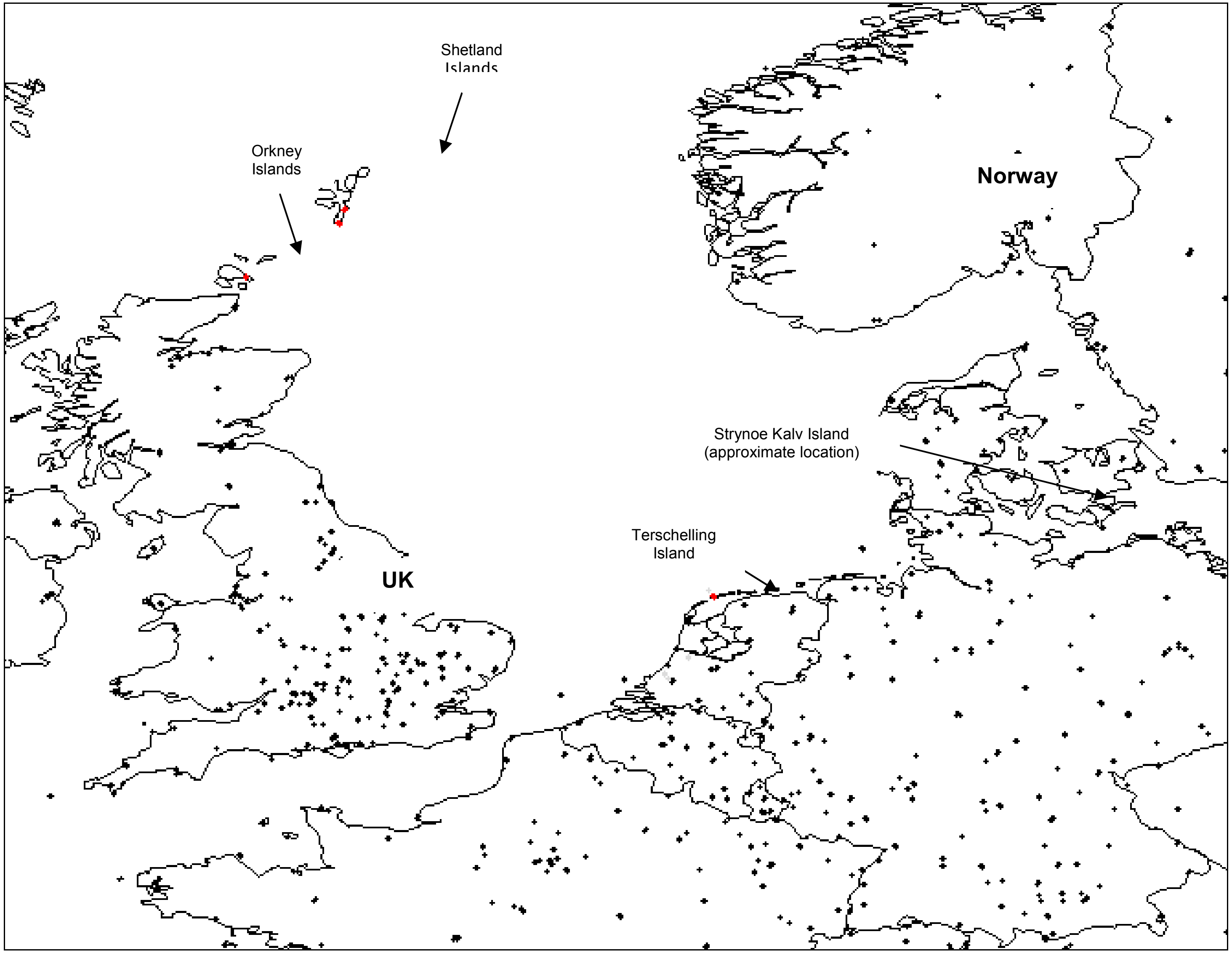
STAGE B. ESTABLISHMENT RISK RANK – RISK OF ESTABLISHING A WILD POPULATION **MODEL 2: SEVEN-FACTOR MODEL FOR BIRDS AND MAMMALS (BOMFORD 2008)** ≤ 6 = low establishment risk; 7-11 = moderate establishment risk; 12-13 = serious establishment risk; ≥14 = extreme establishment risk	**13**	**SERIOUS ESTABLISHMENT 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	**20**	**EXTREME PEST RISK**
VERTEBRATE PESTS COMMITTEE THREAT CATEGORY		**EXTREME – ENDORSED BY VPC**
Median number of references per mammal, for all mammals assessed by (Massam et al 2010) (n=17) Total number of references for this species *(median number for references for Public Safety Risk, Establishment Risk and Overseas Environmental and Agricultural Adverse Impacts)*		37 54 – more than the median number of mammal references were used for this assessment, indicating a decreased level of uncertainty.

WORLDWIDE DISTRIBUTION – Stoat (*Mustela erminea*), includes current and past 1000 years; including natural populations (black) and introduced populations (red) – see next page also.

Each black or red dot is a location where meteorological data was sourced for the climate analysis (see B1), faint grey dots are locations available for CLIMATE analysis but are not within the species' distribution therefore not used.

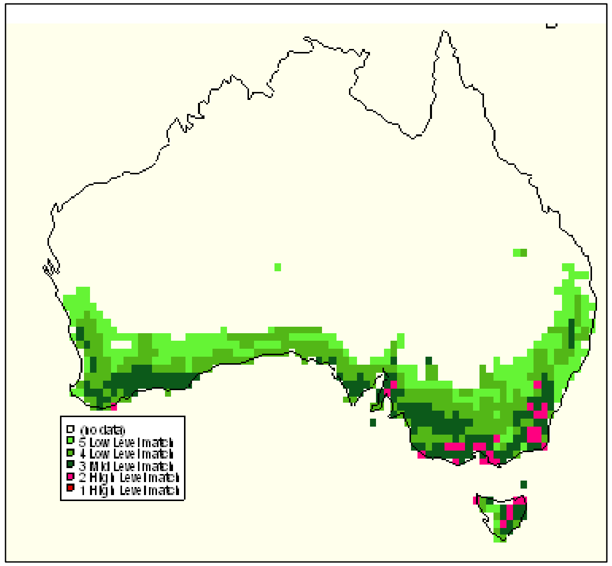


WORLDWIDE DISTRIBUTION – Stoat (*Mustela erminea*), includes current and past 1000 years; including natural populations (black) and introduced populations (red) (continued).



Map 1. Climate match between the world distribution of Stoat (*Mustela erminea*) and Australia for five match classes.

Colour on Map	**Level of Match from Highest (10) to Lowest (6)**	**No. Grid Squares on Map**
Red	10 HIGH MATCH	0
Pink	9 HIGH MATCH	31
Dark Green	8 MODERATE MATCH	157
Mid Green	7 MODERATE MATCH	257
Lime Green	6 LOW MATCH	214
		CMS = 659



Stoat *(Mustela erminea)* 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 (based on 1999 - 2000 data)	Potential Commodity Impact Score (0-3)	Climate Match to Commodity Score (0–5)	Commodity Damage Score (columns 2 X 3 X 4)
Cattle (includes dairy and beef) consumption of stock fodder consumption of stock fodder only therefore commodity value adjusted down by 1/3	11	0	0	0
Timber (includes native and plantation forests)	10	0	0	0
Cereal grain (includes wheat, barley sorghum etc) no reports of damage to this commodity	8	0	0	0
Sheep (includes wool and sheep meat) consumption of stock fodder only therefore commodity value adjusted down by 1/3	5	0	0	0
Fruit (includes wine grapes)	4	0	0	0
Vegetables	3	0	0	0
Poultry and eggs	**2**	**2**	**4**	**16**
Aquaculture(includes coastal mariculture)	2	0	0	0
Oilseeds (includes canola, sunflower etc) no reports of damage to this commodity	1	0	0	0
Grain legumes (includes soybeans) no reports of damage to this commodity	1	0	0	0
Sugarcane	1	0	0	0
Cotton	1	0	0	0
Other crops and horticulture (includes nuts tobacco and flowers etc)	0	0	0	0
Pigs	1	0	0	0
Other livestock (includes goats, deer, camels, rabbits)	**0.5**	**1**	**4**	**2**
Bees (included honey, beeswax and pollination)	0.5	0	0	0
Total Commodity Damage Score (TCDS)				**18**

[Table 9 Rational

Potential Commodity Impact Score (0-3)

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:

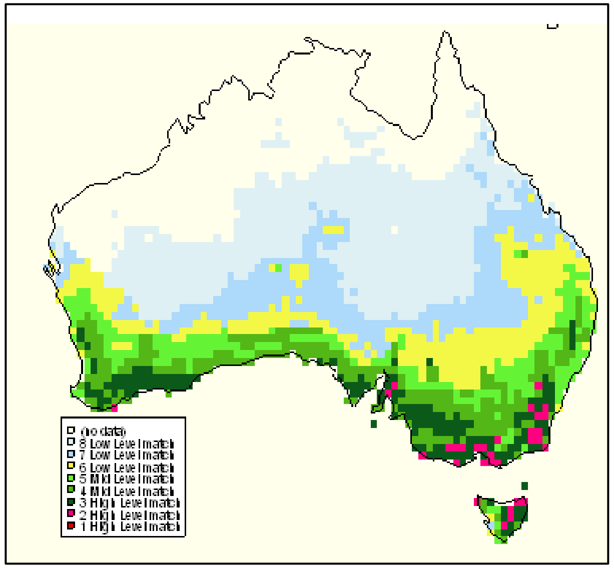
0. *Nil (species does not have attributes to make it capable of damaging this commodity)*
1. *Low (species has attributes making it capable of damaging this or similar commodities and has had the opportunity but no reports or other evidence that it has caused damage in any country or region*
2. *Moderate–serious (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.]*

Map 2. Climate match between the world distribution of Stoat *(Mustela erminea)* and Australia for eight match classes.

Colour on Map	Level of Match from Highest (10) to Lowest (3)	No. Grid Squares on Map
Red	10 HIGH MATCH	0
Pink	9 HIGH MATCH	31
Dark Green	8 HIGH MATCH	157
Mid Green	7 MODERATE MATCH	257
Lime Green	6 MODERATE MATCH	214
Yellow	5 MODERATE MATCH	329
Blue	4 LOW MATCH	372
Light blue	3 LOW MATCH	739



References

Alterio N (1998). Spring home range, spatial organisation and activity of stoats *Mustela erminea* in a South Island Nothofagus forest, New Zealand. *Ecography,* 21:18-24.

Alterio N, Moiler H and Ratz H (1998). Movements and habitat use of feral house cats *Felis catus*, stoats *Mustela erminea* and ferrets *Mustela furo*, in grassland surrounding yellow-eyed penguin *Megadyptes antipodes* breeding areas in spring. *Biological Conservation,* 83(2):187-194.

Animal Health Australia (2007). Rabies. http://www.animalhealthaustralia.com.au/aahc/index.cfm?ADC2BE1B-E9E0-BB39-EA09-981F7B277F5E [Access date:08/09/2008].

Barrett G, Silcocks A, Barry S, Cunningham R and Poulter R (2003). *The New Atlas of Australian Birds*. Royal Australasian Ornithologists Union/Birds Australia.

Basse B, McLennan JA and Wake GC (1999). Analysis of the impact of stoats, Mustela erminea, on northern brown kiwi, Apteryx mantelli, in New Zealand. *Wildlife Research,* 26(2):227-237.

Beggs JR and Wilson PR (1991). The Kaka *Nestor meridionali* - a New Zealand parrot endangered by introduced wasps and mammals. *Biological Conservation,* 56:23-38.

Bomford M (2003). Risk Assessment for the Import and Keeping of Exotic Vertebrates in Australia. Bureau of Rural Sciences, Canberra.

(2006). Risk assessment for the establishment of exotic vertebrates in Australia: recalibration and refinement of models - A report produced for the Department of Environment and Heritage. Bureau of Rural Sciences, Canberra.

(2008). Risk assessment models for establishment of exotic vertebrates in Australia and New Zealand - A report produced for the Invasive Animals Cooperative Research Centre. Bureau of Rural Sciences, Canberra.

Bomford M, Kraus F, Braysher M, Walter L and Brown L (2005). Risk Assessment Model for the Import and Keeping of Exotic Reptiles and Amphibians. A report produced for the Department of Environment and Heritage. Bureau of Rural Sciences, Canberra.

Bourne D (2008). Catching and Handling of Stoats, Weasels etc. (Wildlife Casualty Management). http://wildlife1.wildlifeinformation.org/S/00Man/MammalHusbandryTechniques/UKMHusbIndTech/Cas_Accom_M_Small_Mustelid.htm [Access date:09/07/2008].

Brown L, Barry S, Cunningham D and Bomford M (2006). Current practice in applying CLIMATE for weed risk assessment in Australia. In: Proceedings of the 15th Australian Weeds Conference, Adelaide, South Australia, pp.703-706.

Brown Teal Online (2008). Brown Teal Predators. http://www.brownteal.com/site/?p=predators [Access date:28/10/2008].

Bureau of Rural Sciences (2006). CLIMATE software. Bureau of Rural Sciences, Department of Agriculture, Fisheries and Forestry, Canberra. http://adl.brs.gov.au/anrdl/metadata_files/pe_brs90000003434.xml [Access date:09/04/2010].

Catalogue of Life (2008). Catalogue of Life: 2008 Annual Checklist. http://www.usa.species2000.org [Access date:09/04/2010].

Christidis L and Boles WE (2008). *Systematics and Taxonomy of Australian Birds*. CSIRO Publishing, Collingwood.

CITES (2007). Appendices I, II and III. CITES (the Convention on International Trade in Endangered Species of Wild Fauna and Flora). http://www.cites.org [Access date:01/02/2008].

Corbet GB and Harris S (1991). *The Handbook of British Mammals*. Blackwell Science, Oxford.

Cuthbert R and Davis LS (2002). The impact of predation by introduced stoats on Hutton's shearwaters, New Zealand. *Biological Conservation,* 108(1):79-92.

Cuthbert R and Sommer E (2002). Home range, territorial behaviour and habitat use of stoats (*Mustela erminea*) in a colony of Hutton's shearwater (*Puffinus huttoni*), New Zealand. *New Zealand Journal of Zoology,* 29(2):149-160.

Cuthbert R, Sommer E and Davis LS (2000). Seasonal variation in the diet of stoats in a breeding colony of Hutton's shearwaters. *New Zealand Journal of Zoology,* 27(4):367-373.

de Vos A, Manville RH and Van Gelder RG (1956). Introduced mammals and their influence on native biota. *Zoologica (New York),* 41(4):163-194.

Dept of the Environment Water Heritage and the Arts (2007). Threatened species and threatened ecological communities. http://www.environment.gov.au/biodiversity/threatened/species.html [Access date:09/04/2010].

(2008). EPBC Act List of Threatened Ecological Communities. Australian Government. http://www.environment.gov.au/cgi-bin/sprat/public/publiclookupcommunities.pl [Date accessed:15/01/2008].

Dilks P (1999). Recovery of a Mohua (*Mohoua ochrocephala*) population following predator control in the Eglinton Valley, Fiordland, New Zealand. *Notornis,* 46(3):323-333.

Dilks P, Willans M, Pryde M and Fraser I (2003). Large scale stoat control to protect mohua (*Mohoua ochrocephala*) and kaka (*Nestor meridionalis*) in the Eglinton Valley, Fiordland, New Zealand. *New Zealand Journal of Ecology,* 27(1):1-9.

Dowding JE and Murphy EC (2001). The impact of predation by introduced mammals on endemic shorebirds in New Zealand: a conservation perspective. *Biological Conservation,* 99:47-64.

Edwards MA and Forbes GJ (2003). Food habits of Ermine, *Mustela erminea*, in a forested landscape. *Canadian Field Naturalist,* 117(2):245-248.

Elmeros M (2006). Food habits of stoats *Mustela erminea* and weasels *Mustela nivalis* in Denmark. *Acta Theriologica,* 51(2):179-186.

Global Invasive Species Database (2006). *Mustela erminea* (mammal). Invasive Species Specialist Group http://www.issg.org/database/species/ecology.asp?si=98&fr=1&sts=sss&lang=EN [Access date:10/12/2007].

HAGR Human Ageing Genomic Resources (2006). AnAge Database. Human Ageing Genomic Resources http://genomics.senescence.info/ [Access date:09/04/2010].

Hellstedt P and Henttonen H (2006). Home range, habitat choice and activity of stoats (Mustela erminea) in a subarctic area. *Journal of Zoology (London),* 269(2):205-212.

Hewson R and Healing TD (1971). The Stoat *Mustela erminea* and its prey. *Journal of Zoology (London),* 164(2):239-244.

ITIS Integrated Taxonomic Information System (2007). Integrated Taxonomic Information. www.itis.gov [Access date:31/01/2008].

Kemp J (2001). *Predation on Hutton's shearwater by stoats: effect of a mast seeding year*. Department of Conservation Wellington, New Zealand.

Kildemoes A (1985). The impact of introduced stoats (*Mustela erminea*) on an island population of the water vole, *Arvicola terrestris*. *Acta Zoologica Fennica,* 173:193-195.

King CM (2005). *The Handbook of New Zealand Mammals*. Oxford University Press, Auckland, pp.600.

King CM, Griffiths K and Murphy EC (2001). Advances in New Zealand mammalogy 1990-2000: Stoat and weasel. *Journal of the Royal Society of New Zealand,* 31(1):165-183.

King CM and Powell RA (2007). *The natural history of weasels and stoats: ecology, behavior, and management*. Oxford University Press, Oxford.

Long JL (2003). *Introduced Mammals of the World: Their History, Distribution and Influence*. CSIRO Publishing, Collingwood, Australia.

Martinoli A, Preatoni DG, Chiarenzi B, Wauters LA and Tosi G (2001). Diet of stoats (*Mustela erminea*) in an Alpine habitat: The importance of fruit consumption in summer. *Acta Oecologica,* 22(1):45-53.

Massam M, Kirkpatrick W and Page A (2010). Assessment and prioritisation of risk for 40 exotic animal species Department of Agriculture and Food, Western Australia. Invasive Animals Cooperative Research Centre, Canberra.

McDonald RA and Harris S (2002). Population biology of stoats *Mustela erminea* and weasels *Mustela nivalis* on game estates in Great Britain. *Journal of Applied Ecology,* 39(5):793-805.

McDonald RA and Larivière S *Review of international literature relevant to stoat control*. In: Science for Conservation 170. Department of Conservation, Wellington, New Zealand.

McDonald RA, Webbon C and Harris S (2000). The diet of stoats (*Mustela erminea*) and weasels (*Mustela nivalis*) in Great Britain. *Journal of Zoology (London),* 252(3):363-371.

McLennan JA, Potter MA, Robertson HA, Wake GC, Colbourne R, Dew L, Joyce L, McCann AJ, Miles J, Miller PJ and Reid J (1996). Role of predation in the decline of kiwi, *Apteryx* spp., in New Zealand. *New Zealand Journal of Ecology,* 20:27-35.

Miller C, Elliot M and Alterio N (2001). Home range of stoats (*Mustela erminea*) in podocarp forest, south Westland, New Zealand: Implications for a control strategy. *Wildlife Research,* 28(2):165-172.

Mitchell-Jones AJ, Amori G, Bogdanowicz W, Krystufek B, Reijnders PJH, Spitzenberger F, Stubbe M, Thissen JBM, Vohralik V and Zima J (1999). *The Atlas of European Mammals*. Academic Press, London.

Moorhouse RG, T.; Dilks, P. J.; Powlesland, R. G.; Moran, L.; Taylor, G.; Jones, A.; Knegtmans, J. W.; Wills, D.; Pryde, M.; Fraser, I.; August, A.; August, C. (2003). Control of introduced mammalian predators improved kaka *Nestor meridionalis* breeding success: reversing the decline of a threatened New Zealand parrot. *Biological Conservation,* 110:33-44.

Mustelid Specialist Group (1996). *Mustela erminea*. IUCN Red List of Threatened Species. http://www.iucnredlist.org [Access date:10/12/2007].

Natural Resource Management Standing Committee (2004). Guidelines for the Import, Movement and Keeping of Exotic Vertebrates in Australia. Developed by the Vertebrate Pests Committee http://www.feral.org.au/feral_documents/VPCGuidelinesApril05.pdf [Access date:09/04/2010].

NatureServe (2008). *Mustela erminea* - Linnaeus, 1758 NatureServe Explorer, Virginia, USA. http://www.natureserve.org/explorer/servlet/NatureServe?searchName=Mustela+erminea [Access date:08/05/2008].
Nowak RM (1999). *Walker's Mammals of the World Vol I*. The Johns Hopkins University Press, Baltimore.
O'Donnell CFJ (1996). Predators and the decline of New Zealand forest birds: an introduction to the hole-nesting bird and predator programme. *New Zealand Journal of Zoology,* 23:213-219.
O'Donnell CFJ, Dilks PJ and Elliott GP (1993). Control of a stoat (*Mustela erminea*) population irruption to enhance mohua (yellowhead) (*Mohoua ochrocephala*) breeding success in New Zealand. *New Zealand Journal of Zoology,* 23:279-286.
Pheloung PC (1996). *CLIMATE: a system to predict the distribution of an organism based on climate preferences*. Agriculture Western Australia, Perth.
Polkanov A (2000). *Aspects of the biology, ecology and captive breeding of stoats*. Department of Conservation, Wellington, New Zealand.
Ratz H and Murphy B (1999). Effects of habitat and introduced mammalian predators on the breeding success of Yellow-eyed Penguins *Megadyptes antipodes*, South Island, New Zealand. *Pacific Conservation Biology,* 5(1):16-27.
Remonti L, Balestrieri A and Prigioni C (2007). Role of fruits in the diet of small mustelids (*Mustela* sp.) from the western Italian Alps. *European Journal of Wildlife Research,* 53(1):35-39.
Strahan R (1995). *The Mammals of Australia*. Reed New Holland, Sydney, Auckland, London, Cape Town.
Taylor RH and Tilley JAV (1984). Stoats (*Mustela erminea*) on Adele and Fisherman Islands, Abel Tasman National Park, and other offshore islands in New Zealand. *New Zealand Journal of Ecology,* 7:139-145.
Wilson DE and Reeder DM (1993). *Mammal Species of the World. A Taxonomic and Geographic Reference*. Smithsonian Institution Press, Washington.

Vertebrate Pests Committee Threat Categories(Natural Resource Management Standing Committee 2004)

VPC Threat Category A species' VPC Threat Category is determined from the various combinations of its three risk ranks; (A) Public safety risk rank, (B) Establishment risk rank, (C) Pest risk rank.			
B. Establishment Risk Rank[1]	**C. Pest Risk Rank[1]**	**A. Public Safety Risk Rank**	**Threat Category**
Extreme	Extreme	Highly Dangerous, Moderately Dangerous or Not Dangerous	**Extreme**
Extreme	High	Highly Dangerous, Moderately Dangerous or Not Dangerous	**Extreme**
Extreme	Moderate	Highly Dangerous, Moderately Dangerous or Not Dangerous	**Extreme**
Extreme	Low	Highly Dangerous, Moderately Dangerous or Not Dangerous	**Extreme**
High	Extreme	Highly Dangerous, Moderately Dangerous or Not Dangerous	**Extreme**
High	High	Highly Dangerous, Moderately Dangerous or Not Dangerous	**Extreme**
High	Moderate	Highly Dangerous, Moderately Dangerous or Not Dangerous	**Serious**
High	Low	Highly Dangerous, Moderately Dangerous or Not Dangerous	**Serious**
Moderate	Extreme	Highly Dangerous, Moderately Dangerous or Not Dangerous	**Extreme**
Moderate	High	Highly Dangerous, Moderately Dangerous or Not Dangerous	**Serious**
Moderate	Moderate	Highly Dangerous	**Serious**
Moderate	Moderate	Moderately Dangerous or Not Dangerous	**Moderate**
Moderate	Low	Highly Dangerous	**Serious**
Moderate	Low	Moderately Dangerous or Not Dangerous	**Moderate**
Low	Extreme	Highly Dangerous, Moderately Dangerous or Not Dangerous	**Serious**
Low	High	Highly Dangerous, Moderately Dangerous or Not Dangerous	**Serious**
Low	Moderate	Highly Dangerous	**Serious**
Low	Moderate	Moderately Dangerous or Not Dangerous	**Moderate**
Low	Low	Highly Dangerous	**Serious**
Low	Low	Moderately Dangerous	**Moderate**
Low	Low	Not Dangerous	**Low**

[1] 'Establishment Risk' is referred to as the 'Establishment Likelihood' and 'Pest Risk' is referred to as the 'Establishment Consequences' by the Natural Resource Management Standing Committee (2004).